

SECTION 05120
STRUCTURAL STEEL

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:

1. Structural steel framing shown or noted on Structural Drawings and work noted "Structural Steel" ("SS") on Architectural Drawings. Refer to Architectural Drawings for details and dimensions of items shown on Structural Drawings that are not so detailed or dimensioned.
2. Structure design is based on shown steel sections. Intent of Contract Documents is that designated shapes, thickness, arrangements and grades of material be provided.
 - a. If for any reason sections shown are not readily available, substitute sections may be proposed for use. Registered Design Professionals shall approve Substitutions before submission of shop drawings.
 - b. Coordinate fit of proposed substitution with Architectural details and structural capacity.
 - c. Incorporate approved substitute members in structures at no additional cost to Owner.

B. Related Work Specified Under Other Sections

1. Concrete bearing surfaces, setting of Anchor Rods in concrete - Division 3.
2. Setting of Anchor Rods in masonry and grout pads at masonry wall bearing locations - Division 4.
3. Metal Roof Deck - Section 05310.
4. Metal Floor Deck - Section 05321.
5. Grout - Section 03600.
6. Miscellaneous metal work, consisting of steel framing shown on Architectural Drawings that is not noted "Structural Steel" or with notations of similar intent, and of miscellaneous iron work - Section 05500.
7. Fasteners for anchorage of wood nailers - Division 6.
8. Alteration work related to existing construction for installation of structural steel, including removal of materials other than structural framing to provide access to area of work and to permit installation of new steel work.

C. Products Furnished But Not Installed Under This Section

1. Anchor Rods for columns.
2. Anchor Rods for beams supported on concrete or masonry construction.

1.2 REFERENCES

A. AISC References

1. AISC “Manual of Steel Construction - Allowable Stress Design”, Ninth Edition, including:
 - a. “Specification for Structural Steel Buildings - Allowable Stress Design and Plastic Design”, June 1, 1989.
 - b. “Code of Standard Practice for Steel Buildings and Bridges”, March 7, 2000 except as indicated otherwise in Contract Documents.
 - c. “Specification for Structural Joints Using ASTM A 325 or A 490 Bolts”, approved by Research Council on Structural Connections, June 23, 2000, and endorsed by AISC.
2. AISC “Manual of Steel Construction Volume II Connections - ASD 9th Edition/LRFD 1st Edition”, 1993.
3. AISC “Hollow Structural Sections Connection Manual”, 1st Edition, 1997.
4. AISC “Engineering for Steel Construction”, 1984, except where superseded by provisions of the AISC “Specification for Structural Steel Buildings”, RCSC “Specification for Structural Joints Using ASTM A 325 or A 490 Bolts” and AWS “Structural Welding Code”.
5. AISC “Detailing for Steel Construction”, 2002.

B. Other References

1. ANSI/AWS “Structural Welding Code”, D1.1.
2. SSPC “Steel Structures Painting Manual”, Volume 2, Third Edition.
3. Crane Manufacturer’s Association of America Inc. (CMAA), Specification #70, revised 1994.

1.3 SYSTEM DESCRIPTION

A. Design Requirements

1. Design connections and fabricate work per Reference Standards, except where specifically amended in this Section or superseded by local or State building code requirements.
2. Provide high strength bolted, slip critical or bearing type connections as shown. Bolt design values for bearing type connections shall assume threads in shear planes. Fully pre-tension bolts in bearing type connections. Do not use bolted and welded connections in combination. Make connections of main members per referenced AISC Standards. Use minimum of two bolts for bolted connections. Where type of connections are not shown or designated:
3. Future Expansion
 - a. In areas noted for future expansion or extension, fabricate steel framing to permit connection of future steel framing. Provide similar holes and connections for future framing as provided for typical steel framing. Provide bolted connections for members removed in the future.

