TECHNICAL SPECIFICATIONS

FOR

CH2M HILL PLATEAU

105 KE ISS ASSOCIATED

PENETRATION SEALING AND SAFE

STORAGE ENCLOSURE (SSE) DESIGN

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Project No. 11-6729 Rev. 0
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PART 1 - GENERAL

1.1 SUMMARY

A. Section includes cast-in-place concrete, including formwork, reinforcement, concrete materials, mixture design, placement procedures, and finishes.

B. Related Sections:
   1. Division 05, Section 5000, “Metal Fabrications” for embedded items.
   2. Division 31, Section 2000, “Earth Moving” for drainage fill under slabs-on-grade.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

B. Design Mixtures: For each concrete mixture. Submit alternate design mixtures when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.

   1. Indicate amounts of mixing water to be withheld for later addition at Project site.
   2. Provide documentation of design compressive strength per ACI 301.

C. Steel Reinforcement Shop Drawings: Placing drawings that detail fabrication, bending, and placement. Include bar sizes, lengths, material, grade, bar schedules, stirrup spacing, bent bar diagrams, bar arrangement, splices and laps, mechanical connections, tie spacing, hoop spacing, and supports for concrete reinforcement.

D. Manufacturer Qualifications.

E. Testing Agency Qualifications including field personnel.

   1. Personnel conducting field tests shall be qualified as ACI Concrete Field Testing Technician, Grade 1, according to ACI CP-1 or a similar certification program or through experience and training.

1.3 INFORMATIONAL SUBMITTALS

A. Material certificates: For each of the following:

   1. Cementitious materials.
   2. Admixtures.
   3. Steel reinforcement.
   4. Fiber reinforcement.
   5. Waterstops.
   6. Curing compounds.
8. Adhesives.

B. Material test reports: For the following, from a qualified testing agency, indicating compliance with requirements:

1. Aggregates. Per ASTM C 33 and include service record data indicating absence of deleterious expansion of concrete due to alkali aggregate reactivity.

C. Field quality-control reports: For the following, from the Contractor, indicating compliance with requirements:

1. Batch ticket.
2. Concrete Pour Checklist

D. Field quality-control reports: For the following, from a qualified testing agency, indicating compliance with requirements:

1. Steel reinforcement placement.
2. Headed bolts and studs.
3. Verification of use of required design mixture.
4. Concrete placement, including conveying and depositing.
5. Curing procedures and maintenance of curing temperature.
6. Composite Sample (Slump, Air Content, Concrete Temperature) Tests.
7. Compressive-Strength Tests.

E. Conveying Equipment: Per ACI 301 5.1.2.

F. Temperature Measurements: Per ACI 301 5.1.2.

G. Hot and Cold Weather Concreting Plan.

1.4 QUALITY ASSURANCE

A. Applicability of Standards: Unless the Contract Documents include more stringent requirements, applicable construction industry standards have the same force and effect as if bound or copied directly into the Contract Documents to the extent referenced. Such standards are made a part of the Contract Documents by reference. Publication Dates: Comply with standards in effect as of date of the Contract Documents unless otherwise indicated.

B. Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C 94/C 94M requirements for production facilities and equipment.

1. Manufacturer certified according to NRMCA’s “Certification of Ready Mixed Concrete Production Facilities”.

C. Testing Agency Qualifications: An independent agency, qualified according to ASTM C 1077 and ASTM E 329 for testing indicated.
D. ACI Publications: Comply with the following unless modified by requirements in the Contract Documents:

1. ACI 301, “Specifications for Structural Concrete”, Sections 1 through 5.
2. ACI 117, “Specifications for Tolerances for Concrete Construction and Materials”.
3. ACI 211.1, “Standard Practice for Selecting Proportions for Normal, Heavyweight, and
Mass Concrete”.
4. ACI 305R, “Hot Weather Concreting”.
5. ACI 306R, “Cold Weather Concreting”.

E. Concrete Testing Service: Engage a qualified independent testing agency to perform material evaluation tests.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Steel Reinforcement: Deliver, store, and handle steel reinforcement to prevent bending and damage.

B. Waterstops: Store waterstops under cover to protect from moisture, sunlight, dirt, oil, and other contaminants.

PART 2 - PRODUCTS

2.1 FORM-FACING MATERIALS

A. Forms may be left in place as long as the form is non-combustible.

B. All wood forms shall be fire treated and/or fire painted.

C. Smooth-Formed Finished Concrete: Form-facing panels that will provide continuous, true, and smooth concrete surfaces. Furnish in largest practicable sizes to minimize number of joints.

D. Rough-Formed Finished Concrete: Plywood, lumber, metal, or another approved material. Provide lumber dressed on at least two edges and one side for tight fit.


F. Form-Release Agent: Commercially formulated form-release agent that will not bond with, stain, or adversely affect concrete surfaces and will not impair subsequent treatments of concrete surfaces.


G. Form Ties: Factory-fabricated, removable or snap-off metal or glass-fiber-reinforced plastic form ties designed to resist lateral pressure of fresh concrete on forms and to prevent spalling of concrete on removal.

1. Furnish units that will leave no corrodible metal closer than one inch to the plane of exposed concrete surface.
2. Furnish ties that, when removed, will leave holes no larger than one inch in diameter in concrete surface.

2.2 STEEL REINFORCEMENT

A. Recycled Content of Steel Products: Provide products with an average recycled content of steel products so postconsumer recycled content plus one-half of preconsumer recycled content is not less than 60 percent. No documentation is required since The Steel Recycling Institute indicates that reinforcing bars are made by the electric arc furnace method, which typically has 57.5 percent postconsumer recycled content and 6.5 percent preconsumer recycled content.

B. Reinforcing Bars: ASTM A 615/A 615M, Grade 60, deformed.

C. Low-Alloy-Steel Reinforcing Bars: ASTM A 706/A 706M, deformed.

D. Plain-Steel Welded Wire Reinforcement: ASTM A 185/A 185M, plain, fabricated from as-drawn steel wire into flat sheets.


F. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded wire reinforcement in place. Manufacture bar supports from steel wire, plastic, or precast concrete according to CRSI’s “Manual of Standard Practice”.

2.3 REINFORCEMENT ACCESSORIES

A. Joint Dowel Bars: ASTM A 615/A 615M, Grade 60, plain-steel bars, cut true to length with ends square and free of burrs.

B. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded wire reinforcement in place. Manufacture bar supports from steel wire, plastic, or precast concrete according to CRSI’s “Manual of Standard Practice”, of greater compressive strength than concrete and as follows:

1. For concrete surfaces exposed to view where legs of wire bar supports contact forms, use CRSI Class 1 plastic-protected steel wire or CRSI Class 2 stainless-steel bar supports.

C. Tie Wire: ASTM A853 carbon steel, 16 gage minimum.

2.4 CONCRETE MATERIALS

A. Cementitious Material: Use the following cementitious materials, of the same type, brand, and source, throughout Project:

1. Portland Cement: ASTM C 150, Type I, Type II, or Type I/II. Supplement with the following:

   a. Fly Ash: ASTM C 618, Class F.
B. Normal-Weight Aggregates: ASTM C 33, graded.

   1. Maximum Coarse-Aggregate Size: 1 1/2 inches nominal.
   2. Fine Aggregate: Free of materials with deleterious reactivity to alkali in cement.


2.5 ADMIXTURES


B. Chemical Admixtures: Provide admixtures certified by manufacturer to be compatible with other admixtures and that will not contribute water-soluble chloride ions exceeding those permitted in hardened concrete. Do not use calcium chloride or admixtures containing calcium chloride.

   1. Water-Reducing Admixture: ASTM C 494/C 494M, Type A.
   2. Retarding Admixture: ASTM C 494/C 494M, Type B.
   3. Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type D.
   4. High-Range, Water-Reducing Admixture: ASTM C 494/C 494M, Type F.
   5. Plasticizing and Retarding Admixture: ASTM C 1017/C 1017M, Type II.

2.6 FIBER REINFORCEMENT

A. Synthetic Micro-Fiber: Polypropylene micro-fibers engineered and designed for use in concrete, complying with ASTM C 1116/C 1116M, Type III, 1/2 to 1-1/2 inches

2.7 WATERSTOPS

A. Self-Expanding Butyl Strip Waterstops: Manufactured rectangular or trapezoidal strip, butyl rubber with sodium bentonite or other hydrophilic polymers, for adhesive bonding to concrete, 3/4 by 1 inch.

2.8 CURING MATERIALS

A. Evaporation Retarder: Waterborne, monomolecular film forming, manufactured for application to fresh concrete.

B. Absorptive Cover: AASHTO M 182, Class 2, burlap cloth made from jute or kenaf, weighing approximately 9 oz/sq. yd. when dry.

C. Moisture-Retaining Cover: ASTM C 171, polyethylene film or white burlap-polyethylene sheet.

D. Water: Potable.

E. Clear, Waterborne, Membrane-Forming Curing and Sealing Compound: ASTM C 1315, Type 1, Class A, certified by curing compound manufacturer to not interfere with bonding of floor covering or coatings.
2.9 RELATED MATERIALS


B. Bonding Agent: ASTM C 1059/C 1059M, Type II, non-redispersible, acrylic emulsion or styrene butadiene.

2.10 CONCRETE MIXTURES

A. Prepare design mixtures for each type and strength of concrete, proportioned on the basis of laboratory trial mixture or field test data, or both, according to ACI 301 and ACI 211.1.

B. Cementitious Materials: Use fly ash to reduce the total amount of portland cement, which would otherwise be used, by not more than 20 percent.

C. Admixtures: Use admixtures according to manufacturer’s written instructions.
   1. Use water-reducing, high-range water-reducing and/or plasticizing admixture in concrete, as required, for placement and workability.
   2. Use water-reducing and retarding admixture when required by high temperatures, low humidity, or other adverse placement conditions.
   3. Use water-reducing admixture in pumped concrete, concrete for heavy-use industrial slabs and parking structure slabs, concrete required to be watertight, and concrete with a water-cementitious materials ratio below 0.50.

D. All concrete except Infill Concrete: Proportion normal-weight concrete mixture as follows:
   1. Minimum Compressive Strength: 4,000 psi at 28 days.
   2. Maximum Water-Cementitious Materials Ratio: 0.50.
   3. Slump Limit: Seven inches for concrete with verified slump of 2 to 4 inches before adding high-range water-reducing admixture or plasticizing admixture, plus or minus 1 inch.
   4. Air Content: 5.5 percent, plus or minus 1.5 percent at point of delivery for 1 1/2 in nominal maximum aggregate size.
   5. Air Content: 6 percent, plus or minus 1.5 percent at point of delivery for 1 inch or less nominal maximum aggregate size.
   6. Air Content: Do not allow air content of trowel-finished floors to exceed 3 percent.
   7. Synthetic Micro-Fiber: Uniformly disperse in concrete mixture at manufacturer's recommended rate, but not less than 1.0 lb/cu. yd.

E. Infill Concrete: Proportion normal-weight concrete mixture as follows:
   1. Contractor shall provide a very stiff mix, but placeable mix. Limit personnel access near hole.
   2. Slump Limit: 6 inches for concrete with verified slump of 1 to 3 inches before adding high-range water-reducing admixture or plasticizing admixture, see 2.10E.1.
   3. Minimum Compressive Strength: 2,500 psi at 28 days.
   4. Air Content: No limits.
   5. Synthetic Micro-Fiber: Uniformly disperse in concrete mixture if it reduces slump and is placeable.
2.11  FABRICATING REINFORCEMENT

A. Fabricate steel reinforcement according to CRSI’s “Manual of Standard Practice”.

2.12  CONCRETE MIXING

A. Ready-Mixed Concrete: Measure, batch, mix, and deliver concrete according to ASTM C 94/C 94M and ASTM C 1116/C 1116M, and furnish batch ticket information.

1. When air temperature is between 85 and 90 deg F, reduce mixing and delivery time from 1 1/2 hours to 75 minutes; when air temperature is above 90 deg F, reduce mixing and delivery time to 60 minutes.

PART 3 - EXECUTION

3.1  FORMWORK

A. Design, erect, shore, brace, and maintain formwork, according to ACI 301, to support vertical, lateral, static, and dynamic loads, and construction loads that might be applied, until structure can support such loads.

B. Construct formwork so concrete members and structures are of size, shape, alignment, elevation, and position indicated, within tolerance limits of ACI 117.

C. Limit concrete surface irregularities, designated by ACI 347 as abrupt or gradual, as follows:

2. Class C, 1/2 inch for rough-formed finished surfaces.

D. Chamfer exterior corners and edges of permanently exposed concrete.

3.2  EMBEDDED ITEMS

A. Place and secure anchorage devices and other embedded items required for adjoining work that is attached to or supported by cast-in-place concrete. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.

3.3  STEEL REINFORCEMENT

A. General: Comply with CRSI’s “Manual of Standard Practice” for placing reinforcement.

1. Do not cut or puncture vapor retarder. Repair damage and reseal vapor retarder before placing concrete.

3.4  JOINTS

A. General: Construct joints true to line with faces perpendicular to surface plane of concrete.
B. Construction Joints: Install so strength and appearance of concrete are not impaired, at locations indicated or as approved by Buyer’s Technical Representative.

C. Contraction Joints in Slabs-on-Grade: Form weakened-plane contraction joints, sectioning concrete into areas as indicated. Construct contraction joints for a depth equal to at least one-fourth of concrete thickness as follows:

1. Sawed Joints: Form contraction joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut 1/8 inch wide joints into concrete when cutting action will not tear, abrade, or otherwise damage surface and before concrete develops random contraction cracks. Maximum 12 hours after placement.

D. Isolation Joints in Slabs-on-Grade: After removing formwork, install joint-filler strips at slab junctions with vertical surfaces, such as column pedestals, foundation walls, grade beams, and other locations, as indicated.

E. Waterstops: Install in construction joints and at other joints indicated according to manufacturer's written instructions.

3.5 CONCRETE PLACEMENT

A. Before placing concrete, verify that installation of formwork, reinforcement, and embedded items is complete and that required inspections have been performed.

1. Contractor shall develop a Concrete Pour Checklist. Checklist shall be reviewed with the Buyer’s Technical Representative prior to placing concrete. At a minimum, checklist shall include:

   a. Formwork.
   b. Reinforcing.
   c. Embedded items.
   d. Expected weather.
   e. Concrete Mix.
   f. Testing Requirements.
   g. Approval of all submittals related to pour.
   h. Availability of materials, equipment and labor.

2. Use separate checklist for each day and each concrete mix.

B. Before test sampling and placing concrete, water may be added at Project site, subject to limitations of ACI 301.

1. Do not add water to concrete after adding high-range water-reducing admixtures to mixture.

C. Before test sampling and placing concrete, batch ticket shall be reviewed by the Testing Agency’s field inspector. After depositing concrete, batch ticket shall be completed and submitted.

D. Except Infill Concrete: Deposit concrete continuously in one layer or in horizontal layers of such thickness that no new concrete will be placed on concrete that has hardened enough to cause


seams or planes of weakness. If a section cannot be placed continuously, provide construction joints as indicated. Deposit concrete to avoid segregation.

1. Deposit concrete in horizontal layers of depth to not exceed formwork design pressures and in a manner to avoid inclined construction joints.
2. Consolidate placed concrete with mechanical vibrating equipment according to ACI 301.
3. Do not use vibrators to transport concrete inside forms. Insert and withdraw vibrators vertically at uniformly spaced locations to rapidly penetrate placed layer and at least 6 inches into preceding layer. Do not insert vibrators into lower layers of concrete that have begun to lose plasticity. At each insertion, limit duration of vibration to time necessary to consolidate concrete and complete embedment of reinforcement and other embedded items without causing mixture constituents to segregate.

E. Infill Concrete: Deposit concrete continuously in one layer. It is acceptable to have concrete hardened enough to cause horizontal seams or planes of weakness. Deposit concrete to avoid segregation.

1. Deposit concrete in horizontal layers of depth to not exceed formwork design pressures.
2. Do not consolidate placed concrete with mechanical vibrating equipment.

F. Deposit and consolidate concrete for floors and slabs in a continuous operation, until limits of construction joints, until placement of a panel or section is complete.

1. Consolidate concrete during placement operations so concrete is thoroughly worked around reinforcement and other embedded items and into corners.
3. Screed slab surfaces with a straightedge and strike off to correct elevations.
4. Slope surfaces uniformly to drains where required.
5. Begin initial floating using bull float or darby to form a uniform and open-textured surface plane, before excess bleedwater appears on the surface. Do not further disturb slab surfaces before starting finishing operations.

G. Cold-Weather Placement: Comply with ACI 306.1 and as follows. Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures.

1. When average high and low temperature is expected to fall below 40 deg F, maintain delivered concrete mixture temperature within the temperature range required by ACI 301.
2. Do not use frozen materials or materials containing ice or snow. Do not place concrete on frozen subgrade or on subgrade containing frozen materials.
3. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators unless otherwise specified and approved in mixture designs.

H. Hot-Weather Placement: Comply with ACI 301 and 305R and as follows:

1. Maintain concrete temperature below 90 deg F at time of placement. Chilled mixing water or chopped ice may be used to control temperature, provided water equivalent of ice is calculated to total amount of mixing water. Using liquid nitrogen to cool concrete is Contractor's option.
2. Fog-spray forms, steel reinforcement, and subgrade just before placing concrete. Keep subgrade uniformly moist without standing water, soft spots, or dry areas.
3.6  FINISHING FORMED SURFACES

A. Rough-Formed Finish: As-cast concrete texture imparted by form-facing material with tie holes and defects repaired and patched. Remove fins and other projections that exceed specified limits on formed-surface irregularities.

1. Apply to concrete surfaces not exposed to public view.

B. Smooth-Formed Finish: As-cast concrete texture imparted by form-facing material, arranged in an orderly and symmetrical manner with a minimum of seams. Repair and patch tie holes and defects. Remove fins and other projections that exceed specified limits on formed-surface irregularities.

1. Apply to concrete surfaces exposed to public view.

C. Related Unformed Surfaces: At tops of walls, horizontal offsets, and similar unformed surfaces adjacent to formed surfaces, strike off smooth and finish with a texture matching adjacent formed surfaces. Continue final surface treatment of formed surfaces uniformly across adjacent unformed surfaces unless otherwise indicated.

3.7  FINISHING FLOORS AND SLABS

A. General: Comply with ACI 302.1R recommendations for screeding, re-straightening, and finishing operations for concrete surfaces. Do not wet concrete surfaces.

B. Float Finish: Consolidate surface with power-driven floats or by hand floating if area is small or inaccessible to power driven floats. Re-straighten, cut down high spots, and fill low spots. Repeat float passes and re-straightening until surface is left with a uniform, smooth, granular texture.

1. Apply float finish to surfaces to receive trowel finish.

C. Trowel Finish: After applying float finish, apply first troweling and consolidate concrete by hand or power-driven trowel. Continue troweling passes and re-straighten until surface is free of trowel marks and uniform in texture and appearance. Grind smooth any surface defects that would telegraph through applied coatings or floor coverings.

1. Apply a trowel finish to surfaces exposed to view.
2. Finish and measure surface so gap at any point between concrete surface and an unleveled, freestanding, 10 ft. long straightedge resting on 2 high spots and placed anywhere on the surface does not exceed 1/8 inch.

D. Broom Finish: Apply a broom finish to exterior concrete platforms, steps, ramps, and elsewhere as indicated.

3.8  MISCELLANEOUS CONCRETE ITEMS

A. Filling In: Fill in holes and openings left in concrete structures after work of other trades is in place unless otherwise indicated. Mix, place, and cure concrete, as specified, to blend with in-place construction. Provide other miscellaneous concrete filling indicated or required to complete the Work.
B. Curbs: Provide monolithic finish to interior curbs by stripping forms while concrete is still green and by steel-troweling surfaces to a hard, dense finish with corners, intersections, and terminations slightly rounded.

C. Equipment Bases and Foundations: Provide machine and equipment bases and foundations as shown on Drawings. Set anchor bolts for machines and equipment at correct elevations, complying with diagrams or templates from manufacturer furnishing machines and equipment.

3.9 CONCRETE PROTECTING AND CURING

A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. Comply with ACI 306.1 for cold-weather protection and ACI 301 for hot-weather protection during curing.

B. Evaporation Retarder: Apply evaporation retarder to unformed concrete surfaces if hot, dry, or windy conditions cause moisture loss approaching 0.2 lb/sq. ft. x h before and during finishing operations. Apply according to manufacturer's written instructions after placing, screeding, and bull floating or darbying concrete, but before float finishing.

C. Cure concrete according to ACI 308.1, by one or a combination of the following methods:

1. Moisture Curing: Keep surfaces continuously moist for not less than seven days.
2. Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least 12 inches, and sealed by waterproof tape or adhesive. Cure for not less than seven days. Immediately repair any holes or tears during curing period using cover material and waterproof tape.
3. Curing Compound: Apply uniformly in continuous operation by power spray or roller according to manufacturer's written instructions. Reccoat areas subjected to heavy rainfall within three hours after initial application. Maintain continuity of coating and repair damage during curing period.
   a. Removal: After curing period has elapsed, remove curing compound without damaging concrete surfaces by method recommended by curing compound manufacturer unless manufacturer certifies curing compound will not interfere with bonding of floor covering or coatings used on Project.
4. Curing and Sealing Compound: Apply uniformly to floors and slabs indicated in a continuous operation by power spray or roller according to manufacturer's written instructions. Reccoat areas subjected to heavy rainfall within three hours after initial application. Repeat process 24 hours later and apply a second coat. Maintain continuity of coating and repair damage during curing period.
   a. Removal: After curing period has elapsed, remove curing and sealing compound without damaging concrete surfaces by method recommended by curing compound manufacturer unless manufacturer certifies curing compound will not interfere with bonding of floor covering or coatings used on Project.

3.10 JOINT FILLING

A. Prepare, clean, and install joint filler according to manufacturer's written instructions.
1. Defer joint filling until concrete has aged at least six months. Do not fill joints until construction traffic has permanently ceased.

B. Remove dirt, debris, saw cuttings, curing compounds, and sealers from joints; leave contact faces of joint clean and dry.

C. Install semi-rigid joint filler full depth in saw-cut joints and at least two inches deep in formed joints. Overfill joint and trim joint filler flush with top of joint after hardening.

3.11 CONCRETE SURFACE REPAIRS

A. Defective Concrete: Repair and patch defective areas when approved by Buyer’s Technical Representative. Remove and replace concrete that cannot be repaired and patched to Buyer’s Technical Representative's approval.

B. Patching Mortar: Mix dry-pack patching mortar, consisting of one part portland cement to two and a half parts fine aggregate passing a No. 16 sieve, using only enough water for handling and placing.

C. Repairing Formed Surfaces: Surface defects include color and texture irregularities, cracks, spalls, air bubbles, honeycombs, rock pockets, fins and other projections on the surface, and stains and other discolorations that cannot be removed by cleaning.

1. Immediately after form removal, cut out honeycombs, rock pockets, and voids more than 1/2 inch in any dimension to solid concrete. Limit cut depth to 3/4 inch. Make edges of cuts perpendicular to concrete surface. Clean, dampen with water, and brush-coat holes and voids with bonding agent. Fill and compact with patching mortar before bonding agent has dried. Fill form-tie voids with patching mortar or cone plugs secured in place with bonding agent.

2. Repair defects on surfaces exposed to view by blending white portland cement and standard portland cement so that, when dry, patching mortar will match surrounding color. Patch a test area at inconspicuous locations to verify mixture and color match before proceeding with patching. Compact mortar in place and strike off slightly higher than surrounding surface.

3. Repair defects on concealed formed surfaces that affect concrete's durability and structural performance as determined by Buyer’s Technical Representative.

D. Repairing Unformed Surfaces: Test unformed surfaces, such as floors and slabs, for finish and verify surface tolerances specified for each surface. Correct low and high areas. Test surfaces sloped to drain for trueness of slope and smoothness; use a sloped template.

1. Repair finished surfaces containing defects. Surface defects include spalls, popouts, honeycombs, rock pockets, crazing and cracks in excess of 0.01 inch wide or that penetrate to reinforcement or completely through unreinforced sections regardless of width, and other objectionable conditions.

2. After concrete has cured at least 14 days, correct high areas by grinding.

3. Correct localized low areas during or immediately after completing surface finishing operations by cutting out low areas and replacing with patching mortar. Finish repaired areas to blend into adjacent concrete.

4. Correct other low areas scheduled to remain exposed with a repair topping capable of taking heavy vehicle traffic. Cut out low areas to ensure a minimum repair topping depth of 1/4 inch to match adjacent floor elevations. Prepare, mix, and apply repair topping and
primer according to manufacturer's written instructions to produce a smooth, uniform, plane, and level surface.

5. Repair defective areas, except random cracks and single holes one inch or less in diameter, by cutting out and replacing with fresh concrete. Remove defective areas with clean, square cuts and expose steel reinforcement with at least a 3/4 inch clearance all around. Dampen concrete surfaces in contact with patching concrete and apply bonding agent. Mix patching concrete of same materials and mixture as original concrete except without coarse aggregate. Place, compact, and finish; to blend with adjacent finished concrete. Cure in same manner as adjacent concrete.

6. Repair random cracks and single holes one inch or less in diameter with patching mortar. Groove top of cracks and cut out holes to sound concrete and clean off dust, dirt, and loose particles. Dampen cleaned concrete surfaces and apply bonding agent. Place patching mortar before bonding agent has dried. Compact patching mortar and finish to match adjacent concrete. Keep patched area continuously moist for at least 72 hours.

E. Perform structural repairs of concrete, subject to Buyer's Technical Representative's approval, using epoxy adhesive and patching mortar.

F. Repair materials and installation not specified above may be used, subject to Buyer's Technical Representative's approval.

3.12 FIELD QUALITY CONTROL

A. Testing and Inspecting: Engage a special inspector and qualified testing and inspecting agency to perform field tests and inspections and prepare test reports.

B. Inspections:

1. Steel reinforcement placement.
2. Headed bolts and studs.
3. Verification of use of required design mixture.
4. Concrete placement, including conveying and depositing.
5. Curing procedures and maintenance of curing temperature.

C. Concrete Tests: Testing of composite samples of fresh concrete obtained according to ASTM C 172 shall be performed according to the following requirements:

1. Testing Frequency: Obtain one composite sample for each day's pour of each concrete mixture exceeding five cu. yd., but less than 25 cu. yd., plus one set for each additional 50 cu. yd. or fraction thereof.
2. Slump: ASTM C 143/C 143M; one test at point of placement for each composite sample, but not less than one test for each day's pour of each concrete mixture. Perform additional tests when concrete consistency appears to change.
3. Air Content: ASTM C 231, pressure method, for normal-weight concrete; one test for each composite sample, but not less than one test for each day's pour of each concrete mixture.
4. Concrete Temperature: ASTM C 1064/C 1064M; one test hourly when air temperature is 40 deg F and below and when 80 deg F and above, and one test for each composite sample.
5. Compression Test Specimens: ASTM C 31/C 31M.
a. Standard cylinder shall be 6 inches diameter by 12” long.
b. Cast and laboratory cure three sets of two standard cylinder specimens for each composite sample.
c. Cast and field cure one set of two standard cylinder specimens for each composite sample.

6. Compressive-Strength Tests: ASTM C 39/C 39M; test one set of two laboratory-cured specimens at seven days and one set of two specimens at 28 days and one set of laboratory-cured specimens at 56 days unless directed earlier by the Buyer’s Technical Representative.

   a. Test two field-cured specimens at seven days.
   b. A compressive-strength test shall be the average compressive strength from a set of two specimens obtained from same composite sample and tested at age indicated.

7. When strength of field-cured cylinders is less than 85 percent of companion laboratory-cured cylinders, Contractor shall evaluate operations and provide corrective procedures for protecting and curing in-place concrete.

8. Strength of each concrete mixture will be satisfactory if every average of any three consecutive compressive-strength tests equals or exceeds specified compressive strength and no compressive-strength test value falls below specified compressive strength by more than 500 psi.

9. Test results shall be reported in writing to Buyer’s Technical Representative, concrete manufacturer, and Contractor within 48 hours of testing. Reports of compressive-strength tests shall contain Project identification name and number, date of concrete placement, name of concrete testing and inspecting agency, location of concrete batch in Work, design compressive strength at 28 days, concrete mixture proportions and materials, compressive breaking strength, and type of break for both seven and 28 day tests.

10. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted by Buyer’s Technical Representative but will not be used as sole basis for approval or rejection of concrete.

11. Additional Tests: Testing and inspecting agency shall make additional tests of concrete when test results indicate that slump, air entrainment, compressive strengths, or other requirements have not been met, as directed by Buyer’s Technical Representative. Testing and inspecting agency may conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C 42/C 42M or by other methods as directed by Buyer’s Technical Representative.

12. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

13. Correct deficiencies in the Work that test reports and inspections indicate do not comply with the Contract Documents.

3.13 PROTECTION OF LIQUID FLOOR TREATMENTS

A. Protect liquid floor treatment from damage and wear during the remainder of construction period. Use protective methods and materials, including temporary covering, recommended in writing by liquid floor treatments installer.

END OF SECTION 033000
SECTION 051200 - STRUCTURAL STEEL FRAMING

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes structural steel and grout.

B. Related Sections:
   1. Division 05 Section “Metal Fabrications” for steel lintels and shelf angles not attached to structural-steel frame, miscellaneous steel fabrications, and other metal items not defined as structural steel.
   2. Division 05 Section “Metal Stairs”.
   3. Division 09 Section “Painting” for surface-preparation and priming requirements.

1.2 DEFINITIONS

A. Structural Steel: Elements of structural-steel frame, as classified by AISC 303, “Code of Standard Practice for Steel Buildings and Bridges”.

1.3 PERFORMANCE REQUIREMENTS

A. Delegated Design: Design temporary bracing and supports of the structural steel during erection, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

B. Structural Performance of Temporary Structures: The erected structural steel shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated.

1. General:
   a. Per OSHA, ASCE 37-02 and ASCE 7-05.

2. Wind:
   a. Use component wind forces per ASCE 7-05.
   b. Wind Speed: 85 mph (3 second gust).
   c. Exposure: C.
   d. Importance Factor: 1.0.
   e. For items that exceed 6 weeks in place, the C factor shall be 1.0 not 0.8.

3. Concentrated Live Load: As per OSHA.

4. No connection to the existing structure is allowed.
1.4 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings: Show fabrication of structural-steel components.
   1. Include erection and assembly drawings.
   2. Include details of cuts, connections, splices, camber, holes, and other pertinent data.
   3. Include embedment drawings.
   4. Indicate welds by standard AWS symbols per AWS A2.4, distinguishing between shop and field welds, and show size, length, and type of each weld. Show backing bars that are to be removed and supplemental fillet welds where backing bars are to remain.
   5. Indicate type, size, and length of bolts, distinguishing between shop and field bolts. Identify pretensioned and slip-critical high-strength bolted connections.

C. Welding Procedure Specifications (WPSs) including “pre-qualified” welds, Welder Performance Qualification Records (WPQRs) and Procedure Qualification Records (PQRs): Provide according to AWS D1.1/D1.1M, “Structural Welding Code - Steel”, for each welded joint qualified by testing, including the following:
   1. Power source (constant current or constant voltage).

D. Qualification Data: For qualified professional engineer.

E. Qualification Data: For qualified Installer.

F. Qualification Data: For qualified fabricator.

G. Qualification Data: For qualified testing agency including weld inspectors.

H. Welding Inspection Plan: Testing agency shall provide a plan to document that all required inspections and examinations are completed prior to work becoming inaccessible or hinder progress. Plan shall include the use of weld maps and address welds that require specialized qualifications. Plan shall be coordinated with fabricator.

I. NDE procedures and techniques.

J. Grout Plan: Submit detailed procedures, including manufacturer’s written directions, for grout placement under the base plate to ensure no voids. Procedures shall address base temperature, air temperature, mixing including maximum water amounts, workability time limits, flowability, grout dams, grout hopper, etc.

K. Delegated-Design Submittal: For installed products indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

L. Identification markings: To show conformance to ASTM and AWS standards specified.
1.5 INFORMATIONAL SUBMITTALS

A. Warranty of Quality: Supplier shall provide a signed warranty on supplier’s letterhead stating that all materials supplied are genuine (i.e., not counterfeit), match quality, test reports, markings and fitness of use as required by the project.

B. Mill test reports for structural steel, including chemical and physical properties.

C. Product Test Reports: For the following:
   1. Bolts, nuts, and washers including mechanical properties and chemical analysis.
   2. Direct-tension indicators.
   3. Tension-control, high-strength bolt-nut-washer assemblies.
   4. Shear stud connectors.

D. Source quality-control reports.

E. Field quality-control reports.

F. Minutes of preinstallation conference.

1.6 QUALITY ASSURANCE

A. Applicability of Standards: Unless the Contract Documents include more stringent requirements, applicable construction industry standards have the same force and effect as if bound or copied directly into the Contract Documents to the extent referenced. Such standards are made a part of the Contract Documents by reference. Publication Dates: Comply with standards in effect as of date of the Contract Documents unless otherwise indicated.

B. Fabricator Qualifications: A qualified fabricator that has 5 years experience fabricating steel for projects of similar type, size and quality.

C. Installer Qualifications: A qualified installer that has 5 years experience installing steel for projects of similar type, size and quality.

D. Testing Agency Qualifications: An agency that has inspection personnel that meet IBC qualified special inspector and have 5 years experience inspecting steel for projects of similar type, size and quality including ASTM E164.

E. Weld Inspector Qualifications: Qualify personnel according to AWS QC1, Standard for AWS Certification of Welding Inspectors.


G. Comply with applicable provisions of the following specifications and documents:
   1. AISC 303.
   2. AISC 360.
   3. RCSC’s “Specification for Structural Joints Using ASTM A 325 or A 490 Bolts”.

1-6729 Rev. 0
4. AWS D1.1, Structural Welding Code – Steel.
5. AWS QC1, Standard for AWS Certification of Welding Inspectors.

H. Preinstallation Conference: Conduct conference at Project site.

1. Review special inspection and testing and inspecting agency procedures for field quality control, fall protection, lifts, critical lifts, installation tolerances.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Store materials to permit easy access for inspection and identification. Keep steel members off ground and spaced by using pallets, dunnage, or other supports and spacers. Protect steel members and packaged materials from corrosion and deterioration.

1. Do not store materials on structure in a manner that might cause distortion, damage, or overload to members or supporting structures. Repair or replace damaged materials or structures as directed.

B. Store fasteners in a protected place in sealed containers with manufacturer's labels intact.

1. Fasteners may be repackaged provided Owner's testing and inspecting agency observes repackaging and seals containers.
2. Clean and relubricate bolts and nuts that become dry or rusty before use.
3. Comply with manufacturers' written recommendations for cleaning and lubricating ASTM F 1852 fasteners and for retesting fasteners after lubrication.

PART 2 - PRODUCTS

2.1 STRUCTURAL-STEEL MATERIALS

A. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 25 percent. No documentation is required since USGBC allows a default value of 25 percent to be used for steel, without documentation.

B. W-Shapes: ASTM A 992/A 992M.

C. Channels, Angles-Shapes: ASTM A 36/A 36M.

D. Plate and Bar: ASTM A 36/A 36M.

E. Cold-Formed Hollow Structural Sections: ASTM A 500, Grade B, structural tubing.

F. Steel Pipe: ASTM A 53/A 53M, Type E or S, Grade B.

G. Welding Electrodes: Comply with AWS requirements. E70xx minimum.
2.2 BOLTS, CONNECTORS, AND ANCHORS

A. High-Strength Bolts, Nuts, and Washers: ASTM A 325, Type 1, heavy-hex steel structural bolts; ASTM A 563, Grade DH, heavy-hex carbon-steel nuts; and ASTM F 436, Type 1, hardened carbon-steel washers; all with plain finish.

B. High-Strength Bolts, Nuts, and Washers: ASTM A 490, Type 1, heavy-hex steel structural bolts; ASTM A 563, Grade DH, heavy-hex carbon-steel nuts; and ASTM F 436, Type 1, hardened carbon-steel washers with plain finish.

C. Bolts, Nuts, and Washers: ASTM A 307; ASTM A 563, Grade DH, heavy-hex carbon-steel nuts; and ASTM F 436, Type 1, hardened carbon-steel washers with plain finish.

D. At Contractor’s Option: Tension-Control, High-Strength Bolt-Nut-Washer Assemblies: ASTM F 1852, Type 1, head assemblies consisting of steel structural bolts with splined ends, heavy-hex carbon-steel nuts, and hardened carbon-steel washers.
   1. Finish: Plain.

E. Unheaded Anchor Rods: ASTM F 1554, Grade 36.
   1. Configuration: As shown.
   2. Finish: Plain.

F. Headed Anchor Rods: ASTM F 1554, Grade 36, straight.
   1. Finish: Plain.

G. Threaded Rods: ASTM A 36/A 36M.
   1. Finish: Plain.

2.3 PRIMER AND PAINTING

A. Primer and Paint: Comply with Division 09 painting sections.

2.4 GROUT

A. Nonmetallic, Shrinkage-Resistant Grout: ASTM C 1107, factory-packaged, nonmetallic aggregate grout, noncorrosive and nonstaining, mixed with water to consistency suitable for application and a 30 minute working time.

B. Minimum compressive strength of grout shall 4,000 psi at 28 days.

2.5 FABRICATION

A. Structural Steel: Fabricate and assemble in shop to greatest extent possible. Fabricate according to AISC’s “Code of Standard Practice for Steel Buildings and Bridges” and AISC 360.
B. Shear Connectors: Prepare steel surfaces as recommended by manufacturer of shear connectors. Use automatic end welding of headed-stud shear connectors according to AWS D1.1/D1.1M and manufacturer's written instructions.

C. Fabrication Tolerances, unless specified otherwise, shall be:

1. Fractional: 0.125” +/-.
2. Decimal: 0.06 +/-.
3. Angular: 1 +/- degree.

2.6 SHOP CONNECTIONS

A. High-Strength Bolts: Shop install high-strength bolts according to RCSC’s “Specification for Structural Joints Using ASTM A 325 or A 490 Bolts” for type of bolt and type of joint specified.

1. Joint Type: Snug tightened.

B. Weld Connections: Comply with AWS D1.1/D1.1M for tolerances, appearances, welding procedure specifications, weld quality and methods used in correcting welding work.

2.7 SHOP PRIMING

A. Shop prime steel surfaces except the following:

1. Surfaces embedded in concrete or mortar. Extend priming of partially embedded members to a depth of 2 inches.
2. Surfaces to be field welded.
3. Surfaces to receive sprayed fire-resistant materials (applied fireproofing).

B. Surface Preparation: Clean surfaces to be painted. Remove loose rust and mill scale and spatter, slag, or flux deposits. Prepare surfaces according to the following specifications and standards:

1. SSPC-SP 2, “Hand Tool Cleaning”.

C. Priming: Immediately after surface preparation, apply primer according to manufacturer's written instructions and per Division 09, Section “Painting.” Use priming methods that result in full coverage of joints, corners, edges, and exposed surfaces.

2.8 SOURCE QUALITY CONTROL

A. Testing Agency: Engage an independent testing and inspecting agency to perform shop tests and inspections and prepare test reports.

1. Provide testing agency with access to places where structural-steel work is being fabricated or produced to perform tests and inspections.

B. Correct deficiencies in Work that test reports and inspections indicate does not comply with the Contract Documents.
C. Bolted Connections: Shop-bolted connections will be inspected according to RCSC’s “Specification for Structural Joints Using ASTM A 325 or A 490 Bolts”.

D. Welded Connections: Fillet shop-welded connections shall be visually inspected according to AWS D1.1/D1.1M. Complete penetration welds shall be continuously (in progress) visually inspected according to AWS D1.1/D1.1M, and Ultrasonic Inspection per AWS D1.1 and ASTM E 164.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify, with steel Erector present, elevations of concrete- and masonry-bearing surfaces and locations of anchor rods, bearing plates, and other embedments for compliance with requirements.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 ERECTION

A. Set structural steel accurately in locations and to elevations indicated and according to AISC 303 and AISC 360.

B. Base Plates: A base plate is a steel plate to be in permanent contact with concrete or grout. Clean concrete and masonry-bearing surfaces of bond-reducing materials, and roughen surfaces prior to setting plates. Clean bottom surface of plates. Protect anchor threads during setting of structures.

1. Set plates for structural members on wedges, shims, or setting nuts as required.
2. Snug-tighten anchor rods after supported members have been positioned and plumbed. Do not remove wedges or shims but, if protruding, cut off flush with edge of plate before placing grout.
3. Promptly flow or pack grout solidly between bearing surfaces and plates so no voids remain. Neatly finish exposed surfaces; protect grout and allow to cure. Comply with manufacturer's written installation instructions for shrinkage-resistant grouts.
4. Tighten anchor nuts as specified.

C. Maintain erection tolerances of structural steel within AISC’s “Code of Standard Practice for Steel Buildings and Bridges”.

3.3 FIELD CONNECTIONS

A. High-Strength Bolts: Install high-strength bolts according to RCSC’s “Specification for Structural Joints Using ASTM A 325 or A 490 Bolts” for type of bolt and type of joint specified.

1. Joint Type: Snug tightened.

B. Weld Connections: Comply with AWS D1.1/D1.1M for tolerances, appearances, welding procedure specifications, weld quality and methods used in correcting welding work.
1. Comply with AISC 303 and AISC 360 for bearing, alignment, adequacy of temporary connections, and removal of paint on surfaces adjacent to field welds.

3.4 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified independent testing and inspecting agency to inspect field welds and high-strength bolted connections.

B. Bolted Connections: Bolted connections will be inspected according to RCSC’s “Specification for Structural Joints Using ASTM A 325 or A 490 Bolts”.

C. Welded Connections: Field welds will be visually inspected according to AWS D1.1/D1.1M.

1. Fillet welded connections shall be visually inspected according to AWS D1.1/D1.1M. Complete penetration welds shall be continuously (in progress) visually inspected according to AWS D1.1/D1.1M, and Ultrasonic Inspection per AWS D1.1 and ASTM E 164.

D. Grout Tests: Testing of grout obtained according to ASTM C 109 shall be performed according to the following requirements:

1. Testing Frequency: Obtain at least one sample for each batch of mix, but not less than one per 0.5 cubic yards.
   a. When frequency of testing will provide fewer than five compressive-strength tests for each grout mixture, testing shall be conducted from at least five randomly selected batches or from each batch if fewer than five are used.

2. Strength of each grout mixture will be satisfactory if every average of any three consecutive compressive-strength tests equals or exceeds specified compressive strength and no compressive-strength test value falls below specified compressive strength by more than 500 psi.

3. Test results shall be reported in writing to Buyer’s Technical Representative and Contractor within 48 hours of testing. Reports of compressive-strength tests shall contain Project identification name and number, date of grout placement, name of grout testing and inspecting agency, location of grout batch in Work, design compressive strength at 28 days, grout mixture proportions and materials, compressive breaking strength, and type of break for both 7 and 28 day tests.

4. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted by Buyer’s Technical Representative but will not be used as sole basis for approval or rejection of grout.

5. Additional Tests: Testing and inspecting agency shall make additional tests of grout when test results indicate that compressive strengths or other requirements have not been met, as directed by Buyer’s Technical Representative.

6. Additional testing and inspecting, at Contractor’s expense, will be performed to determine compliance of replaced or additional work with specified requirements.

E. Testing agency will report inspection results promptly and in writing to Contractor and Buyer’s Technical Representative.
F. Correct deficiencies in Work that test reports and inspections indicate does not comply with the Contract Documents.

END OF SECTION 051200
SECTION 054000 - COLD-FORMED METAL FRAMING

PART 1 - GENERAL

1.1 SUMMARY
A. Section Includes:
   1. Load-bearing wall framing.
   2. Roof rafter framing.

1.2 ACTION SUBMITTALS
A. Product Data: For each type of cold-formed steel framing product and accessory.
B. Shop Drawings:
   1. Include layout, spacings, sizes, thicknesses, and types of cold-formed steel framing; fabrication; and fastening and anchorage details, including mechanical fasteners.
   2. Indicate reinforcing channels, opening framing, supplemental framing, strapping, bracing, bridging, splices, accessories, connection details, and attachment to adjoining work.

1.3 INFORMATIONAL SUBMITTALS
A. Product Test Reports: For each listed product, for tests performed by manufacturer and witnessed by a qualified testing agency.
   1. Steel sheet.
   2. Expansion anchors.
   3. Miscellaneous structural clips and accessories.

1.4 DELIVERY, STORAGE, AND HANDLING
A. Protect cold-formed steel framing from corrosion, moisture staining, deformation, and other damage during delivery, storage, and handling.

PART 2 - PRODUCTS

2.1 MANUFACTURERS
A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   1. Dietrich Metal Framing; a Worthington Industries Company.
   2. SCAFCO Corporation.
   3. Steeler, Inc.
2.2 PERFORMANCE REQUIREMENTS

A. Structural Performance: Provide cold-formed steel framing capable of withstanding design loads within limits and under conditions indicated.

1. Exterior Load-Bearing Wall Framing: Horizontal deflection of 1/360 of the wall height.
2. Roof Rafter Framing: Vertical deflection of 1/240 of the horizontally projected span for live loads.

B. Cold-Formed Steel Framing Design Standards:

1. Wall Studs: AISI S211.

C. AISI Specifications and Standards: Unless more stringent requirements are indicated, comply with AISI S100 and AISI S200.

2.3 COLD-FORMED STEEL FRAMING, GENERAL

A. Steel Sheet: ASTM A 1003/A 1003M, Structural Grade, Type H, metallic coated, of grade and coating weight as follows:

1. Grade: ST33H.
2. Coating: G90 or equivalent.

2.4 LOAD-BEARING WALL FRAMING

A. Steel Studs: Manufacturer's standard C-shaped steel studs, of web depths indicated, punched, with stiffened flanges, and as follows:

1. Minimum Base-Metal Thickness: 0.0428 inch.
2. Flange Width: 2 inches.

B. Steel Track: Manufacturer's standard U-shaped steel track, of web depths indicated, unpunched, with straight flanges, and as follows:

1. Minimum Base-Metal Thickness: 0.0428 inch.

C. Steel Box or Back-to-Back Headers: Manufacturer's standard C-shapes used to form header beams, of web depths indicated, unpunched, with stiffened flanges, and as follows:

1. Minimum Base-Metal Thickness: 0.0428 inch.
2. Flange Width: 2 inches.

2.5 ROOF-RAFTER FRAMING

A. Steel Rafters: Manufacturer's standard C-shaped steel sections, of web depths indicated, with stiffened flanges, and as follows:
1. Minimum Base-Metal Thickness: 0.0428 inch.
2. Flange Width: 2 inches, minimum.