1.4 SUBMITTALS

- A. Furnish submittals for items that are identified in this Section by different typeface and a bracketed code (e.g., *Item [L]*). Refer to Section 01340 for definition of codes, types of submittals and administrative requirements governing submittal procedure. Additional submittal requirements about this Section are specified under this Article.
- B. Shop drawings shall be submitted with completed shop drawing transmittal sheet attached at end of this Section.
- C. *Shop drawings [D]*: Show items to be provided per AISC's Structural Steel Detailing Manual. Shop drawings not checked by Contractor will be returned marked "Not Approved".
- D. Submit Structural Steel Shapes and Plates mill test reports to substantiate that steel conforms to specification. Organize and summarize documentation.
- E. Show complete details for cutting, fabricating and connecting of pieces, on shop drawings. Provide separate drawings for erection. Indicate marks for pieces on shop and erection drawings. Use marking system compatible with, and referenced to, marking system noted on Contract Drawings.
- F. Indicate welding by using AWS symbols, showing type, size and location of welds. Prepare welding procedure specifications and diagrams for each weld joint, and use specified weld in work. Assign each joint procedure designation number or code. Show number or code in tail of each welding symbol on shop drawings. Where standard weld type is repeated throughout work, its procedure designation or code may be shown by general note or reference on each shop drawing where that weld type appears. Provide auxiliary views of welds to clarify welded connections.
- G. Differentiate between shop connections and field connections by appropriate symbols on shop drawings. Show location, type and size of connections and connection components. Indicate members or portion of members that shall not be shop painted.
 - 1. Submit weld design and procedures for welds not pre-qualified by ANSI/AWS D1.1-96.
- H. Submit separate setting plans and shop drawings for Anchor Rods. Show, on shop drawings, complete information about bolts, nuts and accessories, identification marking, and setting instructions, including dimensioned locations and elevations. Furnish two copies of Registered Design Professional approved shop drawings, to installer of bolts.
- I. *Welder Qualifications [Q]*: Submit summary sheets showing welder, welding operator and tacker qualifications and welding connection workmanship per ANSI/AWS D1.1-96. Do not submit individual certifications. Certifications shall be kept at manufacturer's plant for Inspector's use.
- J. *Method of Repair [D]*: Submit drawings and description for proposed repair of defective material or improper workmanship as an alternate to removal and replacement. Include method of repair.

K. TESTING AGENCY SUBMITTALS

L. *Tests and Audits [T]*: Submit reports on completed tests and audits showing conformance or non-conformance with Contract Documents. Include visual and non-destructive testing of welds. Testing Agency shall send duplicate copies of tests and audits to Registered Design Professional and to Contractor.

M. Record Documents

1. *As-Built Drawings [D]*: Upon completion of erection of steel, and before Final Payment, furnish two certified rolls of 35 MM microfilm (unpunched, negative) of as-built structural steel shop, erection, and anchor bolt setting drawings to Registered Design Professional. Drawings used for microfilming shall be void of marks and stamps and shall show as-built conditions.
2. Refer to Section 01720 for additional requirements.

1.5 QUALITY ASSURANCE

A. Defective Material or Improper Workmanship

1. Defective material or improper workmanship found at mill, shop, or project site, at any time, will be rejected regardless of previous inspections.
 - a. Remove rejected material or work and provide new materials or work that conforms to Contract Documents.
 - b. Alternatively, rejected material or work may be repaired. Submit written request as specified under Article "Submittals", but do not proceed until Registered Design Professional has approved repair and method. If submittal is not approved by Registered Design Professional, remove and rejected material or work and provide new materials.
2. Provide removal and replacement, or repair, at no additional cost to Owner, and pay costs attributable to delay caused by rejection and corrective action.

B. Welder, Welding Operator And Tack Welder Qualifications

1. Employ on this project only welders, welding operators and tack welders who have been tested and qualified per Section 4, ANSI/AWS-D1.1-96 and other applicable provisions of ANSI/AWS-D1.1-96.
2. Requalify welder, welding operator, or tack welder who has not been performing this particular welding process (for which he was qualified) for six months before employment on this project.
3. Registered Design Professional reserves may require retesting and requalifying of welder, welding operator, or tack welder.

C. Testing Agency

1. Owner will engage and pay for services of qualified, unbiased, commercial Testing Agency to do shop inspections. Owner intends that inspection will be full-time and at each location of fabrication.
2. Testing Agency duties shall include preliminary audit of fabrication shop and equipment to evaluate production and scheduling capabilities of Contractor to comply with intent of

Contract Documents, spot audits of work during fabrication, final audit of work before shipment to site, and determination that materials have been furnished and fabricated per Contract Documents requirements . Acceptance of material and work by Testing Agency shall not relieve Contractor from fulfilling requirements of Contract.