2.6 FRAMING ACCESSORIES

A. Fabricate steel-framing accessories from steel sheet, ASTM A 1003/A 1003M, Structural Grade, Type H, metallic coated, of same grade and coating weight used for framing members.

B. Provide accessories of manufacturer's standard thickness and configuration, unless otherwise indicated, as follows:
   1. Supplementary framing.
   2. Bracing, bridging, and solid blocking.
   3. Anchor clips.
   4. Joist hangers and end closures.
   5. Hole reinforcing plates.

2.7 ANCHORS, CLIPS, AND FASTENERS

A. Steel Shapes and Clips: ASTM A 36/A 36M, zinc coated by hot-dip process according to ASTM A 123/A 123M.

B. Expansion Anchors: Fabricated from corrosion-resistant materials, with allowable load or strength design capacities calculated according to ICC-ES AC193 and ACI 318 greater than or equal to the design load, as determined by testing per ASTM E 488 conducted by a qualified testing agency.

C. Mechanical Fasteners: ASTM C 1513, corrosion-resistant-coated, self-drilling, self-tapping, steel drill screws.
   1. Head Type: Low-profile head beneath sheathing, manufacturer's standard elsewhere.

2.8 MISCELLANEOUS MATERIALS

A. Sealer Gaskets: Closed-cell neoprene foam, 1/4 inch thick, selected from manufacturer's standard widths to match width of bottom track or rim track members.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine supporting substrates and abutting structural framing for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.
3.2 PREPARATION

A. Install load bearing shims or grout between the underside of load-bearing wall bottom track and the top of foundation wall or slab at locations with a gap larger than 1/4 inch to ensure a uniform bearing surface on supporting concrete construction.

B. Install sealer gaskets at the underside of wall bottom track or rim track and at the top of foundation wall or slab at stud or joist locations.

3.3 INSTALLATION, GENERAL

A. Cold-formed steel framing to be field assembled.

B. Install cold-formed steel framing according to AISI S200 and to manufacturer’s written instructions unless more stringent requirements are indicated.

C. Install field-fabricated, cold-formed framing and securely anchor to supporting structure.
   1. Screw, bolt, or weld wall panels at horizontal and vertical junctures to produce flush, even, true-to-line joints with maximum variation in plane and true position between fabricated panels not exceeding 1/16 inch.

D. Install cold-formed steel framing and accessories plumb, square, and true to line, and with connections securely fastened.
   1. Cut framing members by sawing or shearing; do not torch cut.
   2. Fasten cold-formed steel framing members by screw fastening, clinch fastening, or riveting. Wire tying of framing members is not permitted.
      a. Locate mechanical fasteners and install according to Shop Drawings, and complying with requirements for spacing, edge distances, and screw penetration.

E. Install framing members in one-piece lengths unless splice connections are indicated for track or tension members.

F. Install temporary bracing and supports to secure framing and support loads comparable in intensity to those for which structure was designed. Maintain braces and supports in place, undisturbed, until entire integrated supporting structure has been completed and permanent connections to framing are secured.

G. Install insulation, specified in Division 07, Section 2100, “Thermal Insulation”, in built-up exterior framing members, such as headers, sills, boxed joists, and multiple studs at openings, that are inaccessible on completion of framing work.

H. Fasten hole reinforcing plate over web penetrations that exceed size of manufacturer’s approved or standard punched openings.

I. Erection Tolerances: Install cold-formed steel framing level, plumb, and true to line to a maximum allowable tolerance variation of 1/8 inch in 10 feet and as follows:
1. Space individual framing members no more than plus or minus 1/8 inch from plan location. Cumulative error shall not exceed minimum fastening requirements of sheathing or other finishing materials.

3.4 LOAD-BEARING WALL INSTALLATION

A. Install continuous top and bottom tracks sized to match studs. Align tracks accurately and securely anchor at corners and ends, and at spacings as follows:

1. Anchor Spacing: 32 inches.

B. Squarely seat studs against top and bottom tracks with gap not exceeding of 1/8 inch between the end of wall framing member and the web of track. Fasten both flanges of studs to top and bottom tracks. Space studs as follows:

1. Stud Spacing: As indicated on the drawings.

C. Set studs plumb, except as needed for diagonal bracing or required for nonplumb walls or warped surfaces and similar configurations.

D. Align roof framing over studs according to AISI S200, Section C1. Where framing cannot be aligned, continuously reinforce track to transfer loads.

E. Anchor studs abutting structural columns or walls, including masonry walls, to supporting structure as indicated.

F. Install headers over wall openings wider than stud spacing. Locate headers above openings as indicated. Fabricate headers of compound shapes indicated or required to transfer load to supporting studs, complete with clip-angle connectors, web stiffeners, or gusset plates.

1. Frame wall openings with not less than a double stud at each jamb of frame as indicated on Shop Drawings. Fasten jamb members together to uniformly distribute loads.
2. Install runner tracks and jack studs above and below wall openings. Anchor tracks to jamb studs with clip angles or by welding, and space jack studs same as full-height wall studs.

G. Install supplementary framing, blocking, and bracing in stud framing indicated to support fixtures, equipment, services, casework, heavy trim, furnishings, and similar work requiring attachment to framing.

1. If type of supplementary support is not indicated, comply with stud manufacturer's written recommendations and industry standards in each case, considering weight or load resulting from item supported.

H. Install horizontal bridging in stud system, spaced vertically 48 inches. Fasten at each stud intersection.

1. Bridging: Proprietary bridging bars installed according to manufacturer's written instructions.
I. Install miscellaneous framing and connections, including supplementary framing, web stiffeners, clip angles, continuous angles, anchors, and fasteners, to provide a complete and stable wall-framing system.

3.5 JOIST INSTALLATION

A. Install perimeter joist track sized to match joists. Align and securely anchor or fasten track to supporting structure at corners, ends, and spacings indicated on Shop Drawings.

B. Install joists bearing on supporting frame, level, straight, and plumb; adjust to final position, brace, and reinforce. Fasten joists to both flanges of joist track.
   1. Install joists over supporting frame with a minimum end bearing of 1-1/2 inches.
   2. Reinforce ends and bearing points of joists with web stiffeners, end clips, joist hangers, steel clip angles, or steel-stud sections as indicated on Shop Drawings.

C. Space joists not more than 2 inches from abutting walls, and as follows:
   1. Joist Spacing: As indicated.

D. Frame openings with built-up joist headers consisting of joist and joist track, or another combination of connected joists if indicated.
   1. Install web stiffeners to transfer axial loads of walls above.

E. Secure joists to load-bearing interior walls to prevent lateral movement of bottom flange.

F. Install miscellaneous joist framing and connections, including web stiffeners, closure pieces, clip angles, continuous angles, hold-down angles, anchors, and fasteners, to provide a complete and stable joist-framing assembly.

3.6 REPAIRS AND PROTECTION

A. Galvanizing Repairs: Prepare and repair damaged galvanized coatings on fabricated and installed cold-formed steel framing with galvanized repair paint according to ASTM A 780 and manufacturer's written instructions.

B. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and Installer, that ensure that cold-formed steel framing is without damage or deterioration at time of Substantial Completion.

END OF SECTION 054000
SECTION 055000 - METAL FABRICATIONS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
1. Miscellaneous steel framing and supports.
2. Miscellaneous steel trim.
3. Metal bollards.
4. Loose bearing and leveling plates.

B. Related Sections:
1. Division 05 Section "Metal Stairs".
2. Division 09 Section “Painting” for surface-preparation and priming requirements.

C. Products furnished, but not installed, under this Section:
1. Anchor bolts, steel pipe sleeves, slotted-channel inserts, and wedge-type inserts indicated to be cast into concrete.
2. Steel weld plates and angles for casting into concrete.

1.2 ACTION SUBMITTALS

A. Product Data: For the following:
1. Paint products.
2. Grout.

B. Shop Drawings: Show fabrication and installation details for metal fabrications.
1. Include plans, elevations, sections, and details of metal fabrications and their connections. Show anchorage and accessory items.

C. Welding Procedure Specifications (WPSs) including “pre-qualified” welds, Welder Performance Qualification Records (WPQRs) and Procedure Qualification Records (PQRs): Provide according to AWS D1.1/D1.1M, "Structural Welding Code - Steel", for each welded joint qualified by testing, including the following:
1. Power source (constant current or constant voltage).

D. Qualification Data: For qualified Installer.

E. Qualification Data: For qualified Fabricator.
F. Qualification Data: For qualified Testing Agency including weld inspectors.

G. Welding Inspection Plan: Testing agency shall provide a plan to document that all required inspections and examinations are completed prior to work becoming inaccessible or hinder progress. Plan shall include the use of weld maps and address welds that require specialized qualifications. Plan shall be coordinated with fabricator.

H. NDE procedures and techniques.

1.3 INFORMATIONAL SUBMITTALS

A. Identification markings: To show conformance to ASTM and AWS standards specified.

1.4 QUALITY ASSURANCE

A. Applicability of Standards: Unless the Contract Documents include more stringent requirements, applicable construction industry standards have the same force and effect as if bound or copied directly into the Contract Documents to the extent referenced. Such standards are made a part of the Contract Documents by reference. Publication Dates: Comply with standards in effect as of date of the Contract Documents unless otherwise indicated.

B. Fabricator Qualifications: A qualified fabricator that has 5 years experience fabricating steel for projects of similar type, size and quality.

C. Installer Qualifications: A qualified installer that has 5 years experience installing steel for projects of similar type, size and quality.

D. Testing Agency Qualifications: An agency that has inspection personnel that meet IBC qualified special inspector and have 5 years experience inspecting steel for projects of similar type, size and quality including ASTM E164.

E. Weld Inspector Qualifications: Qualify personnel according to AWS QC1, Standard for AWS Certification of Welding Inspectors.


G. Comply with applicable provisions of the following specifications and documents:

1. AISC 303.
2. AISC 360.
3. RCSC’s “Specification for Structural Joints Using ASTM A 325 or A 490 Bolts”.
4. AWS D1.1, Structural Welding Code – Steel.
5. AWS QC1, Standard for AWS Certification of Welding Inspectors.
PART 2 - PRODUCTS

2.1 METALS, GENERAL

A. Metal Surfaces, General: Provide materials with smooth, flat surfaces without blemishes.

2.2 FERROUS METALS

A. Recycled Content of Steel Products: Provide products with average recycled content of steel products so postconsumer recycled content plus one-half of preconsumer recycled content is not less than 25 percent. No documentation is required since the USGBC allows a default value of 25 percent to be used for steel without documentation.

B. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M. First paragraph below specifies yield strength of 30 ksi; revise if higher strength is required.

C. Rolled-Steel Floor Plate: ASTM A 786/A 786M, rolled from plate complying with ASTM A 36/A 36M or ASTM A 283/A 283M, Grade C or D.

D. Steel Tubing: ASTM A 500, cold-formed steel tubing.

E. Steel Pipe: ASTM A 53/A 53M, standard weight (Schedule 40) unless otherwise indicated.

F. Cast Iron: Either gray iron, ASTM A 48/A 48M, or malleable iron, ASTM A 47/A 47M.

2.3 FASTENERS

A. General: Unless otherwise indicated, provide Type 304 stainless-steel fasteners for exterior use and zinc-plated fasteners with coating complying with ASTM B 633 or ASTM F 1941, Class Fe/Zn 5, at exterior walls.

1. Provide stainless-steel fasteners for fastening aluminum.
2. Provide stainless-steel fasteners for fastening stainless steel.
4. Provide bronze fasteners for fastening bronze.

B. Cast-in-Place Anchors in Concrete: Either threaded type or wedge type unless otherwise indicated; galvanized ferrous castings, either ASTM A 47/A 47M malleable iron, or ASTM A 27/A 27M cast steel. Provide bolts, washers, and shims as needed, all hot-dip galvanized per ASTM F 2329.

C. Post-Installed Anchors: As indicated.

2.4 MISCELLANEOUS MATERIALS

A. Shop Primers: Provide primers that comply with Division 09 painting sections.
B. Galvanizing Repair Paint: High-zinc-dust-content paint complying with SSPC-Paint 20 and compatible with paints specified to be used over it.

C. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187.


E. Concrete: Comply with requirements in Division 03 Section 3000, “Cast-in-Place Concrete” for normal-weight, air-entrained, concrete with a minimum 28 day compressive strength of 4,000 psi.

2.5 FABRICATION, GENERAL

A. Shop Assembly: Preassemble items in the shop to greatest extent possible. Use connections that maintain structural value of joined pieces.

B. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges. Remove sharp or rough areas on exposed surfaces.

C. Weld corners and seams continuously to comply with the following:
   1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
   2. Obtain fusion without undercut or overlap.
   3. Remove welding flux immediately.
   4. At exposed connections, finish exposed welds and surfaces smooth and blended.

D. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners or welds where possible. Locate joints where least conspicuous.

E. Fabricate seams and other connections that will be exposed to weather in a manner to exclude water. Provide weep holes where water may accumulate.

F. Where units are indicated to be cast into concrete or built into masonry, equip with integrally welded steel strap anchors not less than 24 inches o.c.

2.6 MISCELLANEOUS FRAMING AND SUPPORTS

A. General: Provide steel framing and supports not specified in other Sections as needed to complete the Work.

B. Fabricate units from steel shapes, plates, and bars of welded construction unless otherwise indicated. Fabricate to sizes, shapes, and profiles indicated and as necessary to receive adjacent construction.
2.7 MISCELLANEOUS STEEL TRIM

A. Unless otherwise indicated, fabricate units from steel shapes, plates, and bars of profiles shown with continuously welded joints and smooth exposed edges. Miter corners and use concealed field splices where possible.

B. Provide cutouts, fittings, and anchorages as needed to coordinate assembly and installation with other work.

C. Galvanize exterior miscellaneous steel trim. Otherwise, prime miscellaneous steel trim with primer specified in Division 09, Section 9113 “Painting”.

2.8 METAL BOLLARDS

A. Fabricate metal bollards from Schedule 40 steel pipe.

B. Prime bollards with primer specified in Division 09, Section 9113 “Painting”.

2.9 LOOSE BEARING AND LEVELING PLATES

A. Provide loose bearing and leveling plates for steel items bearing on masonry or concrete construction. Drill plates to receive anchor bolts and for grouting.

2.10 STEEL WELD PLATES AND ANGLES

A. Provide steel weld plates and angles not specified in other Sections, for items supported from concrete construction as needed to complete the Work. Provide each unit with no fewer than 2 integrally welded steel strap anchors for embedding in concrete.

2.11 FINISHES, GENERAL

A. Comply with NAAMM’s “Metal Finishes Manual for Buyer’s Technical Representative Structural and Metal Products” for recommendations for applying and designating finishes.

B. Finish metal fabrications after assembly.

2.12 STEEL AND IRON FINISHES

A. Galvanizing: Hot-dip galvanize items as indicated to comply with ASTM A 153/A 153M for steel and iron hardware and with ASTM A 123/A 123M for other steel and iron products.

B. Shop prime iron and steel items not indicated to be galvanized unless they are to be embedded in concrete, sprayed-on fireproofing, or masonry, or unless otherwise indicated.

1. Shop prime with primers specified in Division 09, Section 9113, “Painting”.


PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing metal fabrications. Set metal fabrications accurately in location, alignment, and elevation; with edges and surfaces level, plumb, true, and free of rack; and measured from established lines and levels.

B. Fit exposed connections accurately together to form hairline joints. Weld connections that are not to be left as exposed joints but cannot be shop welded because of shipping size limitations. Do not weld, cut, or abrade surfaces of exterior units that have been hot-dip galvanized after fabrication and are for bolted or screwed field connections.

C. Field Welding: Comply with the following requirements:
   1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
   2. Obtain fusion without undercut or overlap.
   3. Remove welding flux immediately.
   4. At exposed connections, finish exposed welds and surfaces smooth and blended.

D. Fastening to In-Place Construction: Provide anchorage devices and fasteners where metal fabrications are required to be fastened to in-place construction.

E. Provide temporary bracing or anchors in formwork for items that are to be built into concrete, masonry, or similar construction.

3.2 INSTALLING METAL BOLLARDS

A. Fill metal-capped bollards solidly with concrete and allow concrete to cure 7 days before installing.

B. Anchor bollards in place with concrete footings. Place concrete and vibrate or tamp for consolidation. Support and brace bollards in position until concrete has cured.

C. Fill bollards solidly with concrete, mounding top surface to shed water.

3.3 INSTALLING BEARING AND LEVELING PLATES


B. Set bearing and leveling plates on wedges, shims, or leveling nuts. After bearing members have been positioned and plumbed, tighten anchor bolts. Do not remove wedges or shims but, if protruding, cut off flush with edge of bearing plate before packing with grout.

C. Pack grout solidly between bearing surfaces and plates to ensure that no voids remain.
3.4 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified independent testing and inspecting agency to inspect field
welds, high-strength bolted connections, and grout.

B. Bolted Connections: Bolted connections will be inspected according to RCSC’s “Specification
for Structural Joints Using ASTM A 325 or A 490 Bolts”.

C. Welded Connections: Field welds will be visually inspected according to AWS D1.1/D1.1M.

   1. Fillet welded connections shall be visually inspected according to AWS D1.1/D1.1M. Complete
      penetration welds shall be continuously (in progress) visually inspected
      according to AWS D1.1/D1.1M, and Ultrasonic Inspection per AWS D1.1 and
      ASTM E 164

D. Grout Tests: Testing of grout obtained according to ASTM C 109 shall be performed according
   to the following requirements:

   1. Testing Frequency: Obtain at least one sample for each batch of mix, but not less than
      one per 0.5 cubic yards.

      a. When frequency of testing will provide fewer than five compressive-strength
         tests for each grout mixture, testing shall be conducted from at least five
         randomly selected batches or from each batch if fewer than five are used.

   2. Strength of each grout mixture will be satisfactory if every average of any three
      consecutive compressive-strength tests equals or exceeds specified compressive strength
      and no compressive-strength test value falls below specified compressive strength by
      more than 500 psi.

   3. Test results shall be reported in writing to Buyer’s Technical Representative and
      Contractor within 48 hours of testing. Reports of compressive-strength tests shall contain
      Project identification name and number, date of grout placement, name of grout testing
      and inspecting agency, location of grout batch in Work, design compressive strength at
      28 days, grout mixture proportions and materials, compressive breaking strength, and
      type of break for both 7 and 28 day tests.

   4. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may
      be permitted by Buyer’s Technical Representative but will not be used as sole basis for
      approval or rejection of grout.

   5. Additional Tests: Testing and inspecting agency shall make additional tests of grout
      when test results indicate that compressive strengths, or other requirements have not been
      met, as directed by Buyer’s Technical Representative.

   6. Additional testing and inspecting, at Contractor’s expense, will be performed to determine
      compliance of replaced or additional work with specified requirements.

E. Testing agency will report inspection results promptly and in writing to Contractor and Buyer’s
   Technical Representative.

F. Correct deficiencies in Work that test reports and inspections indicate does not comply with the
   Contract Documents.
3.5 ADJUSTING AND CLEANING

A. Touchup Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas. Paint uncoated and abraded areas with the same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.

B. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A 780.

END OF SECTION 055000
SECTION 055100 - METAL STAIRS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Industrial-type stairs with steel grating treads.
   2. Railings attached to metal stairs.
   3. Handrails attached to walls adjacent to metal stairs.

B. See Division 05, Section 5213, “Pipe and Tube Railings”, for pipe and tube railings not attached to metal stairs or to walls adjacent to metal stairs.

1.2 ACTION SUBMITTALS

A. Product Data: For metal stairs.

B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.

C. Qualification Data: For qualified testing agency including weld inspectors.

D. Welding Procedure Specifications (WPSs) including “pre-qualified” welds, Welder Performance Qualification Records (WPQRs) and Procedure Qualification Records (PQRs): Provide according to AWS D1.1/D1.1M, "Structural Welding Code - Steel", for each welded joint qualified by testing, including the following:
   1. Power source (constant current or constant voltage).

1.3 INFORMATIONAL SUBMITTALS

A. Mill test reports for structural steel, including chemical and physical properties.

B. Source quality-control reports.

C. Field quality-control reports.

1.4 QUALITY ASSURANCE

A. Applicability of Standards: Unless the Contract Documents include more stringent requirements, applicable construction industry standards have the same force and effect as if bound or copied directly into the Contract Documents to the extent referenced. Such standards are made a part of the Contract Documents by reference. Publication Dates: Comply with standards in effect as of date of the Contract Documents unless otherwise indicated.
B. NAAMM Stair Standard: Comply with “Recommended Voluntary Minimum Standards for Fixed Metal Stairs” in NAAMM AMP 510, “Metal Stairs Manual”, for class of stair designated, unless more stringent requirements are indicated.

1. Industrial-Type Stairs: Industrial class.

C. Weld Inspector Qualifications: Qualify personnel according to AWS QC1, Standard for AWS Certification of Welding Inspectors.

D. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, “Structural Welding Code – Steel”.

PART 2 - PRODUCTS

2.1 METALS

A. Metal Surfaces, General: Provide materials with smooth, flat surfaces unless otherwise indicated. For components exposed to view in the completed Work, provide materials without seam marks, roller marks, rolled trade names, or blemishes.

B. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 25 percent. No documentation is required since USGBC allows a default value of 25 percent to be used for steel without documentation.

C. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.

D. Steel Tubing: ASTM A 500 (cold formed) or ASTM A 513 (Fy = 72 ksi minimum).

E. Steel Bars for Grating Treads: ASTM A 36/A 36M or steel strip, ASTM A 1011/A 1011M or ASTM A 1018/A 1018M.

F. Wire Rod for Grating Crossbars: ASTM A 510.

G. Cast Iron: Either gray iron, ASTM A 48/A 48M, or malleable iron, ASTM A 47/A 47M, unless otherwise indicated.

2.2 BOLTS, CONNECTORS, AND ANCHORS

A. High-Strength Bolts, Nuts, and Washers: ASTM A 325, Type 1, heavy-hex steel structural bolts; ASTM A 563, Grade C, heavy-hex carbon-steel nuts; and ASTM F 436, Type 1, hardened carbon-steel washers; all with plain finish.

B. Tension-Control, High-Strength Bolt-Nut-Washer Assemblies: ASTM F 1852, Type 1, head assemblies consisting of steel structural bolts with splined ends, heavy-hex carbon-steel nuts, and hardened carbon-steel washers.

1. Finish: Plain.
2.3 MISCELLANEOUS MATERIALS

A. Cast-Metal Units: Cast iron, with an integral abrasive, as-cast finish.

B. Provide anchors for embedding units in concrete, either integral or applied to units, as standard with manufacturer.

C. Apply bituminous paint to concealed surfaces of cast-metal units set into concrete.

D. Apply clear lacquer to concealed surfaces of extruded units set into concrete.

E. Fasteners: Provide zinc-plated fasteners with coating complying with ASTM B 633 or ASTM F 1941, Class Fe/Zn 12 for exterior use, and Class Fe/Zn 5 where built into exterior walls. Select fasteners for type, grade, and class required.

F. Shop Primers: Provide primers that comply with Division 09 painting sections.

2.4 FABRICATION, GENERAL

A. Provide complete stair assemblies, including metal framing, hangers, struts, railings, clips, brackets, bearing plates, and other components necessary to support and anchor stairs and platforms on supporting structure.

1. Join components by welding unless otherwise indicated.
2. Use connections that maintain structural value of joined pieces.

B. Preassembled Stairs: Assemble stairs in shop to greatest extent possible. Disassemble units only as necessary for shipping and handling limitations.

C. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges. Remove sharp or rough areas on exposed surfaces.

D. Form bent-metal corners to smallest radius possible without impairing work.

E. Weld connections to comply with the following:

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
2. Obtain fusion without undercut or overlap.
3. Remove welding flux immediately.
4. At exposed connections, finish exposed welds to comply with NOMMA's “Voluntary Joint Finish Standards” for Type 2 welds: completely sanded joint, some undercutting and pinholes okay.

F. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners where possible. Locate joints where least conspicuous.

G. Fabricate joints that will be exposed to weather in a manner to exclude water. Provide weep holes where water may accumulate.

H. Fabrication Tolerances, unless specified otherwise, shall be:
1. Fractional: 0.125” +/-.
2. Decimal: 0.06 +/-.
3. Angular: 1 +/- degree.

2.5 STEEL-FRAMED STAIRS
A. Metal Bar-Grating Stairs: Comply with NAAMM MBG 531, “Metal Bar Grating Manual”.
   1. Fabricate treads and platforms from steel grating with 1-1/4 by 3/16 inch bearing bars at 15/16 inch o.c. and crossbars at 4 inches o.c.
   2. Fabricate grating treads with rolled-steel floor plate nosing and with steel angle or steel plate carrier at each end for stringer connections. Secure treads to stringers with bolts.

2.6 STAIR RAILINGS
A. Welded Connections: Fabricate railings with welded connections. Cope components at connections to provide close fit, or use fittings designed for this purpose. Weld all around at connections, including at fittings.
   1. Finish welds to comply with NOMMA’s “Voluntary Joint Finish Standards” for Type 2 welds: completely sanded joint, some undercutting and pinholes okay.
B. Form changes in direction of railings by bending or by inserting prefabricated elbow fittings.
C. Form curves by bending members in jigs to produce uniform curvature without buckling.
D. Close exposed ends of railing members with prefabricated end fittings.
E. Provide wall returns at ends of wall-mounted handrails.
F. Brackets, Flanges, Fittings, and Anchors: Provide wall brackets, end closures, flanges, miscellaneous fittings, and anchors for interconnecting components and for attaching to other work.
   1. Connect posts to stair framing by direct welding.

2.7 FINISHES
A. Comply with NAAMM’s “Metal Finishes Manual for Buyer’s Technical Representative and Metal Products” for recommendations for applying and designating finishes.
B. Finish metal stairs after assembly.
C. Preparation for Shop Priming: Prepare uncoated ferrous-metal surfaces to comply with SSPC-SP 3, “Power Tool Cleaning”.
D. Apply shop primer to uncoated surfaces of metal stair components. Comply with SSPC-PA 1, “Paint Application Specification No. 1: Shop, Field, and Maintenance Painting of Steel”, for shop painting.
PART 3 - EXECUTION

3.1 INSTALLATION

A. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing metal stairs. Set units accurately in location, alignment, and elevation, measured from established lines and levels and free of rack.

B. Field fit exposed connections accurately together to form hairline joints that cannot be shop connected because of shipping size limitations. Field weld connections that are not to be left as exposed joints but cannot be shop welded because of shipping size limitations. Do not weld, cut, or abrade surfaces of exterior units that have been hot-dip galvanized after fabrication and are for bolted or screwed field connections.

C. Field Welding: Comply with requirements for welding in “Fabrication, General” Article.

D. Attach handrails to wall with wall brackets. Use type of bracket with predrilled hole for exposed bolt anchorage.

3.2 ADJUSTING AND CLEANING

A. Touchup 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 to comply with SSPC-PA 1 for touching up shop-painted surfaces.

3.3 FIELD CONNECTIONS

A. High-Strength Bolts: Install high-strength bolts according to RCSC’s “Specification for Structural Joints Using ASTM A 325 or A 490 Bolts” for type of bolt and type of joint specified.

1. Joint Type: Snug tightened.

B. Weld Connections: Comply with AWS D1.1/D1.1M for tolerances, appearances, welding procedure specifications, weld quality and methods used in correcting welding work.

1. Comply with AISC 303 and AISC 360 for bearing, alignment, adequacy of temporary connections, and removal of paint on surfaces adjacent to field welds.

3.4 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified independent testing and inspecting agency to inspect field welds and high-strength bolted connections.

B. Bolted Connections: Bolted connections will be inspected according to RCSC’s “Specification for Structural Joints Using ASTM A 325 or A 490 Bolts”.

C. Welded Connections: Field welds will be visually inspected according to AWS D1.1/D1.1M.
1. Fillet welded connections shall be visually inspected according to AWS D1.1/D1.1M. Complete penetration welds shall be continuously visually inspected according to AWS D1.1/D1.1M, and Ultrasonic Inspection per ASTM E 164.

D. Correct deficiencies in Work that test reports and inspections indicate does not comply with the Contract Documents.

END OF SECTION 055100
SECTION 055213 - PIPE AND TUBE RAILINGS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Steel railings.

B. Related Sections:
   1. See Division 05, Section 5000, “Metal Stairs” for steel tube railings associated with metal stairs.
   2. See Division 09, Section 9113, “Painting” for surface-preparation and priming requirements.

1.2 ACTION SUBMITTALS

A. Product Data: For the following:
   1. Manufacturer’s product lines of mechanically connected railings.
   2. Railing brackets.

B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.

C. Welding Procedure Specifications (WPSs) including “pre-qualified” welds, Welder Performance Qualification Records (WPQRs) and Procedure Qualification Records (PQRs): Provide according to AWS D1.1/D1.1M, "Structural Welding Code - Steel", for each welded joint qualified by testing, including the following:
   1. Power source (constant current or constant voltage).

1.3 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified testing agency including weld inspectors.

B. Field quality-control reports.

1.4 QUALITY ASSURANCE

A. Applicability of Standards: Unless the Contract Documents include more stringent requirements, applicable construction industry standards have the same force and effect as if bound or copied directly into the Contract Documents to the extent referenced. Such standards are made a part of
the Contract Documents by reference. Publication Dates: Comply with standards in effect as of
date of the Contract Documents unless otherwise indicated.

B. Source Limitations: Obtain each type of railing from single source from single manufacturer.

C. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M,
"Structural Welding Code - Steel".

D. Welding Qualifications: Qualify procedures and personnel according to the following:

1. AWS D1.1/D1.1M, "Structural Welding Code - Steel".

1.5 PROJECT CONDITIONS

A. Field Measurements: Verify actual locations of walls and other construction contiguous with
metal fabrications by field measurements before fabrication.

1.6 COORDINATION AND SCHEDULING

A. Coordinate installation of anchorages for railings. Furnish setting drawings, templates, and
directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items
with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to
Project site in time for installation.

B. Schedule installation so wall attachments are made only to completed walls. Do not support
railings temporarily by any means that do not satisfy structural performance requirements.

PART 2 - PRODUCTS

2.1 METALS, GENERAL

A. Metal Surfaces, General: Provide materials with smooth surfaces, without seam marks, roller
marks, rolled trade names, stains, discolorations, or blemishes.

B. Brackets, Flanges, and Anchors: Cast or formed metal of same type of material and finish as
supported rails unless otherwise indicated.

2.2 STEEL AND IRON

A. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of
preconsumer recycled content not less than 25 percent. No documentation required since
USGBC allows a default value of 25 percent to be used for steel without documentation.

B. Tubing: ASTM A 500 (cold formed) or ASTM A 513.

C. Pipe: ASTM A 53/A 53M, Type F or Type S, Grade A, Standard Weight (Schedule 40), unless
another grade and weight are required by structural loads.
1. Provide galvanized finish.

D. Plates, Shapes, and Bars: ASTM A 36/A 36M.

E. Cast Iron: Either gray iron, ASTM A 48/A 48M, or malleable iron, ASTM A 47/A 47M, unless otherwise indicated.

2.3 FASTENERS

A. General: Provide the following:

1. Hot-Dip Galvanized Railings: Type 304 stainless-steel or hot-dip zinc-coated steel fasteners complying with ASTM A 153/A 153M or ASTM F 2329 for zinc coating.

B. Fasteners for Anchoring Railings to Other Construction: Select fasteners of type, grade, and class required to produce connections suitable for anchoring railings to other types of construction indicated.

C. Fasteners for Interconnecting Railing Components:

1. Provide concealed fasteners for interconnecting railing components and for attaching them to other work, unless exposed fasteners are unavoidable or are the standard fastening method for railings indicated.

D. Post-Installed Anchors: As shown on drawings.

2.4 MISCELLANEOUS MATERIALS

A. Welding Rods and Bare Electrodes: Select according to AWS specifications for metal alloy welded.

B. Etching Cleaner for Galvanized Metal: Complying with MPI#25.

C. Galvanizing Repair Paint: High-zinc-dust-content paint complying with SSPC-Paint 20 and compatible with paints specified to be used over it.

D. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187.


F. Anchoring Cement: Factory-packaged, nonshrink, nonstaining, hydraulic-controlled expansion cement formulation for mixing with water at Project site to create pourable anchoring, patching, and grouting compound.

1. Water-Resistant Product: At exterior locations provide formulation that is resistant to erosion from water exposure without needing protection by a sealer or waterproof coating and that is recommended by manufacturer for exterior use.
2.5 FABRICATION

A. General: Fabricate railings to comply with requirements indicated for design, dimensions, member sizes and spacing, details, finish, and anchorage.

B. Assemble railings in the 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. Use connections that maintain structural value of joined pieces.

C. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.

D. Form work true to line and level with accurate angles and surfaces.

E. Fabricate connections that will be exposed to weather in a manner to exclude water. Provide weep holes where water may accumulate.

F. Cut, reinforce, drill, and tap as indicated to receive finish hardware, screws, and similar items.

G. Connections: Fabricate railings with welded connections at stairs and either welded or nonwelded connections otherwise.

1. Except at stairs, the handrail/guardrail shall be constructed with Speed-Rail slip-on/bolt-on structural pipe fittings, as manufactured by The Hollaender Manufacturing Company or engineer approved equal. Fittings shall be of high-tensile aluminum-magnesium alloy 535.0 manufactured in compliance with ASTM B26, cast from high-purity ingot 535.2 that conforms to ASTM B179. All fittings shall be securely fastened to the pipe with internal/external, reverse knurl, cup point, hexagon socket set screws that conform to FF-S-200, and ANSI/ASME B18.3-1986 Type C/G. Set screws made of alloy steel shall conform to ASTM F912, and zinc plating shall be JS-600. Austenitic grade stainless steel set screws shall be 302 alloy.

H. Welded Connections: Cope components at connections to provide close fit, or use fittings designed for this purpose. Weld all around at connections, including at fittings.

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
2. Obtain fusion without undercut or overlap.
3. Remove flux immediately.
4. At exposed connections, finish exposed surfaces smooth and blended so no roughness shows after finishing and welded surface matches contours of adjoining surfaces.

I. Nonwelded Connections: Connect members with concealed mechanical fasteners and fittings. Fabricate members and fittings to produce flush, smooth, rigid, hairline joints.

1. Fabricate splice joints for field connection using an epoxy structural adhesive if this is manufacturer's standard splicing method.

J. Form changes in direction as follows:
1. By bending or by inserting prefabricated elbow fittings.

K. Bend members in jigs to produce uniform curvature for each configuration required; maintain cross section of member throughout entire bend without buckling, twisting, cracking, or otherwise deforming exposed surfaces of components.

L. Close exposed ends of railing members with prefabricated end fittings.

M. Provide wall returns at ends of wall-mounted handrails unless otherwise indicated. Close ends of returns unless clearance between end of rail and wall is 1/4 inch or less.

N. Brackets, Flanges, Fittings, and Anchors: Provide wall brackets, flanges, miscellaneous fittings, and anchors to interconnect railing members to other work unless otherwise indicated.

O. Provide inserts and other anchorage devices for connecting railings to concrete or masonry work. Fabricate anchorage devices capable of withstanding loads imposed by railings. Coordinate anchorage devices with supporting structure.

P. For railing posts set in concrete, provide steel sleeves not less than 6 inches long with inside dimensions not less than 1/2 inch greater than outside dimensions of post, with metal plate forming bottom closure.

Q. Toe Boards: Where indicated, provide toe boards at railings around openings and at edge of open-sided floors and platforms. Fabricate to dimensions and details indicated.

2.6 STEEL AND IRON FINISHES

A. Galvanized Railings:
   1. Hot-dip galvanize steel and iron railings, including hardware, after fabrication.
   2. Comply with ASTM A 123/A 123M for hot-dip galvanized railings.
   4. Fill vent and drain holes that will be exposed in the finished Work, unless indicated to remain as weep holes, by plugging with zinc solder and filing off smooth.

B. For galvanized railings, provide hot-dip galvanized fittings, brackets, fasteners, sleeves, and other ferrous components.

C. Preparing Galvanized Railings for Shop Priming: After galvanizing, thoroughly clean railings of grease, dirt, oil, flux, and other foreign matter, and treat with etching cleaner.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Fit exposed connections together to form tight, hairline joints.

B. Perform cutting, drilling, and fitting required for installing railings. Set railings accurately in location, alignment, and elevation; measured from established lines and levels and free of rack.
1. Do not weld, cut, or abrade surfaces of railing components that have been coated or finished after fabrication and that are intended for field connection by mechanical or other means without further cutting or fitting.
2. Set posts plumb within a tolerance of 1/16 inch in 3 feet.
3. Align rails so variations from level for horizontal members and variations from parallel with rake of steps and ramps for sloping members do not exceed 1/4 inch in 12 feet.

C. Adjust railings before anchoring to ensure matching alignment at abutting joints.

D. Fastening to In-Place Construction: Use anchorage devices and fasteners where necessary for securing railings and for properly transferring loads to in-place construction.

3.2 RAILING CONNECTIONS

A. Nonwelded Connections: Use mechanical or adhesive joints for permanently connecting railing components. Seal recessed holes of exposed locking screws using plastic cement filler colored to match finish of railings.

B. Welded Connections: Use fully welded joints for permanently connecting railing components. Comply with requirements for welded connections in "Fabrication" Article whether welding is performed in the shop or in the field.

3.3 ANCHORING POSTS

A. Use metal sleeves preset and anchored into concrete for installing posts. After posts have been inserted into sleeves, fill annular space between post and sleeve with nonshrink, nonmetallic grout, mixed and placed to comply with anchoring material manufacturer's written instructions.

B. Form or core-drill holes not less than 5 inches deep and 3/4 inch larger than OD of post for installing posts in concrete. Clean holes of loose material, insert posts, and fill annular space between post and concrete with nonshrink, nonmetallic grout, mixed and placed to comply with anchoring material manufacturer's written instructions.

C. Leave anchorage joint exposed with 1/8 inch buildup, sloped away from post.

3.4 ATTACHING RAILINGS

A. Attach railings to wall with wall brackets, except where end flanges are used. Provide brackets with 1-1/2 inch clearance from inside face of handrail and finished wall surface. Locate brackets as indicated or, if not indicated, at spacing required to support structural loads.

1. Use type of bracket with predrilled hole for exposed bolt anchorage.
2. Locate brackets as indicated or, if not indicated, at spacing required to support structural loads.
3.5 ADJUSTING AND CLEANING

A. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A 780.

3.6 PROTECTION

A. Protect finishes of railings from damage during construction period with temporary protective coverings approved by railing manufacturer. Remove protective coverings at time of Substantial Completion.

3.7 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified independent testing and inspecting agency to inspect post installed anchors.

B. Anchor and anchor installation shall conform to ICC report.

C. Testing agency will report inspection results promptly and in writing to Contractor and BTR.

D. Correct deficiencies in Work that test reports and inspections indicate does not comply with the Contract Documents.

END OF SECTION 055213
SECTION 072100 - THERMAL INSULATION

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Glass-fiber blanket insulation.
   2. Vapor retarders.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

1.3 INFORMATIONAL SUBMITTALS

A. Product test reports.
   B. Research/evaluation reports.

PART 2 - PRODUCTS

2.1 GLASS-FIBER BLANKET INSULATION

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   1. CertainTeed Corporation.
   2. Guardian Building Products, Inc.
   5. Owens Corning.

B. Reinforced-Foil-Faced, Glass-Fiber Blanket Insulation: ASTM C 665, Type III (reflective faced), Class A (faced surface with a flame-spread index of 25 or less); Category 1 (membrane is a vapor barrier), faced with foil scrim, foil-scrim kraft, or foil-scrim polyethylene.
PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Comply with insulation manufacturer's written instructions applicable to products and applications indicated.

B. Install insulation that is undamaged, dry, and unsoiled and that has not been left exposed to ice, rain, or snow at any time.

C. Extend insulation to envelop entire area to be insulated. Cut and fit tightly around obstructions and fill voids with insulation. Remove projections that interfere with placement.

D. Provide sizes to fit applications indicated and selected from manufacturer's standard thicknesses, widths, and lengths. Apply single layer of insulation units to produce thickness indicated unless multiple layers are otherwise shown or required to make up total thickness.

3.2 INSTALLATION OF INSULATION FOR FRAMED CONSTRUCTION

A. Apply insulation units to substrates by method indicated, complying with manufacturer's written instructions. If no specific method is indicated, bond units to substrate with adhesive or use mechanical anchorage to provide permanent placement and support of units.

B. Foam-Plastic Board Insulation: Seal joints between units by applying adhesive, mastic, or sealant to edges of each unit to form a tight seal as units are shoved into place. Fill voids in completed installation with adhesive, mastic, or sealant as recommended by insulation manufacturer.

C. Glass-Fiber Blanket Insulation: Install in cavities formed by framing members according to the following requirements:

1. Use insulation widths and lengths that fill the cavities formed by framing members. If more than one length is required to fill the cavities, provide lengths that will produce a snug fit between ends.

2. Place insulation in cavities formed by framing members to produce a friction fit between edges of insulation and adjoining framing members.

3. Maintain 3 inch clearance of insulation around recessed lighting fixtures not rated for or protected from contact with insulation.

4. For metal-framed wall cavities where cavity heights exceed 96 inches, support unfaced blankets mechanically and support faced blankets by taping flanges of insulation to flanges of metal studs.

3.3 INSTALLATION OF VAPOR RETARDERS

A. Place vapor retarders on the interior side of the exterior wall. Extend vapor retarders to extremities of areas to protect from vapor transmission. Secure vapor retarders in place with adhesives or other anchorage system as indicated. Extend vapor retarders to cover miscellaneous voids in insulated substrates, and tape seams.
B. Seal joints caused by pipes, conduits, electrical boxes, and similar items penetrating vapor retarders with vapor-retarder tape to create an airtight seal between penetrating objects and vapor retarders.

C. Repair tears or punctures in vapor retarders immediately before concealment by other work. Cover with vapor-retarder tape or another layer of vapor retarders.

END OF SECTION 072100
SECTION 074113 - METAL ROOF PANELS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Standing-seam metal roof panels.

1.2 PERFORMANCE REQUIREMENTS

A. Wind-Uplift Resistance: Provide metal roof panel assemblies that comply with UL 580 for wind-uplift-resistance class indicated.
   1. Uplift Rating: UL 90.

B. Structural Performance: Provide metal roof panel assemblies capable of withstanding the effects of gravity loads and the following loads and stresses within limits and under conditions indicated, based on testing according to ASTM E 1592:
   2. Deflection Limits: Metal roof panel assemblies shall withstand wind and snow loads with vertical deflections no greater than 1/180 of the span.

C. Air Infiltration: Air leakage through assembly of not more than 0.03 cfm/sq. ft of roof area when tested according to ASTM E 1680-95 at the following test-pressure difference:

D. Water Penetration: No water penetration when tested according to ASTM E 1646-04 at the following test-pressure difference:
   1. Test-Pressure Difference: Uniform Static 12.0 lbf/sq. ft.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings: Show fabrication and installation layouts of metal roof panels; details of edge conditions, side-seam and endlap joints, panel profiles, corners, anchorages, trim, flashings, closures, and accessories; and special details. Distinguish between factory and field-assembled work.

C. Samples: For each type of exposed finish required.
1.4 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Roof plans, drawn to scale, based on input from installers of the items involved.

B. Product test reports.

C. Field quality-control reports.

D. Warranties: Samples of special warranties.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance data.

1.6 QUALITY ASSURANCE

A. Applicability of Standards: Unless the Contract Documents include more stringent requirements, applicable construction industry standards have the same force and effect as if bound or copied directly into the Contract Documents to the extent referenced. Such standards are made a part of the Contract Documents by reference. Publication Dates: Comply with standards in effect as of date of the Contract Documents unless otherwise indicated.

B. Installer Qualifications: An employer of workers trained and approved by manufacturer.

C. Preinstallation Conference: Conduct conference at Project site.

1.7 WARRANTY

A. Special Warranty: Manufacturer’s standard form in which manufacturer agrees to repair or replace metal roof panel assemblies that fail in materials or workmanship within specified warranty period.

   1. Warranty Period: Two (2) years from date of Substantial Completion.

B. Special Warranty on Panel Finishes: Manufacturer’s standard form in which manufacturer agrees to repair finish or replace metal roof panels that show evidence of deterioration of factory-applied finishes within specified warranty period.

   1. Finish Warranty Period: 20 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PANEL MATERIALS

A. Metallic-Coated Steel Sheet: Restricted flatness steel sheet metallic coated by the hot-dip process and prepainted by the coil-coating process to comply with ASTM A 755/A 755M.
1. Aluminum-Zinc Alloy-Coated Steel Sheet:  ASTM A 792/A 792M, Class AZ50 coating designation, Grade 40; structural quality.
2. Surface: Smooth, flat finish.
3. Exposed Coil-Coated Finish:
   a. Two (2) - Coat Fluoropolymer:  AAMA 621. Fluoropolymer finish containing not less than 70 percent PVDF resin by weight in color coat.
4. Concealed Finish:  Manufacturer's standard white or light-colored acrylic or polyester backer finish.

B. Panel Sealants:
   1. Joint Sealant: ASTM C 920; as recommended in writing by metal roof panel manufacturer.

2.2 MISCELLANEOUS MATERIALS

A. Panel Fasteners:  Self-tapping screws, bolts, nuts, self-locking rivets and bolts, end-welded studs, and other suitable fasteners designed to withstand design loads.  Provide exposed fasteners with heads matching color of metal roof panels by means of plastic caps or factory-applied coating.  Provide EPDM sealing washers.

2.3 STANDING-SEAM METAL ROOF PANELS

A. General:  Provide factory-formed metal roof panels designed to be installed by lapping and interconnecting raised side edges of adjacent panels with joint type indicated and mechanically attaching panels to supports using concealed clips in side laps.  Include clips, cleats, pressure plates, and accessories required for weathertight installation.