3. Welds shall be visually inspected by Testing Agency. Acceptance of welds shall be based on Section 5 and 6 of ANSI/AWS D1.1-96 and other parts of AWS D1.1 as specified. Inspector shall identify accepted welds with distinguishing mark.
4. Besides visual inspection, non-destructive testing of welds shall be done by Testing Agency per Section 6 of ANSI/AWS-D1.1-96 for compliance with Contract Documents and ANSI/AWS-D1.1-96. Personnel performing non-destructive testing shall be qualified as Level II per American Society for Non-Destructive Testing. Test 10 percent of non-fillet welds. Test additional welds or re-test repaired welds selected by Registered Design Professional. Depending upon kind of rejected welds encountered during Testing, use one or more of the following methods:
 - a. Liquid Penetrant Testing per ASTM E 165 for detecting discontinuities that are open to surface inspection. Standards of acceptance shall be in accordance with Section 6 Part C, of AWS D1.1, whichever is applicable.
 - b. Magnetic Particle Testing per ASTM E 709, using an external source for magnetization method, for detecting cracks and other discontinuities at or near surface. Standards of acceptance shall be in accordance with Section 6 Part C, of AWS D1.1, whichever is applicable.
 - c. Radiographic Testing per Part E of Section 6 of ANSI/AWS D1.1-96 for detecting porosity and other discontinuities by X-ray or gamma-ray testing. Acceptance per applicable parts of Article 6.12 OF ANSI/AWS D1.1-96.
 - d. Ultrasonic Testing per Part F of Section 6 of ANSI/AWS D1.1-96 for detecting lamellar discontinuities by pulse echo type using oscillating transducers. Acceptance per Article 6.13 of ANSI/AWS D1.1-96.
5. To assist Testing Agency, provide the following, at no extra cost:
 - a. Labor and handling equipment to manipulate members and to provide ready and convenient access for testing and audit work.
 - b. One copy each of mill orders, mill test certificates, paint invoices and accepted shop drawings.
 - c. Office space for Testing Agency's administrative duties and free and ready access to fabricating shop.

D. Project Meeting for Structural Steel Detailing

1. At least 7 days before beginning shop drawings, hold meeting in Registered Design Professional's office to discuss detailing procedures.
2. Invite representatives concerned with structural steel detailing. Attendees shall include, but not be limited to, the following:
 - a. Contractor's superintendent
 - b. Structural steel fabricator
 - c. Structural steel detailer
 - d. Registered Design Professional
 - e. Owner

3. Registered Design Professional shall distribute an agenda in advance, chair meetings, and provide minutes of meeting to attendees and Owner.
- E. Steel Fabricator shall be certified in Category I per AISC “Qualification Certification Program”.
- F. At least 14 days before meeting submit proposed connections, procedures, calculations, and alternatives to Registered Design Professional for review.

1.6 DELIVERY, STORAGE AND HANDLING

- A. Block and tie material securely during transportation to prevent damage.
- B. Ship small, loose items required for field connections in separate, substantial containers to prevent loss and damage during shipping. Items include clips, ties, lugs, separators, bolts, connectors, shims, and miscellaneous pieces. Identify items for location and use.
 1. Ship Anchor Rods and other bolts and connectors to be embedded in concrete or set in masonry per concrete and masonry construction schedules.
 2. Ship bolts and connectors with each shipment of steel members as needed for erection.
- C. Store steel members at site in locations agreed upon with Registered Design Professional.
- D. Store on shores or blocking to keep steel free from dirt, mud and other foreign materials.
- E. Clean steel to remove contaminants, before erection.
- F. Replace warped or bent members that cannot be properly and satisfactorily straightened by approved procedures, with new members at no extra cost to Owner.
- G. Properly store and transport galvanized steel per American Galvanizers Association’s recommended procedures to prevent wet storage stain.

1.7 PROJECT CONDITIONS

- A. Existing Conditions
 1. Verify location and elevation of steel bearing or setting locations and Anchor Rods before proceeding with erection and in time to permit necessary corrections without delaying erection of steel. Immediately report to Registered Design Professional discrepancies found; otherwise, pay entire cost of removing and resetting incorrectly placed Anchor Rods and cost of repairing or replacing construction damaged during relocation of incorrectly placed Anchor Rods and plates. Alternatively, where approved by Registered Design Professional, pay cost of changes in steel work required to fit incorrectly placed Anchor Rods. If repair or replacing of concrete construction is permitted, perform work by methods acceptable to Registered Design Professional.
 2. Verify existing conditions including existing column spacing, heights, and interference of new and existing work. Check given dimensions, and make measurements necessary to fit new Work or alterations to existing structure. Check sections and connections of existing

structure with respect to new Work or alterations. If actual conditions deviate from those shown, immediately advise Owner's Resident Construction Engineer. Submit necessary changes for approval before proceeding with steel fabrication.

3. Where existing columns are out of plumb, make necessary provisions in new Work to take care of actual conditions. Use connections with slotted holes, shims, or fills, seated connections, or other suitable means approved by Registered Design Professional to accommodate deviations between assumed and actual conditions. Provide welded connections at slotted hole connections after structural steel is erected and plumbed. Shop weld fills in place. Provide bolts or welds to account for maximum eccentricity of connections. Submit details to provide adjustment to Registered Design Professional for approval before preparation of shop drawings.

B. Protection

1. Assume full responsibility for correct plumbing, alignment, and setting of structural steel members. Provide temporary guys, braces, falsework, connections, etc., necessary to maintain structural framing plumb and in proper alignment until time as permanent connections are made, succeeding work is in place, and temporary work is no longer necessary. In addition, provide temporary bracing, shoring and other work to prevent damage to adjacent work or construction attributable to erection procedures and operation of erection equipment. At completion, remove and dispose of temporary work and facilities, off-site.

PART 2 PRODUCTS

2.1 MATERIALS

- A. Structural Steel Shapes and Plates:** Submit mill test reports to substantiate that steel conforms to specification.
1. Wide flanges and structural tees, provide per ASTM A 992, rolled from new steel billets, unless otherwise noted on the Drawings
 2. All other shapes and plates, provide per ASTM A 36, rolled from new steel billets, unless otherwise noted on the Drawings.
- B. Bolts and Accessories:** Submit test reports and certificates. Furnish bolts and nuts as assemblies manufactured by one source.
1. High-Strength Bolts: Heavy hex structural per ASTM A 325, of lengths required for thickness of members joined and for the type of connection.
 - a. Type 1 or 2, plain bolt.
 - b. Bolts for Slip Joints and Vertically Slotted Connections: Unthreaded length of bolt shall exceed the grip of the joint plus washers by 1/16 inch.
 - c. Manufacturers: Any manufacturer fabricating bolts and matching nuts per ASTM A 325 and with proper identification on bolt.
 - d. Direct Tension Indicator Bolt Manufacturers: Fabricated per ASTM A 325 and with proper identification on bolt:
 - 1) LeJeune Bolt Company

- 2) Lohr Structural Fasteners Inc.
 - 3) NSS Industries
 2. Nuts for High-Strength Bolts: Heavy hexagon per ASTM A 563.
 - a. For type 1 or 2 plain bolt - Grade C, plain nut.
 - b. For slip joint bolting - Standard nut plus jam nut or locking nut.
 3. Washers for High-Strength Bolts: Hardened steel per ASTM F 436.
 - a. For type 1 or 2 plain bolt - Finished washer, plain.
 4. Anchor Rods: ASTM F 1554, Grade 55, with weldability supplement S1, threaded and nipped at top and bottom with ASTM F 436, Type 1, hardened carbon steel washers.
 5. Nuts for Anchor Rods: Per ASTM A 563, Grade A, heavy hexagonal carbon steel nuts.
 6. Common Bolts: Unfinished bolts per ASTM A 307, Grade A, with hexagon heads. Furnish of lengths required to suit thickness of materials joined, but to project not more than ¼ inch beyond nut.
 7. Nuts for Common Bolts: Grade A, hexagon, per ASTM A 563.
- C. Structural Steel Primer Paint: A white, flat finish, lead and chromate free, rust inhibitive alkyd primer meeting or exceeding the performance requirements of SSPC-Paint 25.
1. Tnemec “99W White”
 2. Sherwin Williams “Universal Metal Primer B50WW8”
 3. PPG/Pittsburgh Paints “2.8 VOC Alkyd Primer UC87019”
 4. International Coatings, Inc. “Interlac 260FD”
- D. *Mono-Rail Bumpers and Mounting Brackets [P]*: Furnish and install per Drawings and manufacturer’s recommended procedures. Submit manufacturer’s information specific to this project. Bumpers and mounting brackets shall be sufficient to resist bumper lateral loads from cranes of capacity equal to that indicated on the Drawings.
1. Gantrex Crane Runway Products.

2.2 COMPONENTS

- A. Steel Structural Tubing: Hollow structural square or rectangular shapes, cold-formed per ASTM A 500 Grade B except where higher strength is noted or specified on Drawings.
- B. Steel Pipe: Hollow structural round shapes per ASTM A 53, Type S, Grade B or cold-formed per ASTM A 500, Grade B except where higher strength is noted or shown on Drawings.
- C. Columns:
1. Furnish columns in single lengths, without splices, except where multiple lengths are shown. Fabricate columns straight and true for full length per referenced AISC Specifications.
 2. Fabricate columns with base and cap plates. Cut and finish column ends square at base plates, cap plates, and splices. Provide slotted holes for connections at top of wind columns to permit deflection of framing member above.
 3. Fabricate base and cap plates from rolled steel plates. Press, flatten, or mill plates to obtain proper bearing per AISC requirements. Weld plates to columns at both web and

flanges of column. Provide anchor bolt holes and grout holes in plates, oversized per AISC recommendations, to permit slight adjustment in column location.