1. Steel Panel Systems:  Unless more stringent requirements are indicated, comply with ASTM E 1514.
2. Manufacturers:  Subject to compliance with requirements, provide products by one of the following:
   a. Firestone Metal Products; UC-6 Panel.
   b. MBCI; a division of NCI Building Systems, BattenLok HS.
3. Profile: Vertical, seamed-joint, as indicated on Drawings.
   a. Exterior Finish:  Two (2) - coats fluoropolymer.
   b. Color:  As selected by Owner from manufacturer's standard range.
   c. Clips:  Floating to accommodate thermal movement.
   d. Material:  Metallic coated steel.
5. Joint Type: Seamed.
6. Panel Coverage: 12". 
7. Panel Height: 2” inches.

2.4 ACCESSORIES

A. Roof Panel Accessories: Provide components approved by roof panel manufacturer and as required for a complete metal roof panel assembly including trim, copings, fasciae, corner units, ridge closures, clips, flashings, sealants, gaskets, fillers, closure strips, and similar items. Match material and finish of metal roof panels unless otherwise indicated.

1. Closures: Provide closures at eaves and ridges, fabricated of same metal as metal roof panels.
2. Closure Strips: Closed-cell, expanded, cellular, rubber or crosslinked, polyolefin-foam or closed-cell laminated polyethylene; minimum one (1) inch thick, flexible closure strips; cut or premolded to match metal roof panel profile. Provide closure strips where indicated or necessary to ensure weathertight construction.
3. Backing Plates: Provide metal backing plates at panel end splices, fabricated from material recommended by manufacturer.

B. Flashing and Trim: Formed from same material as roof panels, prepainted with coil coating, minimum 0.028 inch thick. Provide flashing and trim as required to seal against weather and to provide finished appearance. Locations include, but are not limited to, eaves, rakes, corners, bases, framed openings, ridges, fasciae, and fillers. Finish flashing and trim with same finish system as adjacent metal roof panels.

2.5 FABRICATION

A. Fabricate and finish metal roof panels and accessories at the factory to greatest extent possible, by manufacturer’s standard procedures and processes and as necessary to fulfill indicated performance requirements. Comply with indicated profiles and with dimensional and structural requirements.

B. Provide panel profile, including major ribs and intermediate stiffening ribs, if any, for full length of panel.

C. Fabricate metal roof panel side laps with factory-installed captive gaskets or separator strips that provide a tight seal and prevent metal-to-metal contact, in a manner that will seal weathertight and minimize noise from movements within panel assembly.

D. Sheet Metal Accessories: Fabricate flashing and trim to comply with recommendations in SMACNA’s “Buyer’s Technical Representative Sheet Metal Manual” that apply to the design, dimensions, metal, and other characteristics of item indicated.
PART 3 - EXECUTION

3.1 PREPARATION

A. Miscellaneous Framing: Install subpurlins, eave angles, furring, and other miscellaneous roof panel support members and anchorage according to metal roof panel manufacturer's written instructions.

3.2 METAL ROOF PANEL INSTALLATION

A. Standing-Seam Metal Roof Panels: Fasten metal roof panels to supports with concealed clips at each standing-seam joint at location, spacing, and with fasteners recommended by manufacturer.

1. Install clips to supports with self-tapping fasteners.
2. Install pressure plates at locations indicated in manufacturer’s written installation instructions.
3. Seamed Joint: Crimp standing seams with manufacturer-approved, motorized seamer tool so clip, metal roof panel, and factory-applied sealant are completely engaged.

3.3 ACCESSORY INSTALLATION

A. General: Install accessories with positive anchorage to building and weathertight mounting and provide for thermal expansion. Coordinate installation with flashings and other components.

1. Install components required for a complete metal roof panel assembly including trim, copings, ridge closures, seam covers, flashings, sealants, gaskets, fillers, closure strips, and similar items.
2. Flashing and Trim: Comply with performance requirements, manufacturer's written installation instructions, and SMACNA’s “Buyer’s Technical Representative Sheet Metal Manual”. Provide concealed fasteners where possible, and set units true to line and level as indicated. Install work with laps, joints, and seams that will be permanently watertight and weather resistant.

3.4 CLEANING

A. Remove temporary protective coverings and strippable films, if any, as metal roof panels are installed unless otherwise indicated in manufacturer's written installation instructions. On completion of metal roof panel installation, clean finished surfaces as recommended by metal roof panel manufacturer. Maintain in a clean condition during construction.

END OF SECTION 074113
SECTION 074213 - METAL WALL PANELS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Exposed-fastener, lap-seam metal wall panels.

1.2 PERFORMANCE REQUIREMENTS

A. Structural Performance: Provide metal wall panel assemblies capable of withstanding the effects the following loads and stresses within limits and under conditions indicated, based on testing according to ASTM E 1592:

   1. Wind Loads: Determine loads based on the following minimum design wind pressures:
      a. Uniform pressure of 30 lbf/sq. ft., acting inward or outward.

   2. Deflection Limits: Metal wall panel assemblies shall withstand wind loads with horizontal deflections no greater than 1/180 of the span.

B. Air Infiltration: Air leakage through assembly of not more than 0.03 cfm/sq. ft of wall area when tested according to ASTM E 283-04 at the following test-pressure difference:

   1. Test-Pressure Difference: 15 lbf/sq. ft.

C. Water Penetration under Static Pressure: No water penetration when tested according to ASTM E 331-00 at the following test-pressure difference:

   1. Test-Pressure Difference: 15 lbf/sq. ft.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings: Show fabrication and installation layouts of metal wall panels; details of edge conditions, joints, panel profiles, corners, anchorages, attachment system, trim, flashings, closures, and accessories; and special details. Distinguish between factory, shop and field-assembled work.

C. Samples: For each type of exposed finish required.
1.4 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Exterior elevations drawn to scale and coordinating penetrations and wall-mounted items.

B. Product test reports.

C. Warranties: Samples of special warranties.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance data.

1.6 QUALITY ASSURANCE

A. Applicability of Standards: Unless the Contract Documents include more stringent requirements, applicable construction industry standards have the same force and effect as if bound or copied directly into the Contract Documents to the extent referenced. Such standards are made a part of the Contract Documents by reference. Publication Dates: Comply with standards in effect as of date of the Contract Documents unless otherwise indicated.

B. Installer Qualifications: An employer of workers trained and approved by manufacturer.

C. Preinstallation Conference: Conduct conference at Project site.

1.7 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of metal wall panel assemblies that fail in materials or workmanship within specified warranty period.

1. Warranty Period: Two (2) years from date of Substantial Completion.

B. Special Warranty on Panel Finishes: Manufacturer's standard form in which manufacturer agrees to repair finish or replace metal wall panels that show evidence of deterioration of factory-applied finishes within specified warranty period.

1. Finish Warranty Period: 20 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PANEL MATERIALS

A. Metallic-Coated Steel Sheet: Restricted flatness steel sheet metallic coated by the hot-dip process and prepainted by the coil-coating process to comply with ASTM A 755/A 755M.
1. **Aluminum-Zinc Alloy-Coated Steel Sheet**: ASTM A 792/A 792M, Class AZ50 coating designation, Grade 40; structural quality.

2. **Surface**: Smooth, flat finish.

3. **Exposed Coil-Coated Finish**: 
   
a. Two (2) - Coats Fluoropolymer: AAMA 621. Fluoropolymer finish containing not less than 70 percent PVDF resin by weight in color coat.

4. **Concealed Finish**: Manufacturer's standard white or light-colored acrylic or polyester backer finish.

B. **Panel Sealants**:


### 2.2 MISCELLANEOUS MATERIALS

A. **Panel Fasteners**: Self-tapping screws, bolts, nuts, self-locking rivets and bolts, end-welded studs, and other suitable fasteners designed to withstand design loads. Provide exposed fasteners with heads matching color of metal wall panels by means of plastic caps or factory-applied coating. Provide EPDM, PVC, or neoprene sealing washers.

B. **Panel Fasteners**:

1. Exposed-Fastener, Lap-Seam Metal Wall Panels

A. Provide factory-formed metal wall panels designed to be field assembled by lapping side edges of adjacent panels and mechanically attaching panels to supports using exposed fasteners in side laps. Include accessories required for weathertight installation.

1. **Manufacturers**: Subject to compliance with requirements, provide products by one of the following:
   
a. AEP-Span; HR-36.
   
b. CENTRIA Buyer’s Technical Representative Structural Systems; Style-Rib Panel.
   
c. Fabral; Hefti-Rib.
   
d. MBCI; Div. of NCI Building Systems; 7.2 Panel.

2. **Profile**: Vee rib.

3. **Material**: Aluminum-zinc alloy-coated steel sheet, 0.034 inch nominal thickness.
   
a. Exterior Finish: Two (2) - coats fluoropolymer.
   
b. Color: As selected by Owner from manufacturer's standard range.

4. **Major-Rib Spacing**: 7.2” o.c.

5. **Panel Coverage**: 36”.

6. **Panel Height**: 1.5”.
2.4 ACCESSORIES

A. Wall Panel Accessories: Provide components required for a complete metal wall panel assembly including trim, copings, fasciae, mullions, sills, corner units, clips, flashings, sealants, gaskets, fillers, closure strips, and similar items. Match material and finish of metal wall panels, unless otherwise indicated.

1. Backing Plates: Provide metal backing plates at panel end splices, fabricated from material recommended by manufacturer.

2. Closure Strips: Closed-cell, expanded, cellular, rubber or crosslinked, polyolefin-foam or closed-cell laminated polyethylene; minimum one (1) inch thick, flexible closure strips; cut or premolded to match metal wall panel profile. Provide closure strips at each panel end lap to ensure weathertight construction.

B. Flashing and Trim: Formed from 0.028 inch minimum thickness aluminum-zinc alloy-coated steel sheet prepainted with coil coating. Provide flashing and trim as required to seal against weather and to provide finished appearance. Locations include, but are not limited to, bases, drips, sills, jambs, corners, endwalls, framed openings, rakes, fasciae, parapet caps, soffits, reveals, and fillers. Finish flashing and trim with same finish system as adjacent metal wall panels.

2.5 FABRICATION

A. General: Fabricate and finish metal wall panels and accessories at the factory to greatest extent possible, by manufacturer's standard procedures and processes, as necessary to fulfill indicated performance requirements demonstrated by laboratory testing. Comply with indicated profiles and with dimensional and structural requirements.

B. Fabricate metal wall panels in a manner that eliminates condensation on interior side of panel and with joints between panels designed to form weathertight seals.

C. Provide panel profile, including major ribs and intermediate stiffening ribs, if any, for full length of panel.

D. Sheet Metal Accessories: Fabricate flashing and trim to comply with recommendations in SMACNA’s “Buyer’s Technical Representative Structural Sheet Metal Manual” that apply to the design, dimensions, metal, and other characteristics of item indicated.

PART 3 - EXECUTION

3.1 PREPARATION

A. Miscellaneous Framing: Install subgirts, base angles, sills, furring, and other miscellaneous wall panel support members and anchorages according to ASTM C 754 and metal wall panel manufacturer's written recommendations.
3.2 METAL WALL PANEL INSTALLATION

A. Lap-Seam Metal Wall Panels: Fasten metal wall panels to supports with fasteners at each lapped joint at location and spacing recommended by manufacturer.

1. Lap ribbed or fluted sheets one full rib corrugation. Apply panels and associated items for neat and weathertight enclosure. Avoid “panel creep” or application not true to line.
2. Provide metal-backed washers under heads of exposed fasteners bearing on weather side of metal wall panels.
3. Locate and space exposed fasteners in uniform vertical and horizontal alignment. Use proper tools to obtain controlled uniform compression for positive seal without rupture of washer.
4. Install screw fasteners with power tools having controlled torque adjusted to compress washer tightly without damage to washer, screw threads, or panels. Install screws in predrilled holes.
5. Provide sealant tape at lapped joints of metal wall panels and between panels and protruding equipment, vents, and accessories.
6. At panel splices, nest panels with minimum six (6) inch end lap, sealed with butyl-rubber sealant and fastened together by interlocking clamping plates.

3.3 ACCESSORY INSTALLATION

A. General: Install accessories with positive anchorage to building and weathertight mounting, and provide for thermal expansion. Coordinate installation with flashings and other components.

1. Install components required for a complete metal wall panel assembly including trim, copings, corners, seam covers, flashings, sealants, gaskets, fillers, closure strips, and similar items.

B. Flashing and Trim: Comply with performance requirements, manufacturer's written installation instructions, and SMACNA’s “Buyer’s Technical Representative Structural Sheet Metal Manual”. Provide concealed fasteners where possible, and set units true to line and level as indicated. Install work with laps, joints, and seams that will be permanently watertight and weather resistant.

3.4 CLEANING AND PROTECTION

A. Remove temporary protective coverings and strippable films, if any, as metal wall panels are installed, unless otherwise indicated in manufacturer's written installation instructions. On completion of metal wall panel installation, clean finished surfaces as recommended by metal wall panel manufacturer. Maintain in a clean condition during construction.

B. After metal wall panel installation, clear weep holes and drainage channels of obstructions, dirt, and sealant.

END OF SECTION 074213
SECTION 076200 - SHEET METAL FLASHING AND TRIM

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Formed low-slope roof sheet metal fabrications.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings: Show installation layouts of sheet metal flashing and trim, including plans, elevations, expansion-joint locations, and keyed details. Distinguish between shop and field-assembled work.
   1. Include details for forming, joining, supporting, and securing sheet metal flashing and trim, including pattern of seams, termination points, fixed points, expansion joints, expansion-joint covers, edge conditions, special conditions, and connections to adjoining work.

C. Samples: For each exposed product and for each finish specified.

1.3 INFORMATIONAL SUBMITTALS

A. Warranty: Sample of special warranty.

1.4 CLOSEOUT SUBMITTALS

A. Maintenance data.

1.5 QUALITY ASSURANCE

A. Applicability of Standards: Unless the Contract Documents include more stringent requirements, applicable construction industry standards have the same force and effect as if bound or copied directly into the Contract Documents to the extent referenced. Such standards are made a part of the Contract Documents by reference. Publication Dates: Comply with standards in effect as of date of the Contract Documents unless otherwise indicated.

B. Sheet Metal Flashing and Trim Standard: Comply with SMACNA’s “Buyer’s Technical Representative Sheet Metal Manual” unless more stringent requirements are specified or shown on Drawings.
1.6 WARRANTY

A. Special Warranty on Finishes: Manufacturer’s standard form in which manufacturer agrees to repair finish or replace sheet metal flashing and trim that shows evidence of deterioration of factory-applied finishes within 20 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 SHEET METALS

A. General: Protect mechanical and other finishes on exposed surfaces from damage by applying a strippable, temporary protective film before shipping.

B. Metallic-Coated Steel Sheet: Restricted flatness steel sheet, metallic coated by the hot-dip process and prepainted by the coil-coating process to comply with ASTM A 755/A 755M.

1. Zinc-Coated (Galvanized) Steel Sheet: ASTM A 653/A 653M, G90 coating designation; structural quality.
2. Aluminum-Zinc Alloy-Coated Steel Sheet: ASTM A 792/A 792M, Class AZ50 coating designation, Grade 40; structural quality.
3. Exposed Coil-Coated Finish:
   a. Two (2) Coats Fluoropolymer: AAMA 621. Fluoropolymer finish containing not less than 70 percent PVDF resin by weight in color coat.

4. Color: As selected by Owner from manufacturer’s full range.

2.2 MISCELLANEOUS MATERIALS

A. General: Provide materials and types of fasteners, solder, welding rods, protective coatings, separators, sealants, and other miscellaneous items as required for complete sheet metal flashing and trim installation and recommended by manufacturer of primary sheet metal or manufactured item unless otherwise indicated.

B. Fasteners: Wood screws, annular threaded nails, self-tapping screws, self-locking rivets and bolts, and other suitable fasteners designed to withstand design loads and recommended by manufacturer of primary sheet metal or manufactured item.

1. General: Blind fasteners or self-drilling screws, gasketed, with hex-washer head.
   a. Exposed Fasteners: Heads matching color of sheet metal using plastic caps or factory-applied coating.

2. Fasteners for Zinc-Coated (Galvanized) or Aluminum-Zinc Alloy-Coated Steel Sheet: Hot-dip galvanized steel according to ASTM A 153/A 153M or ASTM F 2329 or Series 300 stainless steel.
C. Elastomeric Sealant: ASTM C 920, elastomeric polymer sealant; low modulus; of type, grade, class, and use classifications required to seal joints in sheet metal flashing and trim and remain watertight.

D. Butyl Sealant: ASTM C 1311, single-component, solvent-release butyl rubber sealant; polyisobutylene plasticized; heavy bodied for hooked-type expansion joints with limited movement.

E. Bituminous Coating: Cold-applied asphalt emulsion complying with ASTM D 1187.

2.3 FABRICATION, GENERAL

A. General: Custom fabricate sheet metal flashing and trim to comply with recommendations in SMACNA’s “Buyer’s Technical Representative Structural Sheet Metal Manual” that apply to design, dimensions, geometry, metal thickness, and other characteristics of item indicated. Fabricate items at the shop to greatest extent possible.

1. Obtain field measurements for accurate fit before shop fabrication.
2. Form sheet metal flashing and trim without excessive oil canning, buckling, and tool marks and true to line and levels indicated, with exposed edges folded back to form hems.
3. Conceal fasteners and expansion provisions where possible. Exposed fasteners are not allowed on faces exposed to view.

B. Sealed Joints: Form nonexpansion but movable joints in metal to accommodate elastomeric sealant.

C. Expansion Provisions: Where lapped expansion provisions cannot be used, form expansion joints of intermeshing hooked flanges, not less than one (1) inch deep, filled with butyl sealant concealed within joints.

D. Fabricate cleats and attachment devices from same material as accessory being anchored or from compatible, noncorrosive metal.

E. Seams: Fabricate nonmoving seams with flat-lock seams. Tin edges to be seamed, form seams, and solder.

2.4 LOW-SLOPE ROOF SHEET METAL FABRICATIONS

A. Roof-Edge Flashing Drip Edge and Fascia Cap: Fabricate in minimum 96 inch long, but not exceeding 10 foot long, sections. Furnish with six (6) inch wide, joint cover plates. Fabricate from the following materials:

1. Galvanized Steel: 0.028 inch thick.
2. Aluminum-Zinc Alloy-Coated Steel: 0.028 inch thick.
PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. General: Anchor sheet metal flashing and trim and other components of the Work securely in place, with provisions for thermal and structural movement so that completed sheet metal flashing and trim shall not rattle, leak, or loosen, and shall remain watertight. Use fasteners, solder, welding rods, protective coatings, separators, sealants, and other miscellaneous items as required to complete sheet metal flashing and trim system.

1. Install sheet metal flashing and trim true to line and levels indicated. Provide uniform, neat seams with minimum exposure of sealant.
2. Install sheet metal flashing and trim to fit substrates and to result in watertight performance. Verify shapes and dimensions of surfaces to be covered before fabricating sheet metal.
3. Space cleats not more than 12 inches apart. Anchor each cleat with two (2) fasteners. Bend tabs over fasteners.
4. Install exposed sheet metal flashing and trim without excessive oil canning, buckling, and tool marks.
5. Torch cutting of sheet metal flashing and trim is not permitted.

B. Metal Protection: Where dissimilar metals will contact each other or corrosive substrates, protect against galvanic action by painting contact surfaces with bituminous coating or by other permanent separation as recommended by SMACNA.

1. Coat the back side of uncoated sheet metal flashing and trim with bituminous coating where flashing and trim will contact wood, ferrous metal, or cementitious construction.

C. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim. Space movement joints at a maximum of 10 feet with no joints allowed within 24 inches of corner or intersection. Where lapped expansion provisions cannot be used or would not be sufficiently watertight, form expansion joints of intermeshing hooked flanges, not less than one (1) inch deep, filled with sealant concealed within joints.

D. Fastener Sizes: Use fasteners of sizes that will penetrate wood blocking not less than 1 and 1/4 inches for nails and not less than 3/4 inch for wood screws.

E. Seal joints as shown and as required for watertight construction.

3.2 ROOF FLASHING INSTALLATION

A. General: Install sheet metal flashing and trim to comply with performance requirements and SMACNA’s “Buyer’s Technical Representative Structural Sheet Metal Manual”. Provide concealed fasteners where possible, set units true to line, and level as indicated. Install work with laps, joints, and seams that will be permanently watertight and weather resistant.

B. Roof Edge Flashing: Anchor to resist uplift and outward forces according to recommendations in SMACNA’s “Buyer’s Technical Representative Structural Sheet Metal Manual” and as indicated.
Interlock bottom edge of roof edge flashing with continuous cleat anchored to substrate at staggered three (3) inch centers.

3.3 CLEANING AND PROTECTION

A. Remove temporary protective coverings and strippable films as sheet metal flashing and trim are installed unless otherwise indicated in manufacturers written installation instructions.

END OF SECTION 076200
SECTION 079200 - JOINT SEALANTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Silicone joint sealants.
   2. Latex joint sealants.

1.2 ACTION SUBMITTALS

A. Product Data: For each joint-sealant product indicated.

B. Joint-Sealant Schedule: Include the following information:
   1. Joint-sealant application, joint location, and designation.
   2. Joint-sealant manufacturer and product name.

1.3 INFORMATIONAL SUBMITTALS

A. Product test reports.

B. Warranties.

1.4 WARRANTY

A. Special Installer’s Warranty: Manufacturer’s standard form in which Installer agrees to repair or replace joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period.

   1. Warranty Period: Two (2) years from date of Substantial Completion.

B. Special Manufacturer’s Warranty: Manufacturer’s standard form in which joint-sealant manufacturer agrees to furnish joint sealants to repair or replace those that do not comply with performance and other requirements specified in this Section within specified warranty period.

   1. Warranty Period: Two (2) years from date of Substantial Completion.
PART 2 - PRODUCTS

2.1 SILICONE JOINT SEALANTS

A. Neutral-Curing Silicone Joint Sealant: ASTM C 920.
   1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
      a. BASF Building Systems.
      b. Dow Corning Corporation.
      c. GE Advanced Materials - Silicones.
      d. May National Associates, Inc.
      e. Pecora Corporation.
      f. Sika Corporation; Construction Products Division.
      g. Tremco Incorporated.

2. Type: Single component (S).
3. Grade: Nonsag (NS).
5. Uses Related to Exposure: Nontraffic (NT).

2.2 LATEX JOINT SEALANTS

A. Latex Joint Sealant: Acrylic latex or siliconized acrylic latex, ASTM C 834, Type OP, Grade NF.
   1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
      a. BASF Building Systems.
      b. Bostik, Inc.
      c. May National Associates, Inc.
      d. Pecora Corporation.
      e. Tremco Incorporated.

2.3 JOINT SEALANT BACKING

A. Cylindrical Sealant Backings: ASTM C 1330, Type O (open-cell material), and of size and density to control sealant depth and otherwise contribute to producing optimum sealant performance.

B. Bond-Breaker Tape: Polyethylene tape or other plastic tape recommended by sealant manufacturer.
2.4 MISCELLANEOUS MATERIALS

A. Primer: Material recommended by joint-sealant manufacturer where required for adhesion of sealant to joint substrates indicated, as determined from preconstruction joint-sealant-substrate tests and field tests.