D. Girders, Beams and Purlins

1. Fabricate with natural camber up. Natural camber shall not exceed 1/8-inch for every 10 feet of span.
2. Provide double angle connections for beams and girders to develop not less than:
 - a. 50 percent of total allowable uniform load for non-composite members.
 - b. 75 percent of total allowable uniform load for composite members.
 - c. Loads shown on Drawings.
3. Connections need not exceed 100 percent of allowable web shear of member.

E. Door and Other Frames

1. Assemble and fabricate from structural shapes specially selected for straightness, trueness and freedom from warp, twist and defects. Fabricate frames in true rectangular shape to dimensions noted and per AISC Code of Standard Practice - Section 10. Cope and weld joints. Grind exposed welds smooth and flush with adjacent surfaces.
2. Install bar stops on pedestrian door frames by plug welding. Where noted to be removable, install bar stops with flat head screws, countersunk flush and spaced not more than 24-inches on center.
3. Provide concealed clip angles and two expansion bolts for connecting bottom of frames to concrete slabs and foundations. Provide concealed steel strap anchors, not less than 1/8-inch thick, 1-1/2 inch wide, and 10-inches long for securing frame verticals to adjacent masonry or cast-in-place concrete. Weld strap anchors to frame to coincide with horizontal jointing at masonry and space not more than 24-inches on center.

F. Miscellaneous Framing

1. Provide bracing, wall framing, parapet framing, opening framing and other miscellaneous framing shown and noted to be structural steel, with either holes or other connection work or both.
2. Verify framing, supports, and openings for roof mounted mechanical and electrical equipment with approved certified manufacturer equipment drawings for correct dimensions, sizes, and locations.
3. Fabricate bracing so as to provide draw for alignment of framing. Fabricate connections at both ends of bracing members to develop not less than 100 percent of full strength of member.

G. *Mono-Rails [P]*:

1. Steel sections of sizes shown, selected for trueness of web and flange, prepared for tight joints and complete with removable end stops, bolts, splices, clamps, plates, shims, and fillers, as detailed or required for complete installation.
2. Protective Coating:
 - a. Carboline Company "Carbomastic 15 Low Odor".

2.3 ACCESSORIES

- A. Welded Studs: Per Section 7 of ANSI/AWS D1.1-96 for “Stud Welding”; of length and shank diameter noted.
 - 1. Shear Studs: Shear connector type.
 - 2. Headed Studs: Headed studs for concrete anchorage.
 - 3. Threaded Studs: Threaded studs complete with nut and washer.
 - 4. Manufacturers:
 - a. Champion Fasteners
 - b. ISC “Inventory Sales Company”
 - c. TRW “Nelson Division”
 - d. TFP Corporation “Tru-Weld Type CA”.

2.4 FABRICATION

- A. Furnish and fabricate per the design and details shown and per approved shop drawings.
 - 1. Fabricate shop connections for welding or high-strength bolting.
 - 2. Fabricate field connections for high-strength bolting.
 - 3. Fabricate field connections that cannot be bolted for welding.
- B. Provide holes for bolted connections during shop fabrication. Do not burn or torch-cut holes. Drill, do not punch, holes in material 7/8-inch thick or greater.
- C. Provide holes, 1/16 inch-diameter larger than bolt diameters for connection of wood nailers. Locate and space holes as noted; otherwise space holes 24-inches on center.
- D. Fabricate items built or anchored into adjacent concrete or masonry construction with anchorage devices, bolts, anchors and clips.
- E. Provide clips, ties, lugs, separators, bolts, fittings, shims, fillers, connectors, weld electrodes, and miscellaneous items required for fabrication and erection of field-connected materials.
- F. Furnish members of proper length and assemble without excessive use of fillers. Join and assemble members without sharp projections, serrated edges, sharp edges, or sharp corners at joints. Cope, block, miter, and grind edges with care. Furnish members free from twists, bends, distortions and open joints. Mark pieces with same identifying number or symbol as used to identify pieces on shop drawings.
- G. Welding
 - 1. Perform welding with specified electrodes and qualified welders, welding operators, and tack welders per specified Reference Standards. Provide necessary jigs and holding devices for shop welding. Dog or clamp down work to prevent distortion during welding. Control welding sequence to minimize residual stresses and member distortion.
 - 2. Where possible design weld details and procedures to permit welding in flat and horizontal position using ANSI/AWS prequalified welds. Avoid undercut, insufficient throat or leg, lack of fusion, and weld spatter. Repair defective welds immediately or remove and install

- new welds conforming with Specifications, at no extra cost to Owner. Qualify non-prequalified welds per ANSI/AWS D1.1-96.
3. Place "SMAW" fillet welds larger than 5/16-inch in not less than two passes. Remove slag coating before starting succeeding pass. Weld lengths shall be net effective lengths. Add approximately 3/4-inch to theoretical length of intermittent welds to allow for craters. Fill craters.
 4. Conform to minimum thickness, preheat, and interpass requirements. Minimum weld size shall be based on material thickness and shall not be reduced by preheating.
 5. For welds exposed to weather, make continuous welds so as to be weather tight and grind smooth.
 6. Welding Electrodes:
 - a. Shielded Metal Arc Welding: E70 series electrodes per ANSI/AWS A5.1 or A5.5.
 - b. Submerged Arc Welding: Flux and F7 series electrodes per ANSI/AWS A5.17 or A5.23.
 - c. Gas Metal Arc Welding: Solid ER07 series electrodes per ANSI/AWS A5.18.
 - d. Flux Cored Arc Welding: E7 series electrodes per ANSI/AWS A5.20.
 7. Install welded studs under conditions conducive to formation of sound welds. Do not weld when steel is less than 20 degrees Fahrenheit or when steel surface is wet or exposed to rain or snow. Preheat steel surfaces, where necessary, to 100 degrees Fahrenheit minimum.

H. Welded Studs

1. Surfaces to receive welded studs shall be free from dirt, loose rust, oil, excessive mill scale, paint, and materials or contaminants that would cause defective weld. Use wire brushing, sand blasting, grinding or other suitable cleaning methods.
2. Shear Studs: Furnish and install shear studs on steel members, of sizes and in locations shown. Install shear studs per Section 7 of ANSI/AWS D1-1-96 using an electric stud welding system and equipment recommended by stud manufacturer, modified as follows:
 - a. To provide minimum 2000 amperes power for welding.
 - b. To permit only one stud gun to operate at one time from power source.
 - c. To allow power source to regain full power between welds.
 - d. To time each welding cycle automatically.
3. Headed Studs: Furnish and install headed studs on steel members for anchorage to concrete. Unless otherwise noted, space headed studs at not more than 12-inches on center.
4. Threaded Studs:
 - a. Furnish and install threaded studs on steel members in locations shown. Unless otherwise noted, space threaded studs at not more than 24-inches on center.

2.5 FINISHES

A. Surfaces not to be shop painted include:

1. Contact surfaces at slip critical connections.
2. Surfaces to receive adhered application of fireproofing.
3. Surfaces at field welds and field-welded studs to 2-inches beyond weld areas.
4. Top flanges of beams that shall receive welded studs for composite construction.
5. Crane rails.
6. Steel members to be galvanized.

7. Steel surfaces in contact with concrete or steel members embedded in concrete.

B. Surfaces to be shop painted include:

1. All surfaces except as defined under “Surfaces not to be shop painted”.
2. Surfaces inaccessible after shop assembly.
3. Surfaces at bearing-type connections.

C. Surfaces to be painted after connections are made include:

1. Surfaces at slip critical connections.
2. Surfaces at welded connections.

D. Preparation, Cleaning

1. Except as otherwise specified in later paragraphs, clean steel to be shop-painted by power tool cleaning per SSPC-SP3 or brush-off blast cleaning per SSPC-SP7. Standard for surface preparation to be achieved by cleaning shall be B, C, D St 3, or B, C, D Sa 1, per SSPC-Vis1-67T.
2. For field-contact surfaces, clean surfaces per Paragraph 1 above.
3. Clean remaining steel per SSPC-SP3 or SSPC-SP7.
4. Definition of cleaning and its visual aspects are as follows:

	Specification and Subject	Photo SSPS-Vis 1	Purpose
SSPC-SP3	Power Tool Cleaning	B,C,D St 3	Removal of loose rust, loose mill scale, and loose paint to degree specified, by power tool chipping, descaling sanding, wire brushing and grinding.
SSPC-SP7	Brush-Off Blast Cleaning	B,C,D Sa 1	Removal of loose rust, loose mill scale, and loose paint to degree specified by brush-off blast cleaning. Tightly adhered mill scale, rust and paint may remain on surface.