B. Cleaners for Nonporous Surfaces: Chemical cleaners acceptable to manufacturers of sealants and sealant backing materials.

C. Masking Tape: Nonstaining, nonabsorbent material compatible with joint sealants and surfaces adjacent to joints.

PART 3 - EXECUTION

3.1 PREPARATION

A. Surface Cleaning of Joints: Clean out joints immediately before installing joint sealants to comply with joint-sealant manufacturer’s written instructions.
   1. Remove laitance and form-release agents from concrete.
   2. Clean nonporous joint substrate surfaces with chemical cleaners or other means that do not stain, harm substrates, or leave residues capable of interfering with adhesion of joint sealants.

B. Joint Priming: Prime joint substrates where recommended by joint-sealant manufacturer or as indicated by preconstruction joint-sealant-substrate tests or prior experience. Apply primer to comply with joint-sealant manufacturer's written instructions. Confine primers to areas of joint-sealant bond; do not allow spillage or migration onto adjoining surfaces.

C. Masking Tape: Use masking tape where required to prevent contact of sealant or primer with adjoining surfaces that otherwise would be permanently stained or damaged by such contact or by cleaning methods required to remove sealant smears. Remove tape immediately after tooling without disturbing joint seal.

3.2 INSTALLATION

A. Sealant Installation Standard: Comply with recommendations in ASTM C 1193 for use of joint sealants as applicable to materials, applications, and conditions indicated.

B. Install sealant backings of kind indicated to support sealants during application and at position required to produce cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.
   1. Do not leave gaps between ends of sealant backings.
   2. Do not stretch, twist, puncture, or tear sealant backings.
   3. Remove absorbent sealant backings that have become wet before sealant application and replace them with dry materials.
C. Install bond-breaker tape behind sealants where sealant backings are not used between sealants and backs of joints.

D. Install sealants using proven techniques that comply with the following and at the same time backings are installed:

1. Place sealants so they directly contact and fully wet joint substrates.
2. Completely fill recesses in each joint configuration.
3. Produce uniform, cross-sectional shapes and depths relative to joint widths that allow optimum sealant movement capability.

E. Tooling of Nonsag Sealants: Immediately after sealant application and before skinning or curing begins, tool sealants according to requirements specified in subparagraphs below to form smooth, uniform beads of configuration indicated; to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint.

1. Remove excess sealant from surfaces adjacent to joints.
2. Use tooling agents that are approved in writing by sealant manufacturer and that do not discolor sealants or adjacent surfaces.
3. Provide concave joint profile per Figure 8A in ASTM C 1193, unless otherwise indicated.

F. Clean off excess sealant or sealant smears adjacent to joints as the Work progresses by methods and with cleaning materials approved in writing by manufacturers of joint sealants and of products in which joints occur.

3.3 FIELD QUALITY CONTROL

A. Evaluation of Field-Adhesion Results: Sealants not evidencing adhesive failure or noncompliance with other indicated requirements will be considered satisfactory. Remove sealants that fail to adhere to joint substrates or to comply with other requirements. Retest failed applications until test results prove sealants comply with indicated requirements.


1. Joint Locations:
   b. Joints between metal panels.
   c. Joints between different materials listed above.
   d. Perimeter joints between materials listed above and frames of doors and louvers.
   e. Control and expansion joints in ceilings and other overhead surfaces.
   f. Other joints as indicated.


3. Joint-Sealant Color: As selected by Buyer’s Technical Representative from manufacturer’s full range of colors.

C. Joint-Sealant Application: Interior joints in horizontal traffic surfaces.
1. Joint Locations:
   b. Other joints as indicated.


3. Joint-Sealant Color: As selected by Buyer’s Technical Representative from manufacturer’s full range of colors.


1. Joint Locations:
   a. Control and expansion joints on exposed interior surfaces of exterior walls.
   b. Perimeter joints of exterior openings where indicated.
   c. Vertical joints on exposed surfaces of concrete walls and partitions.
   d. Perimeter joints between interior wall surfaces and frames of interior doors.
   e. Other joints as indicated.


3. Joint-Sealant Color: As selected by Buyer’s Technical Representative from manufacturer’s full range of colors.

END OF SECTION 079200
SECTION 081113 - HOLLOW METAL DOORS AND FRAMES

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes hollow-metal work.

1.2 DEFINITIONS

A. Minimum Thickness: Minimum thickness of base metal without coatings according to NAAMM-HMMA 803 or SDI A250.8.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: Include elevations, door edge details, frame profiles, metal thicknesses, preparations for hardware, and other details.

C. Schedule: Prepared by or under the supervision of a supplier using the same reference numbers for details and openings as those on Drawings.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Amweld International, LLC.
2. Ceco Door Products; an Assa Abloy Group company.
4. Steelcraft; an Ingersoll-Rand company.

2.2 EXTERIOR HOLLOW-METAL DOORS AND FRAMES


1. Physical Performance: Level A according to SDI A250.4.
2. Doors:

   a. Type: As indicated in the Door and Frame Schedule.
c. **Face:** Metallic-coated steel sheet, minimum thickness of 0.053 inch, with minimum A40 coating.  
d. **Edge Construction:** Model 1, Full Flush.  
e. **Core:** Polystyrene Manufacturer's standard insulation material.  

3. **Thermal-Rated Doors:** Provide doors fabricated with thermal-resistance value (R-value) of not less than 4.0 deg F x h x sq. ft./Btu when tested according to ASTM C 1363.  

4. **Frames:**  
   a. **Materials:** Metallic-coated steel sheet, minimum thickness of 0.053 inch, with minimum A40 coating.  
   b. **Construction:** Full profile welded.  

5. **Exposed Finish:** Prime.  

### 2.3 FRAME ANCHORS  

**A. Jamb Anchors:**  
1. **Stud-Wall Type:** Designed to engage stud, welded to back of frames; not less than 0.042 inch thick.  
2. **Postinstalled Expansion Type for In-Place Structural Steel Sub-Framing:** Minimum 1/4 inch diameter bolts and fasteners. Provide pipe spacer from frame to wall, with throat reinforcement plate, welded to frame at each anchor location.  

**B. Floor Anchors:** Formed from same material as frames, minimum thickness of 0.042 inch, and as follows:  
   1. **Monolithic Concrete Slabs:** Clip-type anchors, with two (2) holes to receive fasteners.  

### 2.4 MATERIALS  

**A. Cold-Rolled Steel Sheet:** ASTM A 1008, Commercial Steel (CS), Type B; suitable for exposed applications.  

**B. Metallic-Coated Steel Sheet:** ASTM A 653, Commercial Steel (CS), Type B.  

**C. Frame Anchors:** ASTM A 879, Commercial Steel (CS), 04Z coating designation; mill phosphatized.  
   1. For anchors built into exterior walls, steel sheet complying with ASTM A 1008 or ASTM A 1011, hot-dip galvanized according to ASTM A 153, Class B.  

**D. Inserts, Bolts, and Fasteners:** Hot-dip galvanized according to ASTM A 153.  

**E. Mineral-Fiber Insulation:** ASTM C 665, Type I (blankets without membrane facing).
2.5 FABRICATION

A. Fabricate hollow-metal work to be rigid and free of defects, warp, or buckle. Accurately form metal to required sizes and profiles, with minimum radius for metal thickness. Where practical, fit and assemble units in manufacturer’s plant. To ensure proper assembly at Project site, clearly identify work that cannot be permanently factory assembled before shipment.

B. Hollow-Metal Doors:

1. Exterior Doors: Provide weep-hole openings in bottoms of exterior doors to permit moisture to escape. Seal joints in top edges of doors against water penetration.

C. Hollow-Metal Frames: Where frames are fabricated in sections due to shipping or handling limitations, provide alignment plates or angles at each joint, fabricated of same thickness metal as frames.

1. Frames: Provide closed tubular members with no visible face seams or joints, fabricated from same material as door frame. Fasten members at crossings and to jambs by butt welding.
2. Provide countersunk, flat or oval-head exposed screws and bolts for exposed fasteners unless otherwise indicated.
3. Floor Anchors: Weld anchors to bottoms of jambs with at least four (4) spot welds per anchor. However, for slip-on drywall frames; provide anchor clips or countersunk holes at bottoms of jambs.
4. Jamb Anchors: Provide number and spacing of anchors as follows:
   a. Stud-Wall Type: Locate anchors not more than 18 inches from top and bottom of frame. Space anchors not more than 32 inches o.c. and as follows:
      1) Four (4) anchors per jamb from 60 to 90 inches high.
   b. Postinstalled Expansion Type: Locate anchors not more than six (6) inches from top and bottom of frame. Space anchors not more than 26 inches o.c.
   c. Postinstalled Bolted Type: Locate anchors not more than six (6) inches from top and bottom of frame. Space anchors not more than 26 inches o.c.

D. Hardware Preparation: Factory prepare hollow-metal work to receive templated mortised hardware; include cutouts, reinforcement, mortising, drilling, and tapping according to SDI A250.6, the Door Hardware Schedule, and templates.

1. Reinforce doors and frames to receive nontemplated, mortised, and surface-mounted door hardware.
2. Comply with applicable requirements in SDI A250.6 and BHMA A156.115 for preparation of hollow-metal work for hardware.

2.6 STEEL FINISHES

A. Prime Finish: Clean, pretreat, and apply manufacturer’s standard primer.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Hollow-Metal Frames: Install hollow-metal frames of size and profile indicated. Comply with SDI A250.11 or NAAMM-HMMA 840 as required by standards specified.

1. Set frames accurately in position; plumbed, aligned, and braced securely until permanent anchors are set. After wall construction is complete, remove temporary braces, leaving surfaces smooth and undamaged.
   a. Remove temporary braces necessary for installation only after frames have been properly set and secured.
   b. Check plumb, square, and twist of frames as walls are constructed. Shim as necessary to comply with installation tolerances.

2. Floor Anchors: Provide floor anchors for each jamb and mullion that extends to floor, and secure with postinstalled expansion anchors.


4. Installation Tolerances: Adjust hollow-metal door frames for squareness, alignment, twist, and plumb to the following tolerances:
   a. Squareness: Plus or minus 1/16 inch, measured at door rabbet on a line 90 degrees from jamb perpendicular to frame head.
   b. Alignment: Plus or minus 1/16 inch, measured at jambs on a horizontal line parallel to plane of wall.
   c. Twist: Plus or minus 1/16 inch, measured at opposite face corners of jambs on parallel lines, and perpendicular to plane of wall.
   d. Plumbness: Plus or minus 1/16 inch, measured at jambs at floor.

B. Hollow-Metal Doors: Fit hollow-metal doors accurately in frames, within clearances specified below. Shim as necessary.

3.2 ADJUSTING AND CLEANING

A. Final Adjustments: Check and readjust operating hardware items immediately before final inspection. Leave work in complete and proper operating condition. Remove and replace defective work, including hollow-metal work that is warped, bowed, or otherwise unacceptable.

B. Prime-Coat Touchup: Immediately after erection, sand smooth rusted or damaged areas of prime coat and apply touchup of compatible air-drying, rust-inhibitive primer.

END OF SECTION 081113
SECTION 087100 - DOOR HARDWARE

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes:

1. Mechanical door hardware for the following:

a. Swinging doors.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

B. Other Action Submittals:

1. Door Hardware Schedule: Coordinate final door hardware schedule with doors, frames, and related work to ensure proper size, thickness, hand, function, and finish of door hardware.

a. Format: Use same scheduling sequence and format and use same door numbers as in the Contract Documents.

b. Content: Include the following information:

1) Identification number, location, hand, size, and material of each door and frame.

2) Complete designations, including name and manufacturer, type, style, function, size, quantity, function, and finish of each door hardware product.

2. Keying Schedule: Prepared by or under the supervision of Installer, detailing Owner's final keying instructions for locks.

1.3 QUALITY ASSURANCE

A. Applicability of Standards: Unless the Contract Documents include more stringent requirements, applicable construction industry standards have the same force and effect as if bound or copied directly into the Contract Documents to the extent referenced. Such standards are made a part of the Contract Documents by reference. Publication Dates: Comply with standards in effect as of date of the Contract Documents unless otherwise indicated.

B. Means of Egress Doors: Latches do not require more than 15 lbf to release the latch. Locks do not require use of a key, tool, or special knowledge for operation.
1.4 DELIVERY, STORAGE, AND HANDLING

A. Deliver keys and permanent cores to Owner by registered mail or overnight package service.

1.5 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of door hardware that fail in materials or workmanship within specified warranty period.

1. Warranty Period: Two years from date of Substantial Completion, unless otherwise indicated.

a. Manual Closers: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 SCHEDULED DOOR HARDWARE

A. Provide door hardware for each door as scheduled in Part 3 "Door Hardware Schedule" Article to comply with requirements in this Section.

1. Door Hardware Sets: Provide quantity, item, size, finish or color indicated, and named manufacturers' products.

B. Designations: Requirements for design, grade, function, finish, size, and other distinctive qualities of each type of door hardware are indicated in Part 3 "Door Hardware Schedule" Article. Products are identified by using door hardware designations, as follows:

1. Named Manufacturers' Products: Manufacturer and product designation are listed for each door hardware type required for the purpose of establishing minimum requirements. Manufacturers' names are abbreviated in Part 3 "Door Hardware Schedule" Article.

2. References to BHMA Designations: Provide products complying with these designations and requirements for description, quality, and function.

2.2 HINGES

A. Hinges: BHMA A156.1. Provide template-produced hinges for hinges installed on hollow-metal doors and hollow-metal frames.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. IVES Hardware; an Ingersoll-Rand company.

b. Stanley Commercial Hardware; Div. of The Stanley Works.
2.3 MECHANICAL LOCKS AND LATCHES

A. Strikes: Provide manufacturer’s standard strike for each lock bolt or latchbolt complying with requirements indicated for applicable lock or latch and with strike box and curved lip extended to protect frame; finished to match lock or latch.

1. Flat-Lip Strikes: For locks with three-piece antifriction latchbolts, as recommended by manufacturer.

B. Bored Locks: BHMA A156.2; Grade 1; Series 4000.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Corbin Russwin Buyer’s Technical Representative Structural Hardware; n ASSA ABLOY Group Company.

2.4 LOCK CYLINDERS

A. Lock Cylinders: Tumbler type, constructed from brass or bronze, stainless steel, or nickel silver.

1. Manufacturer: Same manufacturer as for locking devices.
2. Manufacturers: Subject to compliance with requirements, provide the following:

B. Construction Cores: Provide construction cores that are replaceable by permanent cores. Provide 6 construction master keys.

2.5 KEYING


1. No Master Key System: Only change keys operate cylinder.

B. Keys: Nickel silver or Brass.

1. Stamping: Permanently inscribe each key with a visual key control number and include the following notation:
   a. Notation: "DO NOT DUPLICATE".

2. Quantity: In addition to one extra key blank for each lock, provide the following:
2.6 SURFACE CLOSERS

A. Surface Closers: BHMA A156.4; rack-and-pinion hydraulic type with adjustable sweep and latch speeds controlled by key-operated valves and forged-steel main arm. Comply with manufacturer's written recommendations for size of door closers depending on size of door, exposure to weather, and anticipated frequency of use. Provide factory-sized closers, adjustable to meet field conditions and requirements for opening force.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Corbin Russwin Buyer’s Technical Representative Structural Hardware; an ASSA ABLOY Group company.
   b. LCN Closers; an Ingersoll-Rand company.

2.7 MECHANICAL STOPS AND HOLDERS

A. Floor-Mounted Stops: BHMA A156.16; polished cast brass, or bronze base metal.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. IVES Hardware; an Ingersoll-Rand company.
   b. Stanley Commercial Hardware; Div. of The Stanley Works.
   c. Trimco.

2.8 DOOR GASKETING

A. Door Gasketing: BHMA A156.22; air leakage not to exceed 0.50 cfm per foot of crack length for gasketing, as tested according to ASTM E 283; with resilient or flexible seal strips that are easily replaceable and readily available from stocks maintained by manufacturer.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. National Guard Products.
   b. Pemko Manufacturing Co.; an ASSA ABLOY Group company.
   c. Reese Enterprises, Inc.

2.9 THRESHOLDS

A. Thresholds: BHMA A156.21; fabricated to full width of opening indicated.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. National Guard Products.
b. Pemko Manufacturing Co.; an ASSA ABLOY Group company.
c. Reese Enterprises, Inc.

2.10 FABRICATION

A. Fasteners: Provide door hardware manufactured to comply with published templates prepared for machine, wood, and sheet metal screws. Provide screws that comply with commercially recognized industry standards for application intended, except aluminum fasteners are not permitted. Provide Phillips flat-head screws with finished heads to match surface of door hardware, unless otherwise indicated.

2.11 FINISHES

A. Provide finishes complying with BHMA A156.18 as indicated in door hardware schedule.

B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Steel Doors and Frames: For surface applied door hardware, drill and tap doors and frames according to ANSI/SDI A250.6.

B. Mounting Heights: Mount door hardware units at heights to comply with the following unless otherwise indicated or required to comply with governing regulations.


C. Install each door hardware item to comply with manufacturer's written instructions. Where cutting and fitting are required to install door hardware onto or into surfaces that are later to be painted or finished in another way, coordinate removal, storage, and reinstallation of surface protective trim units with finishing work specified in Division 09 Sections. Do not install surface-mounted items until finishes have been completed on substrates involved.

1. Set units level, plumb, and true to line and location. Adjust and reinforce attachment substrates as necessary for proper installation and operation.

2. Drill and countersink units that are not factory prepared for anchorage fasteners. Space fasteners and anchors according to industry standards.

D. Hinges: Install types and in quantities indicated in door hardware schedule but not fewer than the number recommended by manufacturer for application indicated or one hinge for every 30 inches of door height, whichever is more stringent, unless other equivalent means of support for door, such as spring hinges or pivots, are provided.

E. Lock Cylinders: Install construction cores to secure building and areas during construction period.
1. Replace construction cores with permanent cores as directed by Owner.
2. Furnish permanent cores to Owner for installation.

F. Thresholds: Set thresholds for exterior doors and other doors indicated in full bed of sealant.

G. Stops: Provide floor stops for doors unless wall or other type stops are indicated in door hardware schedule. Do not mount floor stops where they will impede traffic.

H. Perimeter Gasketing: Apply to head and jamb, forming seal between door and frame.

I. Door Bottoms: Apply to bottom of door, forming seal with threshold when door is closed.

J. Adjustment: Adjust and check each operating item of door hardware and each door to ensure proper operation or function of every unit. Replace units that cannot be adjusted to operate as intended. Adjust door control devices to compensate for final operation of heating and ventilating equipment and to comply with referenced accessibility requirements.

3.2 DOOR HARDWARE SCHEDULE

Door Hardware Set No. 1
Locations: Electrical Room and Enclosure Entry Door each to have the following:

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<th>Item</th>
<th>Manufacturer</th>
<th>Product</th>
<th>Finish</th>
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<td>US 26D</td>
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<td></td>
<td></td>
<td>1/2 -NRP</td>
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<td>&amp; 32-SERIES</td>
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END OF SECTION 087100
SECTION 099113 - PAINTING

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes surface preparation and the application of paint systems on the following interior and exterior substrates:

1. Steel.
2. Galvanized-Metal.

1.2 DEFINITIONS

A. Gloss Level 6: 70 to 85 units at 60 degrees, according to ASTM D 523.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product. Include preparation requirements and application instructions.

B. Samples: For each type of paint system and each color and gloss of topcoat.

C. Product List: For each product indicated. Include printout of current "MPI Approved Products List" for each product category specified, with the proposed product highlighted.

1.4 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Paint: 5 percent, but not less than 1 gal. of each material and color applied.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to products listed in other Part 2 articles for the paint category indicated.
2.2 PAINT, GENERAL

A. MPI Standards: Provide products that comply with MPI standards indicated and that are listed in its "MPI Approved Products List".

B. Material Compatibility:

1. Provide materials for use within each paint system that are compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
2. For each coat in a paint system, provide products recommended in writing by manufacturers of top coat for use in paint system and on substrate indicated.

C. VOC Content: Provide materials that comply with VOC limits of authorities having jurisdiction.

D. Colors: As selected by Owner from manufacturer's full range.

2.3 METAL PRIMERS

A. Primer, Alkyd, Anti-Corrosive for Metal: MPI #79.

1. Akzo Nobel Paints; Devoe High Performance Coatings, Devguard 4160 Multi-Purpose Tank & Structural Primer, 4160.
2. Columbia Paint; Industrial, Brushable Metal Primer-Red, 07-022.
4. Rodda; Barrier III HS, High Solids Rust Inhibitive Metal Primer, 70 82951.
5. Sherwin-Williams; Protective & Marine, Kem Kromik Universal Primer, B50WZ1.

B. Primer, Galvanized, Water Based: MPI #134.

1. Akzo Nobel Paints; Devoe High Performance Coatings, Devflex 4020 Direct to Metal Primer & Flat Finish, 4020PF.
2. Columbia Paint; Industrial, Universal H2O Metal Primer - White, 05-550-PP.
3. PPG; PPG, Int/Ext WB Industrial Primer, 90-912.
4. Rodda; Rodda Paint, Metal Master Primer - White, 508901.

2.4 WATER-BASED PAINTS

A. Light Industrial Coating, Water Based, Gloss (Gloss Level 6): MPI #164.

1. Akzo Nobel Paints; Devoe High Performance Coatings, Devflex WB Acrylic SG Enamel, 4216L.
2. Columbia Paint; Hi-Performance, Acry-Shield Gloss Enamel, 05-260.
4. Rodda; Metal Master, W.B. Light Industrial Coatings - Gloss, 33580.
PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.

B. Verify suitability of substrates, including surface conditions and compatibility with existing finishes and primers.

C. Proceed with coating application only after unsatisfactory conditions have been corrected.
   1. Application of coating indicates acceptance of surfaces and conditions.

3.2 PREPARATION

A. Comply with manufacturer's written instructions and recommendations in "MPI Manual" applicable to substrates and paint systems indicated.

B. Clean substrates of substances that could impair bond of paints, including dust, dirt, oil, grease, and incompatible paints and encapsulants.
   1. Remove incompatible primers and reprime substrate with compatible primers or apply tie coat as required to produce paint systems indicated.

3.3 APPLICATION

A. Apply paints according to manufacturer's written instructions and recommendations in "MPI Manual."

B. Apply paints to produce surface films without cloudiness, spotting, holidays, laps, brush marks, roller tracking, runs, sags, ropiness, or other surface imperfections. Cut in sharp lines and color breaks.

3.4 CLEANING AND PROTECTION

A. Protect work of other trades against damage from paint application. Correct damage to work of other trades by cleaning, repairing, replacing, and refinishing, as approved by Buyer’s Technical Representative, and leave in an undamaged condition.

B. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.

3.5 PAINTING SCHEDULE

A. Steel Substrates:
1. Water-Based Light Industrial Coating System:
   a. Prime Coat: Approved shop primer or prime with alkyd, anti-corrosive for metal, MPI #79.
   c. Topcoat: Light industrial coating, water based, gloss (Gloss Level 6), MPI #164.