E. Shop Priming

1. Apply one coat of priming paint, unless otherwise specified or noted on Drawings.
2. Surfaces to be shop painted include:
 - a. All surfaces except as defined under “Surfaces not to be shop painted”.
 - b. Surfaces inaccessible after shop assembly.
 - c. Surfaces at bearing-type connections.
3. Surfaces to be painted after connections are made include:
 - a. Surfaces at slip critical connections.
 - b. Surfaces at welded connections.
4. Surfaces not to be shop painted include:
 - a. Contact surfaces at slip critical connections.
 - b. Surfaces at field welds and field-welded studs to 2 inches beyond such weld areas.
 - c. Top flanges of beams that will receive welded studs for composite construction.
 - d. Crane rails.
 - e. Steel members to be galvanized.

- f. Steel surfaces in contact with concrete or steel members embedded in concrete.
5. Apply paint to clean, dry surfaces by brush, spray, or roller. Do not use dipping process.
6. Apply paint coating evenly and uniformly, without skips or runs, to produce dry paint film thickness of not less than 2.0 mils.
7. Allow paint to dry before handling or loading steel work for shipment. Apply erection marks on members after painting in same location and of same design as shown on approved erection drawings.

F. Galvanizing

1. Galvanize members exposed to weather when in final location, unless otherwise noted, and members specifically noted on Drawings as galvanized.
 - a. Galvanized rolled, pressed and forged steel shapes, plates, bars and strips per ASTM A 123 with an average weight of zinc coating of 2.0 ounces per square foot of actual surface for members less than 1/4-inch thick, and 2.3 ounces per square foot of actual surface for members 1/4-inch and thicker.
 - b. Galvanized iron and steel hardware per ASTM A 153 with minimum weight of zinc coating, in ounces per square foot of surface per TABLE 1 of ASTM A 153, for various classes of materials used on project.
2. Apply galvanizing after built-up members are completely fabricated. Straighten shapes and assemblies true to line and plane after galvanizing. Repair damage to galvanized surfaces with galvanized touch-up paint.
3. Remove excess zinc from bolt holes and shop fit specified bolts in holes.
4. Follow proper detailing and fabrication procedures per ASTM A 143, A 384 and A 385 to provide optimum hot dip galvanizing.

PART 3 EXECUTION

3.1 ERECTION

- A. Erect and install members accurately to lines and elevations shown. Unless otherwise noted, erect vertical members plumb, horizontal members level, and intersections of members at right angles. Make connections after members have been plumbed, leveled, and aligned properly.
 1. Erect girts in unbroken level lines, with 3/4-inch to 1 inch open space between ends of aligned members where members are protected from weather and without open space where exposed to weather. Install sag rods in locations noted. Thread ends of sag rods, draw girts up level with nuts, and install lock nuts.
- B. Connect members temporarily with sufficient bolts to insure safety of structure until permanent connections are made. Use bolts of same size and type as used for permanent connections. Remove temporary bolts as permanent connections are made and install permanent bolts of type specified.
- C. Tension bracing while aligning framing. Clamp horizontal bracing to beams at intersections. Where shown, join bracing intersections with splice plates.

- D. Members that do not fit together during erection because of errors in shop fabrication shall be reported to Registered Design Professional. Correct minor misfits as part of field erection. Only light drifting shall be permitted to draw members together. Drifting to match unfair holes shall not be permitted. Reaming to match unfair holes shall be permitted provided that quantity of reaming does not exceed 1/16-inch and that reaming to be done does not decrease critical edge distance beyond amount considered minimum by referenced AISC Specification. Where necessary to enlarge holes, criteria specified for holes made in shop shall apply to holes made in field, and proper size bolt shall be used. Where misfitting members cannot be corrected as specified above, provide new members. Correct misfit members, including replacement, at no additional cost to Owner and without altering Contract Schedule and Completion Date.
- E. Do not cut or alter any members in the field without prior written consent from Registered Design Professional. Use hacksaw to cut members in the field. Do not burn or flame cut members in the field without prior written consent of Registered Design Professional. If consent is given, burned members shall be free from serrations and gouges at radius burns and at re-entrant corners. Occasional serrations not exceeding 1/16 -inch in depth shall be permitted along straight cuts. Grind burned edges to remove sharp edges and corners. Burning of holes shall not be permitted.
- F. Place grout under steel column bases and elsewhere as shown. Mix and place grout per manufacturers directions. Place grout to fill voids and to make full contact with underside of bearing surfaces. Place grout as soon as possible and before installation of enclosure systems.
- G. Apply protective coating to structural members including base plates and anchor rods that occur in fill areas below floor slabs where members are not encased in concrete. Clean surfaces and apply coating per manufacturer's recommendations to minimum one-coat dry film thickness of 5 mils.

3.2 CONNECTIONS

- A. Welding
 - 1. Complete field welding per requirements specified for shop welding.
 - 2. Use low hydrogen weld rod for welding to existing steel framing unless steel is shown to be compatible with proposed weld rod.
- B. High Strength Bolting
 - 1. Install high strength steel bolts per referenced "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts". Tension each bolt by "turn-of-nut tightening" method or "alternate design bolt" method to a total not less than that stated in referenced "Specifications for Structural Joints using ASTM A 325 or A 490 Bolts" for type and size of bolt used.
 - 2. Install bolt in properly sized hole and place washer under turned element. Tension bolt assembly as specified until required tension is obtained. Do not loosen and reuse bolt assembly after it has been tensioned.

3. Before bolting members, clean faying surfaces of defects, coatings, and contaminants that would prevent solid seating of parts or that would interfere with development of friction between parts for slip-critical connections.

C. Common Bolting

1. Where bolts shall be exposed in finished work, install bolts so that nut end shall not be exposed to view. Draw connections up tight using impact wrenches. Use lock washers for common bolting.

D. Monorail Beams

1. Install monorail beams plumb, and level to tolerance of 1/8-inch in 50 feet.
2. Weld bottom flanges of abutting monorail beams and grind smooth and flush.
3. Retighten bolts 30 days after initial installation.

3.3 ALTERATIONS TO EXISTING STEEL

- A. Provide alterations to existing structural steel, removal of steel, reinstallation of existing members, and installation of new steel as shown.
- B. Before cutting or removing any steel, brace and support existing structure if appropriate to temporarily absorb loads which may be imposed by alteration work. Remove steel by saw cutting and cold chiseling; burning is not permitted without written consent of Registered Design Professional. Drill and ream new bolt holes if appropriate for new connections.
- C. Accurately fabricate new steel members to conform to existing conditions and connect as specified.
- D. Existing steel to be removed and not required in alteration work shall become property of Contractor and shall be removed from site.
- E. Field measure existing construction if appropriate for proper fabrication of work and accurate fit of steel members. Dimensions noted on Drawings shall be field verified.
- F. Bolt, or weld if approved by Owner, to existing steel. Use low-hydrogen electrode for welding.

3.4 REPAIR/RESTORATION

- A. Degrease, clean and field paint portions of bolts, washers, faying surfaces, adjacent surfaces that remain exposed after assembly, unpainted splice plates, cover plates, welded areas and paint surfaces damaged during shipment and erection. Paint with one coat of same type prime paint used in shop.
- B. After erection of steel, shop coat of paint on exposed framing shall be suitable to receive General Painter's field coats. Where surfaces are damaged during erection or where necessary for General Painter to scrape off shop coat and repaint same, or to remove clay, mud and other foreign materials, cost of this work shall be borne by Contractor.

- C. It is the intent that shop coat of paint serve as finish coat for steel members, with no additional coats being applied to members (except that columns and door frames shall receive an additional finish coat applied by General Contractor.) After erection, examine shop coat and touch-up paint damaged and bare areas (including welds and fasteners). If surfaces are not adequately covered, as determined by Resident Construction Engineer, apply further coats to achieve complete coverage of surfaces at no additional cost to Owner. Completed surfaces shall be clean, free of dirt, mud and other foreign matter; if surfaces are soiled, clean and repaint same as directed.
- D. After erection of steel, clean galvanized surfaces to be free from clay, mud, and other foreign matter. Apply zinc rich touch-up paint per ASTM A 780 to surfaces damaged during shipment and erection.

3.5 FIELD QUALITY CONTROL

- A. The Owner will provide for field inspection of work, at his expense. Requirements shall be similar to those specified for shop inspection. Besides testing of welds, high strength bolted connections shall be tested and checked by Testing Agency using calibrated torque wrench per referenced "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts". If one or more bolts in any connection are found to be below minimum tension, bolts in that connection shall be checked. Retorque bolts found to be below minimum tension. Bolts shall be rechecked for conformance to Specification.
- B. Framing shall be inspected for plumb of vertical members, level or slope of horizontal members, alignment and plane of vertical and horizontal members, angle of intersection of members, defective members, efficiency of common bolt connections, primer coating, touch-up painting, and to ascertain that materials are furnished and erected in accordance with requirements of Contract Documents.

END OF SECTION

Revision History	
Date	Rev. No.
A	0
B	0
C	0
D	0
E	0
F	0
02-19-09	0

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