B. Galvanized-Metal Substrates:

1. Water-Based Light Industrial Coating System:
   a. Prime Coat: Shop primer specified in Section where substrate is specified or prime with alkyd, anti-corrosive for metal, MPI #134.
   c. Topcoat: Light industrial coating, water based, gloss (Gloss Level 6), MPI #164.

END OF SECTION 099113
SECTION 101400 - SIGNAGE

PART 1 - GENERAL

1.1 SUMMARY
   A. This Section includes the following:
      1. Dimensional characters.

1.2 ACTION SUBMITTALS
   A. Product Data: For each type of product indicated.
   B. Shop Drawings: Show fabrication and installation details for signs.
      1. Show sign mounting heights, locations of supplementary supports to be provided by
         others, and accessories.
      2. Provide message list, typestyles, and graphic elements.
   C. Samples: For each sign type and for each color and texture required.

PART 2 - PRODUCTS

2.1 MATERIALS
   A. Aluminum Sheet and Plate: ASTM B 209, alloy and temper recommended by aluminum
      producer and finisher for type of use and finish indicated, and with at least the strength and
      durability properties of Alloy 5005-H32.

2.2 DIMENSIONAL CHARACTERS
   A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering
      products that may be incorporated into the Work include, but are not limited to, the following:
      1. ACE Sign Systems, Inc.
      2. ASI-Modulex, Inc.
      5. Grimco, Inc.
      6. Innerface Sign Systems, Inc.
B. Cutout Characters: Provide characters with square-cut, smooth, eased edges. Comply with the following requirements:

1. Aluminum Sheet: 0.25 inch thick.
   b. Color: As selected by Owner Representative from manufacturer's full range.


2.3 ACCESSORIES

A. Anchors and Inserts: Provide nonferrous-metal or hot-dip galvanized anchors and inserts for exterior installations and elsewhere as required for corrosion resistance. Use toothed steel or lead expansion-bolt devices for drilled-in-place anchors. Furnish inserts, as required, to be set into concrete or masonry work.

2.4 FABRICATION

A. General: Provide manufacturer's standard signs of configurations indicated.

1. Conceal fasteners if possible; otherwise, locate fasteners where they will be inconspicuous.

2.5 ALUMINUM FINISHES

A. Baked-Enamel Finish: AA-C12C42R1x (Chemical Finish: cleaned with inhibited chemicals; Chemical Finish: acid-chromate-fluoride-phosphate conversion coating; Organic Coating: as specified below). Apply baked enamel complying with paint manufacturer's written instructions for cleaning, conversion coating, and painting.

1. Organic Coating: Thermosetting, modified-acrylic enamel primer/topcoat system complying with AAMA 2603 except with a minimum dry film thickness of 1.5 mils, medium gloss.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Dimensional Characters: Mount characters using standard fastening methods to comply with manufacturer's written instructions for character form, type of mounting, wall construction, and condition of exposure indicated. Provide heavy paper template to establish character spacing and to locate holes for fasteners.

1. Projected Mounting: Mount characters at projection distance from wall surface indicated.

END OF SECTION 101400
SECTION 275125 - MONITORING SYSTEM PANEL

PART 1 – GENERAL

1.1 SUMMARY

A. Technical specifications and requirements are presented for the 105-KE Reactor Interim Safe Storage (ISS) Monitoring System Panel (MSP) specified herein and in applicable contract requirements. The basic function of the MSP is to monitor the status of the Safe Storage Enclosure (SSE) key building parameters.

B. The MSP shall include a communications link for remote interrogation of monitored building parameters. The MSP shall be designed and configured to interface with an existing remote Windows® operating system based Operator Interface Computer (OIC). The OIC is configured with Human-Machine Interface (HMI) project application software to collect, display, etc., data provided by multiple (up to nine) MSP installations.

C. Communications between the MSP and the OIC will be via the internet through a wireless modem in the MSP, to be installed by this subcontractor.

D. Key building parameters that will be monitored by the MSP shall include temperature at ground level (two places), temperature at the high point, and water level in the low-point sump area.

E. The Hanford Site is located in the State of Washington. The general environmental conditions vary from -31°C to 45°C (-23°F to 113°F), and 0% to 100% relative humidity. All electronic equipment must be installed in an enclosure suitable for use in a wind-driven dust and dirt atmosphere and shall be capable of reliable operation in this environment for a minimum of 10 years.

F. Major MSP deliverables by the subcontractor unless noted otherwise are as follows:

1. Provide all equipment, materials, labor, and services to procure, fabricate, and test the MSP remote system, including Sixnet wireless modem, signal converters, power supply, and field instruments, etc.
2. AT&T SIM card shall be used in a Sixnet wireless modem for data transmission to the remote OIC. The SIM card shall be coordinated with Washington Closure Hanford.
3. Application software and project-specific programming for the MSP wireless modem.
4. Documentation of the entire MSP, software, and special licenses for the Sixnet wireless modem.
5. Testing of the MSP.

1.2 ABBREVIATIONS

ANSI American National Standards Institute.
AWG American wire gauge.
MSP Monitoring System Panel.
CHPRC CH2M Hill Plateau Remediation Company.
HMI Human-Machine Interface (a.k.a., MMI).
IEEE Institute of Electrical and Electronics Engineers.
NEC National Electrical Code.
NEMA National Electrical Manufacturers Association.
NRTL Nationally Recognized Testing Laboratories.
OIC Operator Interface Computer.
RCC River Corridor Closure.
RTD Resistance Temperature Device.
SSE Safe Storage Enclosure.
SSRS Subcontractor Submittal Requirements Summary.
UL Underwriters Laboratory.
VAC Volts Alternating Current.
WCH Washington Closure Hanford

1.3 REFERENCE DRAWINGS AND DOCUMENTS

A. Electrical and Instrumentation Drawings H-1-97170 through H-1-97175.


1.4 CODES AND STANDARDS

A. Codes, specifications, and standards listed below form a part of this technical specification to the extent indicated by the references. In the event of conflicts or discrepancies between this document and the referenced codes, specifications, or standards, the more stringent applicable requirements shall govern. Where no issue date is indicated, material will conform to the issue of the code or standard in effect at the time of material purchase by the subcontractor.

B. The enclosures and instruments specified herein shall be designed and manufactured according to the latest revision of the following codes and standards:

3. Underwriters Laboratory (UL) 508A, Standard for Industrial Control Panels.

1.5 TECHNICAL SUBMITTALS

A. All required submittals shall be submitted in accordance with the submittal requirements. The following submittals shall be submitted and approved prior to procurement, assembly, and installation.

1. Equipment used for panel fabrication if other than specified on the Material/Parts List shall have a submittal.

B. Provide the following documents/information for approval prior to the shipment of equipment:
1. Original product data for each product and component specified, and manuals supplied by original manufacturer. Product data shall identify, at a minimum, manufacturer, model number, input, output, range, and ratings.
2. Manufacturer’s recommended maintenance requirements.
3. Recommended spare parts list.

C. Warranty provisions shall be in accordance with subcontract general condition “Warranty”.

D. Red-lined, marked-up project drawings shall be submitted showing differences from the project drawings or different materials used.

E. Supplier shall warrant “all items furnished under this Purchase Order/Contract Order are genuine (i.e., not counterfeit) and match the quality, test reports, markings, and/or fitness for use required by the Purchase Order/Contract Order”. The statement shall be on supplier letterhead and signed by an authorized agent of the supplier. Any materials furnished as part of this Purchase Order/Contract Order that have been previously found to be suspect/counterfeit by the U.S. Department of Energy shall not be accepted.

PART 2 - MATERIALS AND EQUIPMENT

2.1 GENERAL

A. A MSP shall be provided for remotely monitoring key building parameters configured to interface with an existing Windows® operating system based OIC. The OIC is configured with HMI project application to collect, display, archive, etc., data provided by multiple (up to nine) MSP installations.

B. The MSP shall integrate information from field devices and transmitters, and shall transmit the information to the remote monitoring station. The MSP shall include the capability for connecting to a communications link for remote interrogation of monitored building parameters.

C. Communications between the MSP and the OIC will be via a digital Global System for Mobile communication (GSM)2 cellular telephone. The cellular modem is to be provided with an outdoor antenna and interconnecting cable. Subcontractor shall provide mounting and install to get required signal. The subcontractor shall position the antenna such that there is no interference with the received signal or the structure.

D. All materials and equipment shall be new, unused, suitable, and rated for the intended use. All electrical equipment shall be accepted, certified, listed, labeled, or otherwise determined to be safe by an OSHA-recognized NRTL label applied by the manufacturer.

E. The MSP shall be fabricated to UL 508A standards and carry a UL 508A label.

2.2 EQUIPMENT REQUIREMENTS

A. Modems, signal transmitters, power supplies, circuit breakers, fuses, terminal blocks, fittings, hardware, software, field-mounted devices, instruments, sensors, and all necessary wiring,
cabling, conduit, and miscellaneous hardware necessary for the full and complete operation of the ISS MSP shall be provided and installed by the subcontractor.

B. Enclosure for the equipment shall be a NEMA Type 4 (for outdoor use) hinged cover with an internal mounting panel.

C. Terminal blocks shall be provided in the MSP enclosure for termination of field sensor cables and 120 volts alternating current (VAC) supply power. Terminal blocks shall be of the “finger safe” type and shall have captive screws.

D. All conductors energized at 50 volts or more shall be suitably guarded, isolated, or insulated to preclude exposure to shock hazards.

2.3 APPLICATION SOFTWARE

A. Sixnet Modem operating software for programming and configuration may be required.

B. Project-specific programming is provided for future activation of additional SSE MSP installations such as this one. Coordination with CHPRC and Washington Closure Hanford personnel is required so that the new MSP may be activated.

2.4 FIELD DEVICES

A. Level Switch:

1. Electrical rating = one SPDT snap action microswitch, 5 A or greater, 250 VAC, 60Hz.
2. Minimum media specific gravity = 1.0.
3. Alarm at a minimum of 2 in. of liquid on surface to be monitored.

B. ISS Temperature Elements:

1. Sensor.
   a. Element: thin-film platinum resistance temperature device (RTD), 100 ohms at 0°C (0.00385 ohms/ohm/°C).
   b. Operating range: -50°C to + 400°C (-58°F to + 752°F).
   c. Tolerance: Class B, 3°C.
   d. Leads: three-wire single element.
   e. Response time: less than 10 seconds.

2. Sheath.
   a. Material: 304 (or better) Stainless Steel.
   b. Outside diameter: 0.125 in.
   c. Wall thickness: 0.02 in.
   d. Tip style: Air (for use in still air).
   e. Termination: Screw cover head.
   f. Mounting: Rigid steel nipple.
2.6 CONTROLS - GENERAL

A. All wiring shall be identified with permanent wire labels. Each end of each conductor shall be uniquely identified with to/from information. Conductor identification shall be included on point-to-point wiring diagrams.

B. Each device and/or component provided, installed, designed, or interfaced by the subcontractor shall be permanently labeled.

C. Each electrical/control termination point on each device and/or component shall be permanently labeled with a unique identification number.

D. Each analog and discrete instrument loop shall be provided with a fused disconnect switch on current and voltage loops and a non-fused disconnect on resistive measuring loops so that the device or loop may be removed from service for calibration or maintenance without affecting the operation of other loops.

E. The alternating current or direct current power supply to each device and/or component shall be provided with a fused disconnect for calibration and maintenance purposes.

2.7 CABLES AND COMMUNICATION LINE

A. Data transfer within the ISS shall be accomplished using the minimum wire sizes specified below:

1. Analog instrumentation shall use shielded, twisted pair armored cable, #16 AWG.
2. Digital instrument loops shall use twisted pair armored cable, #14 AWG.

2.7 ELECTRICAL ENCLOSURES

A. All equipment shall be industrial duty, NEMA Type 4 for outdoor use.

B. Enclosures shall be sized based on installed equipment, minimum clearances, and wirebending radius.

C. Enclosures shall be constructed in accordance with UL 508A requirements. Enclosures shall be painted with ANSI 49 gray enamel that is electrodeposited over cleaned, phosphatized steel.

D. All doors shall be gasketed and equipped with eyes for padlocks.

PART 3 - EXECUTION

3.1 FIELD OPERATIONS/SERVICES

A. Provide all equipment, materials, labor, and services required to procure, fabricate, and test the MSP.
3.3 TESTING AND CERTIFICATION

A. Tests and inspections shall be performed in accordance with a subcontractor prepared, contractor approved test plan to establish that all installed systems operate properly and conform to the design. Completed documentation shall be available for review by the contractor. Subcontractor testing and inspections shall verify, as a minimum, the following performance requirements:

1. Update time from digital input change of state or analog input step change until display on OIC workstation shall be 30 seconds or less.
2. Analog outputs shall fail in a full range state, and digital outputs shall fail in an alarm condition.
3. MSP shall be equipped with automatic restart capabilities for start up after restoration of normal power.

3.4 VERIFICATION OF COMPLIANCE

A. Prior to use of the MSP, submit written verification that the system complies with the specifications contained in this section, that the system has been tested to verify that it functions as intended, and that the onsite records have been completed.

3.5 QUALITY ASSURANCE/QUALITY CONTROL

A. In addition to the Supplier Quality Assurance Program requirements, the subcontractor shall submit a quality control inspection plan that identifies the inspection requirements and acceptance criteria. Inspections shall be documented on a quality control inspection plan.

B. Inspection personnel shall be qualified or certified to perform inspections as required by the design documents. Inspections shall be performed by persons other than those who performed or directly supervised the work being inspected.

END OF SECTION 275125
SECTION 311000 - SITE CLEARING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Removing existing vegetation.
   2. Clearing and grubbing.
   3. Removing above and below-grade site improvements.
   4. Disconnecting, capping or sealing site utilities.
   5. Temporary erosion-control measures.

1.2 PROJECT CONDITIONS

A. Traffic: Minimize interference with adjoining roads and other adjacent occupied or used facilities during site-clearing operations.
   1. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from Building Manager.
   2. Provide alternate routes around closed or obstructed traffic ways if required by Building Manager.

B. Salvageable Improvements: Carefully remove items indicated to be salvaged and store on site.

C. Utility Locator Service: Notify utility locator service for area where Project is located before site clearing.

D. Do not commence site clearing operations until temporary erosion-control measures are in place.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Satisfactory Soil Material: Requirements for satisfactory soil material are specified in Division 31 Section “Earth Moving”.
   1. Obtain approved borrow soil material off-site when satisfactory soil material is not available on-site.
PART 3 - EXECUTION

3.1 PREPARATION

A. Protect and maintain benchmarks and survey control points from disturbance during construction.

B. Protect existing site improvements to remain from damage during construction.
   1. Restore damaged improvements to their original condition, as acceptable to Building Manager.

3.2 TEMPORARY EROSION CONTROL

A. Provide temporary erosion-control measures to prevent soil erosion and discharge of soil-bearing water runoff or airborne dust to adjacent areas and walkways according to Site Drawings and requirements of authorities having jurisdiction.

B. Inspect, maintain, and repair erosion-control measures during construction until permanent vegetation has been established.

C. Remove erosion controls and restore and stabilize areas disturbed during removal.

3.3 EXISTING UTILITIES

A. Locate, identify, disconnect, and seal or cap utilities indicated to be removed or abandoned in place.
   1. Arrange with BTR to shut off indicated utilities.

B. Interrupting Existing Utilities: Do not interrupt utilities serving facilities unless permitted under the following conditions and then only after arranging to provide temporary utility services according to requirements indicated:
   1. Notify BTR not less than 5 days in advance of proposed utility interruptions.
   2. Do not proceed with utility interruptions without BTR’s written permission.

3.4 CLEARING AND GRUBBING

A. Remove obstructions, shrubs, and other vegetation to permit installation of new construction.

B. Fill depressions caused by clearing and grubbing operations with satisfactory soil material unless further excavation or earthwork is indicated.
   1. Place fill material in horizontal layers not exceeding a loose depth of 8 inches, and compact each layer to a density equal to adjacent original ground.
3.5  SITE IMPROVEMENTS

A. Remove existing above and below-grade improvements as indicated and necessary to facilitate new construction.

END OF SECTION 311000
SECTION 312000 - EARTH MOVING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Preparing subgrades.
   2. Excavating and backfilling for buildings and structures.
   3. Preparing subgrades and base course for crushed rock surfaces.
   4. Drainage course for concrete slabs-on-grade.
   5. Excavating and backfilling for utility trenches.

1.2 ACTION SUBMITTALS

A. Material submittals for each type of fill material used.
   1. Borrow fill gradation and soil classification laboratory report.
   2. Laboratory testing reports for Maximum Dry Density of Borrow fill material.
   3. Top Course gradation and testing report with comparison to WSDOT specifications.
   4. Base Course gradation and testing report with comparison to WSDOT specifications.
   5. Control Density Fill mix design.
   6. Tested strengths for proposed Controlled Density Fill material.
   7. Bedding course material.

B. Excavation shoring/safety plan as needed for any excavations that are at or exceed 4 feet depth and where the sides of excavations are not laid back at a 1.5 horizontal to 1.0 vertical slope ratio. Excavation design shall be stamped by a Washington state licensed engineer.

C. Excavation shoring/safety plan as needed for any excavations that exceed 20 feet. Excavation design shall be stamped by a Washington state licensed engineer.
   1. Exception: Excavations shown on the design drawings are already engineered if constructed as shown.

1.3 INFORMATION SUBMITTALS

A. Field quality control reports.
   1. Truck Trip tickets for Controlled Density Fill.
   2. Field compaction reports for subgrade and fill material.

1.4 DEFINITIONS

A. Backfill: Soil material used to fill an excavation.
1. **Initial Backfill:** Backfill placed beside and over pipe in a trench, including haunches to support sides of pipe.

2. **Final Backfill:** Backfill placed over initial backfill to fill a trench.

B. **Bedding Course:** Aggregate layer placed over the excavated subgrade in a trench before laying pipe.

C. **Borrow Soil:** Satisfactory soil imported from off-site for use as fill or backfill.

D. **Drainage Course:** Aggregate layer supporting the slab-on-grade that also minimizes upward capillary flow of pore water.

E. **Excavation:** Removal of material encountered above subgrade elevations and to lines and dimensions indicated.

   1. **Authorized Additional Excavation:** Excavation below subgrade elevations or beyond indicated lines and dimensions as directed by Buyer’s Technical Representative. Authorized additional excavation and replacement material will be paid for according to Contract provisions for changes in the Work.

   2. **Unauthorized Excavation:** Excavation below subgrade elevations or beyond indicated lines and dimensions without direction by Buyer’s Technical Representative. Unauthorized excavation, as well as, remedial work directed by Buyer’s Technical Representative, shall be without additional compensation.

F. **Fill:** Soil materials used to raise existing grades.

G. **Structures:** Buildings, footings, foundations, retaining walls, slabs, tanks, curbs, mechanical and electrical appurtenances, or other man-made stationary features constructed above or below the ground surface.

H. **Subgrade:** Uppermost surface of an excavation or the top surface of a fill or backfill immediately below drainage fill, drainage course, or topsoil materials.

I. **Utilities:** On-site underground pipes, conduits, ducts, and cables, as well as underground services within buildings.

1.5 **QUALITY ASSURANCE**

A. **Applicability of Standards:** Unless the Contract Documents include more stringent requirements, applicable construction industry standards have the same force and effect as if bound or copied directly into the Contract Documents to the extent referenced. Such standards are made a part of the Contract Documents by reference. Publication Dates: Comply with standards in effect as of date of the Contract Documents unless otherwise indicated.

B. **Pre-excavation Conference:** Conduct conference at Project site.

C. **Obtain all necessary excavation permits.**
D. All subgrade preparation, excavation, satisfactory soil preparation, fill placement, and slope stability shall be under the supervision and approval of the Geotechnical Firm. The Geotechnical Firm will be Shannon and Wilson.

PART 2 - PRODUCTS

2.1 SOIL MATERIALS

A. General: Excavated on site soil materials may be used for fill. If on site soil materials are not adequate, provide borrow soil materials from off site for general backfill needs. Locations of available Hanford pits will be provided at time of bid. Availability of satisfactory soils is up to the Contractor to verify.

B. Satisfactory Soils: Well graded pit run conforming to Soil Classification Groups GW, GP, GM, SW, SP, and SM according to ASTM D 2487, or a combination of these groups; free of rock or gravel larger than 3 inches in any dimension, debris, waste, frozen materials, vegetation, other deleterious matter, and not more than 5 percent passing a No. 200 sieve.

1. Soils from Pit 23 shall be carefully selected, screened and/or sorted to achieve specified gradation.
2. Alternate well graded soil materials up to 8 inches in any dimension may be approved by Geotechnical Firm depending on soil material, compaction equipment, number of passes, lift heights, etc.

C. Unsatisfactory Soils: Soil Classification Groups GC, SC, CL, ML, OL, CH, MH, OH, and PT according to ASTM D 2487, or a combination of these groups.

1. Unsatisfactory soils also include satisfactory soils not maintained within 2 percent of optimum moisture content at time of compaction.

D. Base Course: Base Course conforming to WSDOT M41-10 Section 9-03.9(3).

E. Top Course: Top Course conforming to WSDOT M41-10 Section 9-03.9(3).

F. Bedding Course: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D 2940; except with 100 percent passing a 1 inch sieve and not more than 8 percent passing a No. 200 sieve.

2.2 CONTROLLED DENSITY FILL (CDF)

A. Excavatable Slurry Fill / Backfill.

1. Contain a maximum of 94 lbs of cement per yard of slurry fill / backfill.
2. Minimum stable air content of 20 percent.
3. Maximum water content of 36 gallons per yard of backfill.
4. Maximum compressive strength of 150 psi at 28 days.
5. CDF shall not to be used in saturated ground conditions or standing water. Contractor shall notify Buyer’s Technical Representative if saturated ground conditions or standing water are encountered.

2.3 ACCESSORIES

A. Detectable Warning Tape: Acid and alkali-resistant, polyethylene film warning tape manufactured for marking and identifying underground utilities, a minimum of 6 inches wide and 4 mils thick, continuously inscribed with a description of the utility, with metallic core encased in a protective jacket for corrosion protection, detectable by metal detector when tape is buried up to 30 inches deep; colored to comply with local practice or requirements of authorities having jurisdiction.

B. Soil separation fabric shall be Mirafi 140N or approved equal.

PART 3 - EXECUTION

3.1 PREPARATION

A. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by earth moving operations.

B. Protect and maintain erosion and sedimentation controls during earth moving operations.

C. Protect subgrades and foundation soils from freezing temperatures and frost. Remove temporary protection before placing subsequent materials.

3.2 EXCAVATION, GENERAL

A. Unclassified Excavation: Excavate to subgrade elevations regardless of the character of surface and subsurface conditions encountered. Unclassified excavated materials may include rock, soil materials, and obstructions.

B. Prior to over-excavating, verify extents of overexcavations with geotechnical firm and BTR.

3.3 EXCAVATION FOR STRUCTURES

A. Excavate to indicated elevations and dimensions within a tolerance of plus or minus 2 inches. If applicable, extend excavations a sufficient distance from structures for placing and removing concrete formwork, for installing services and other construction, and for inspections.

1. Excavations for Footings and Foundations: Minimize disturbance to bottom of excavation. Some over excavation will likely be needed. Excavation should be trimmed out with gravel and compacted before placing foundations.
3.4 EXCAVATION FOR WALKS AND PAVEMENTS
A. Excavate surfaces under walks and pavements to indicated lines, cross sections, elevations, and subgrades taking into account base material and thickened edges as applicable.

3.5 EXCAVATION FOR UTILITY TRENCHES
A. Excavate trenches to indicated gradients, lines, depths, and elevations.

B. Excavate trenches to uniform widths to provide the following clearance on each side of pipe or conduit. Excavate trench walls vertically from trench bottom to 12 inches higher than top of pipe or conduit unless otherwise indicated.
   1. Clearance: 12 inches each side of pipe or conduit or as indicated.

C. Trench Bottoms: Excavate and shape trench bottoms to provide uniform bearing and support of pipes and conduit. Remove projecting stones and sharp objects along trench subgrade. Allow for pipe bedding as indicated or to 4 inches minimum.
   1. Excavate trenches 6 inches deeper than elevation required in rock or other unyielding bearing material, 4 inches deeper elsewhere, to allow for bedding course.

3.6 SUBGRADE INSPECTION
A. Proof-roll subgrade below the building slabs and pavements to identify soft pockets and areas of excess yielding. Do not proof-roll wet or saturated subgrades.

B. Reconstruct subgrades damaged by freezing temperatures, frost, rain, accumulated water, or construction activities, as directed by BTR, without additional compensation.

C. Test or inspect subgrade materials as required for compaction requirements as applicable.

3.7 UNAUTHORIZED EXCAVATION
A. Fill unauthorized excavation under foundations or wall footings by extending bottom elevation of concrete foundation or footing to excavation bottom, without altering top elevation. Concrete fill, with 28 day compressive strength of 2,500 psi, may be used when approved by BTR.
   1. Fill unauthorized excavations under other construction, pipe, or conduit as directed by BTR.

3.8 STORAGE OF SOIL MATERIALS
A. Stock pile borrow-soil materials and excavated soil materials without intermixing. Place, grade, and shape stockpiles to drain surface water. Cover to prevent windblown dust.
   1. Stockpile soil materials away from edge of excavations.
3.9 UTILITY TRENCH BACKFILL

A. Place backfill on subgrades free of mud, frost, snow, or ice.

B. Place and compact bedding course on trench bottoms and where indicated. Shape bedding course to provide continuous support for bells, joints, and barrels of pipes and for joints, fittings, and bodies of conduits.

C. Trenches under Footings: Backfill trenches excavated under footings and within 24 inches of bottom of footings with Controlled Density Fill (CDF); fill with concrete to elevation of bottom of footings. Concrete is specified in Division 03, Section 3000, “Cast-in-Place Concrete”.

D. Trenches under Roadways: Provide 4 inch thick, concrete-base slab support for piping or conduit less than 30 inches below surface of roadways. After installing and testing, completely encase piping or conduit in a minimum of 4 inches of concrete before backfilling or placing roadway base course. Concrete is specified in Division 03, Section 3000, “Cast-in-Place Concrete”.

E. Place Controlled Density Fill (CDF) as initial backfill of to a height of 12 inches over the pipe or conduit.

1. Coordinate backfilling with utilities testing.

F. Place and compact final backfill of satisfactory soil to final subgrade elevation.

G. Install detectable warning tape directly above utilities, 12 inches below finished grade, except 6 inches below subgrade under pavements and slabs.

3.10 SOIL FILL

A. Plow, scarify, bench, or break up sloped surfaces steeper than 1 vertical to 4 horizontal so fill material will bond with existing material.

B. Place and compact fill material in layers to required elevations as follows:

1. Under unimproved areas, use satisfactory fill material.
2. Under walks and pavements, use satisfactory fill material except where CDF is required.
3. Under steps and ramps, use satisfactory fill or CDF.
4. Under building slabs, use satisfactory fill or CDF.
5. Under footings and foundations, use satisfactory fill or CDF.

3.11 SOIL MOISTURE CONTROL

A. Uniformly moisten or aerate subgrade and each subsequent fill or backfill soil layer before compaction to within 2 percent of optimum moisture content.

1. Do not place backfill or fill soil material on surfaces that are muddy, frozen, or contain frost or ice.
2. Remove and replace, or scarify and air dry, otherwise satisfactory soil material that exceeds optimum moisture content by 2 percent and is too wet to compact to specified dry unit weight.
3.12 COMPACTION OF SOIL BACKFILLS AND FILLS

A. Place backfill and fill soil materials in layers not more than 8 inches in loose depth for material compacted by heavy compaction equipment when observation by geotechnical firm, and not more than 4 inches in loose depth for material compacted by hand-operated tampers.

B. Place backfill and fill soil materials evenly on all sides of structures to required elevations, and uniformly along the full length of each structure.

C. Compact soil materials to not less than the following percentages of maximum dry unit weight according to ASTM D 1557:

1. Under structures, and pavements, compact top 12 inches of existing subgrade and each layer of backfill or fill soil material at 95 percent.
2. Under building slabs, walkways and steps, compact top 12 inches of existing subgrade and each layer of backfill or fill soil material at 93 percent.
3. Under unpaved areas, compact top 6 inches below subgrade and compact each layer of backfill or fill soil material at 85 percent.
4. For utility trenches not under structures or pavement, compact each layer of backfill soil material at 85 percent.
5. When fill is placed and compacted in accordance with recommendations of on-site geotechnical representative(s), compaction testing is not required.
6. Some soil materials will not be testable per ASTM D1557. Testing Agency will observe soil materials, placement methodology, equipment, lifts, etc. to determine if ASTM D1557 may be used or if other methods are appropriate.

3.13 GRADING

A. General: Uniformly grade areas to a smooth surface, free of irregular surface changes. Comply with compaction requirements and grade to cross sections, lines, and elevations indicated.

B. Site Rough Grading: Slope grades to direct water away from buildings and to prevent unintended ponding. Finish subgrades to required elevations within the following tolerances:

1. Unpaved Areas: Plus or minus 1 inch.
2. Walks: Plus or minus 1/2 inch.
3. Pavements: Plus or minus 1/2 inch.

C. Grading inside Building Lines: Finish subgrade to a tolerance of 1/2 inch when tested with a 10 foot straightedge. Over excavation and trimming out excavations with gravel is anticipated.

3.14 BASE COURSES UNDER CONCRETE FOUNDATIONS, SLABS-ON-GRADE AND WALKS

A. Place base course on subgrades free of mud, frost, snow, or ice.

B. On prepared subgrade, place base course under concrete foundations, slabs-on-grade and walks as follows:
1. Shape base course to required crown elevations and cross-slope grades.
2. Place base course that exceeds 6 inches in compacted thickness in layers of equal thickness, with no compacted layer more than 6 inches thick or less than 3 inches thick.
3. Compact subgrade and base course at within 2 percent of optimum moisture content to required grades, lines, cross sections, and thickness.
4. Minimum thickness is 6”, compacted, unless otherwise indicated.
5. In lieu of base course, top course may be used.

3.15 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified geotechnical engineering testing agency to perform tests and inspections.

B. Allow testing agency to inspect and test subgrades and each fill or backfill layer. Proceed with subsequent earth moving only after test results for previously completed work comply with requirements.

C. Testing frequency:

1. For materials not testable by ASTM D1557:
   a. Testing Agency will perform full time observation of earth moving. Contractor shall comply with requirements of Testing Agency.

2. If approved by Testing Agency, for materials testable by ASTM D1557:
   a. Under Structures and Pavements: Provide 1 compaction test per lift per day for every 3,000 square feet of subgrade or fill material, minimum 3 tests per day.
   b. In trenches: Provide one compaction test per lift per day for every 150 linear feet of subgrade or fill material. Other areas: Provide 1 compaction test per lift per day for every 5,000 square feet of subgrade or fill material.

D. When testing agency reports that subgrades, fills, or backfills have not achieved degree of compaction specified, scarify and moisten or aerate, or remove and replace soil materials to depth required; re-compact and retest until specified compaction is obtained.

3.16 PROTECTION

A. Protecting Graded Areas: Protect newly graded areas from traffic, freezing, and erosion. Keep free of trash and debris.

B. Repair and reestablish grades to specified tolerances where completed, or partially completed surfaces become eroded, rutted, settled, or where they lose compaction due to subsequent construction operations or weather conditions.

C. Where settling occurs before Project correction period elapses, remove finished surfacing, backfill with additional soil material, compact, and reconstruct surfacing.

1. Restore appearance, quality, and condition of finished surfacing to match adjacent work, and eliminate evidence of restoration to greatest extent possible.
3.17 DISPOSAL OF SURPLUS AND WASTE MATERIALS

A. Remove surplus satisfactory soil and waste materials, including unsatisfactory soil, trash, and debris, and legally dispose of them only as approved.

END OF SECTION 312000
January 30, 2012

Mr. Paul Giever, PE  
Meier Architecture Engineering, Inc.  
8697 Gage Boulevard  
Kennewick, Washington 99336

RE: GEOTECHNICAL ENGINEERING STUDY; 105-KE REACTOR OVERBUILD, HANFORD NUCLEAR RESERVATION, WASHINGTON

Dear Mr. Giever:

Shannon & Wilson, Inc. prepared this letter report for the 105-KE Reactor Overbuild on the Hanford Nuclear Reservation, Washington. The purpose of this letter report is to present a subsurface conditions review summary and provide earthwork, foundation, lateral earth pressure, and subgrade modulus recommendations, and current seismic design criteria.

To prepare this letter report, Shannon & Wilson, Inc.:

- Discussed the proposed site improvements with Mr. Paul Giever, PE of Meier Architecture Engineering (Meier);
- Reviewed the preliminary plans and specifications Section 312000 – Earth Moving, dated November 2011;
- Attended project meetings CH2M HILL Plateau Remediation Company (CHPRC) and Meier on January 13 and 26, 2012 at Meier’s office;
- Attended a project meeting on-site with CHPRC and FE&C to review existing conditions and potential import source Pit 23 on January 17, 2012;
- Reviewed project area geologic maps;
- Reviewed local well logs from the Washington State Department of Ecology’s well database; and
- Reviewed Shannon & Wilson, Inc. files of local projects.

Shannon & Wilson, Inc. prepared this letter report for Meier for the 105-KE Reactor Overbuild design and construction. Do not use or rely upon this letter report for other locations or purposes without the written consent of Shannon & Wilson, Inc.
PROJECT LOCATION AND DESCRIPTION

The project site is located at the 105-KE Reactor building, 100 East Area, Hanford Nuclear Reservation, Washington. The Columbia River flows southwest to northeast about 2,000 feet northwest of the project site. The 100 B & C area is about 3 miles southwest of the site, and the 100 N area is about 2 miles northeast. The State Route (SR) 240 Vernita Bridge crosses the Columbia River about 6½ miles west of the site. We show the approximate site location in Figure 1, Vicinity Map.

The 105-KE Reactor produced weapons-grade plutonium from about 1955 to 1971. Most of the facilities were deactivated when operations were halted. Subsequent environmental studies concluded that operations, disposal practices, spills, and unplanned releases resulted in contamination of facility structures and underlying soil and groundwater in the 100 Area.

CHPRC is carrying out the 105-KE Reactor Decommissioning as set in motion by the 1992 Record of Decision (ROD): Decommissioning of Eight Surplus Production Reactors at the Hanford Site, Richland, Washington. (58 FR 48509) The 1992 ROD allowed for an approximately 75-year interim safe storage (ISS) of the reactor, followed by reactor removal to Hanford’s Environmental Restoration Disposal Facility (ERDF). Later, technological advances necessitated the US Department of Energy (DOE) to reconsider the ISS for short-term dismantlement, removal, and disposal. In 2009, DOE issued the “Engineering Evaluation/Cost Analysis for 105-KE Reactor Decommissioning” (EE/CA) to satisfy environmental requirements for the alternatives analysis. The EE/CA concludes that Alternative 4, immediate reactor dismantlement and waste transport to ERDF, is the preferred option. Beyond meeting the Environmental Protection Agency (EPA) criteria, the EE/CA states that Alternative 4 “…immediate removal of the reactor facilitates CERCLA response actions at nearby soil remediation sites that cannot, due to structural stability issues, be completed while the reactor structure remains.”

Meier is preparing plans to construct an ISS facility over the remaining reactor building. Shannon & Wilson discussed the proposed ISS facility with Meier and reviewed the 30 Percent Plans, as provided by Meier in an email dated November 30, 2011. Meier indicates the ISS
facility will be constructed upon a minimum 23 feet of import fill due to contaminated soil remediation efforts. The underlying soils (below the proposed 23-foot import material fill) are contaminated, which restricts the construction means, methods, and efforts.

On January 17, 2012, Shannon & Wilson observed remediation fill placement efforts at the north 105-KE Reactor Building side. Mr. Wayne Smith (FE&C, remediation earthwork contractor) indicated the 8 to 14-foot-thick fill pad was loosely placed in about 2 to 4-foot-thick lifts. Mr. Smith operated an excavator from the fill pad for an unknown period of time. The fill pad exhibited loose, non-uniform side slopes with occasional large cobbles. We observed loose particles on the fill side slopes and signs that side slope material may occasionally ravel, or experience minor sloughing, indicating a relatively loose placement.

An ISS facility containment structure will be constructed over the remaining Reactor building portions. The Meier plans indicate the ISS facility footprint extends beyond the original footprint about 6.1 meters and slopes down at about 1½:1H:1V inclination to native grades. We show the work area and proposed excavation limits in Figure 2, Site Plan.

**SITE DESCRIPTION AND SUBSURFACE CONDITIONS**

**Surface Conditions**

The 105-KE Reactor area has undergone extensive contaminated soil remediation efforts to date. Under contract to CHPRC, FE&C completed large quantity contaminated soil excavation and disposal. FE&C also constructed an uncontrolled/undocumented fill pad along the south Reactor building side to shield their equipment and personnel from the underlying radiation contaminants. The constructed fill pad has relatively steep side slopes (possibly about 1H:1V) and exhibits raveling and/or sloughing of granular particles. Based on the material raveling and/or sloughing, we estimate the fill is moderately loosely placed.

Original backfill and/or native material excavations exhibit steep cut slopes (probably about 1H:1V) with few loose particles. Deeper excavations typically have about 1- to 2-foot-wide benches about mid-slope.
General Site Geology

Based on the Geologic Map of the Priest Rapids 1:100,000 Quadrangle, Washington (Reidel 1994),¹ the project site lies at or near the mapped contact between the Pleistocene age (approximately 13,000 years old) outburst flood gravels (Qfg3) and sands and gravels of the youngest outburst flood deposits (Qfg4). The publication indicates that Qfg4 “…actual grain sizes range from fine sediments to boulders.” The publication indicates the Qfg4 geologic unit mainly consists of reworked Qfg3, or “…outburst flood gravels with beds of fine sediment….”

Generalized Subsurface Conditions

Based on our review of existing information and understanding of site work to date, we anticipate subsurface conditions near the 105-KE Reactor will consist of the generalized soil units in Table 1 below.

<table>
<thead>
<tr>
<th>Estimated Depth (feet)</th>
<th>Generalized Soil Unit Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Upper</td>
<td>Lower</td>
</tr>
<tr>
<td>0</td>
<td>12 to 15</td>
</tr>
<tr>
<td>12 to 15</td>
<td>24 to 30</td>
</tr>
<tr>
<td>24 to 30</td>
<td>~ 50</td>
</tr>
<tr>
<td>&gt; ~50</td>
<td>Outburst Sand and Gravel: Medium dense to very dense, slightly silty to silty, sandy GRAVEL to gravelly SAND with potential cobbles to boulders.</td>
</tr>
</tbody>
</table>

Groundwater

Local well logs\(^2\) indicate the groundwater table is approximately 50 to 75 feet bgs. We anticipate the local groundwater elevations are slightly higher than the Columbia River level, but likely influenced by river fluctuations relative to the affected hydraulic gradient. The Columbia River experiences seasonal fluctuations with the highest levels typically occurring in the late winter to late spring from upper drainage system runoff.

**RECOMMENDATIONS**

Prior to the recent contaminant remediation efforts, we anticipate the site consisted of approximately 50 feet of fill, or more, dating back to the original Reactor construction. The remediation efforts removed materials on the Reactor building north, east, and west sides to about 24 feet bgs, or greater. On the north Reactor building side, the remediation contractor placed about 8 to 14 feet of uncontrolled/undocumented fill to shield the equipment and personnel from contaminants below. The current site topography is shown in Figure 2, Site Plan.

Engineered fill will be constructed almost throughout the proposed improvement foundation areas to about 15 to 24 feet (or greater) bgs; portions on the Reactor south side may require less fill. We anticipate the import materials will consist of sandy GRAVEL to gravelly SAND with minor fines contents, likely from local quarry Pit 23. The import material gradations will widely vary based on the quarry location (i.e., depth and lateral distribution).

The proposed structure may be constructed on conventional foundations (i.e., spread and continuous footings) **provided the uncontrolled/undocumented fill is mitigated to reduce potential settlements.** Meier indicates spread footings may be founded about 4 feet below adjacent grades. Shannon & Wilson should observe earthwork on a nearly full-time basis to document contractor means and methods and complete field testing of the foundation supporting materials. We provide earthwork, foundation, lateral earth pressures, subgrade modulus, and current seismic design criteria recommendations below.

Subsurface explorations to support our engineering analyses and recommendations were not desirable due to the known contaminated soil conditions. Therefore, Shannon & Wilson anticipates geotechnical engineering recommendations will be evaluated by the geotechnical

engineer at or during construction for design review. Our design recommendations are not valid without Shannon & Wilson’s field review.

**Earthwork**

Surface vegetation, topsoil, and any other deleterious materials must be stripped within the proposed Overbuild structure footprint and all areas to receive structural fill, including a minimum 10 feet beyond exterior foundations or a 1 Horizontal to 1 Vertical (H:1V) slope plus five feet, whichever is greater. The stripped materials are not suitable for use in engineered fill.

Remove the uncontrolled/undocumented fill to a minimum two foundation widths plus two feet below the footing elevations. The removed material may be used in controlled fill construction.

Prior to fill placement on cut ground surfaces, remove loose or disturbed soil and debris. Scarify the exposed soil surface to a minimum 12 inches deep. Moisture condition the scarified subgrade soils to within 2 percent of optimum, then compact to a minimum in-place dry density of 93 percent of the Modified Proctor maximum dry density, as determined by ASTM International (ASTM) Designation: D 1557, *Laboratory Compaction Characteristics of Soil Using Modified Effort*.

Our experience indicates large vibratory-type compactors (e.g., vibratory roller) are preferable for the anticipated granular soils. Vibratory-type equipment should be operated at a maximum 1½ miles per hour (mph). The Contractor may elect performance testing to request increased compaction equipment speed. Increased compaction equipment speeds shall be approved only by the geotechnical engineer.

Fill should be free of debris, organic material, and any other deleterious material. We recommend using a well-graded, 3-inch minus, pit-run sand and gravel with less than 5 percent fines, or crushed rock for structural fill, except where noted. Shannon & Wilson, Inc. should review and approve material for import prior to transporting to the site.

Moisture condition fill material to within 2 percent of optimum and place in maximum 8-inch-thick, horizontal, loose lifts. Compact the fill to a minimum in-place dry density of 95 percent of ASTM D 1557 maximum laboratory dry density. Typically, five to eight passes will be required. Lift thicknesses may be adjusted by the geotechnical engineer based on construction observation and performance testing.
Hand-operated compaction equipment only should be allowed within 3 feet of below-grade structures. Place fill within hand-operated compaction equipment areas in maximum 4-inch-thick loose lifts.

Local quarry sources may contain aggregate greater than approximately 6 to 8 inches, which may be acceptable for structural fill with the proper compaction and testing procedures, provided the material is well graded. Typical in-place density testing procedures may not apply to coarse gravels, depending on coarse aggregate quantity and size, gradation, and fines content. Additionally, Pit 23 material gradations may vary significantly, which poses significant challenges to typical nuclear density field testing. In such cases, a performance specification shall be determined in the field by the geotechnical engineer. Generally, we recommend placing gravely materials in 6- to 8-inch-thick maximum, horizontal, loose lifts, depending on the actual particle sizes and available compaction equipment. Using heavy vibratory-type equipment, compact each lift with steady, uniform passes until a non-yielding state is achieved. Typically, eight or more passes will be required.

**Temporary Excavations/Slopes**

Based on our subsurface conditions review, we characterize the anticipated silty, sandy, gravelly site soils as Occupational Safety and Health Administration Type C with maximum temporary slopes of 1½H:1V. The Contractor is responsible for the temporary excavation slope and the safety of all temporary excavations based on exposed ground conditions.

**Shallow Foundations**

The proposed structure can be supported on conventional foundations bearing on compacted crushed gravel placed over the prepared subgrade (i.e., engineered fill). The crushed gravel shall consist of a minimum 6 to 8-inch-thick layer of ¾-inch-minus crushed rock (or similar). Crushed gravel placed beneath footings should extend a minimum 6 inches beyond the footings on both sides and then slope at 1H:1V. Prepare the subgrade and place granular structural fill according to the above “Earthwork” recommendations.

Embed continuous strip and isolated footings a minimum 30 inches below adjacent grades for frost protection and bearing considerations. Use minimum 24-inch-wide continuous and spread footings. Footings constructed in accordance with the above recommendations may be designed using Figure 3, Bearing Resistance Versus Footing Width (which assumes a minimum footing
depth of 4 feet). The allowable bearing pressure may be increased by one-third for short-term, transient loading conditions (i.e., seismic and/or wind loads).

We anticipate foundation settlements may control footing design, as opposed to the allowable or ultimate bearing resistances. We plot 1-inch settlement limited bearing resistance curves on Figure 3, along with the ultimate and allowable bearing resistances. In general, the depth of influence below the footing bottom increases as the footing size increases. The zone of influence is typically considered equal to two foundation widths below the footing bottom. We assume there is no stress overlap from adjacent footings. Footings located less than two times the footing width (2B) from each other will increase stresses beneath the adjacent footing, resulting in increased settlement. We expect elastic settlements to generally occur as loads are applied.

Clean debris and loose or disturbed soil from footing excavations prior to placing structural fill and/or concrete. Slope the ground surface away from the exterior footings to direct water away and prevent ponding next to the footings.

Lateral loads acting on the footings may be resisted by passive earth pressures acting against the footing sides and friction forces on the footing bottoms. For lateral displacement design of compacted, level backfill, use an ultimate passive resistance of 275 psf per foot of embedment depth at depths greater than 2 feet below adjacent grades. Use a maximum 0.45 friction coefficient for footings placed on crushed rock.

**Subgrade Modulus**

We anticipate crane pads with crushed rock underlayment may be designed using a Modulus of Subgrade Reaction, $k_s$, of 200 pounds per cubic inch (pci). Alternatively, we anticipate crane pads may be designed with an increased $k_s$ provided construction field testing consisting of plate load tests around potential crane pad areas. We anticipate increased $k_s$ values may range from about 250 to 400 pci based on our testing experience at other Hanford locations and anticipated import material gradations.

**Below-grade and Retaining Structures**

In Table 2 below, we provide equivalent fluid weights for lateral earth pressure design of below-grade and/or retaining wall structures. We assume that the structural wall backfill is adequately drained to avoid saturation and introduction of hydrostatic pressures. For calculation of active
pressures, we assume that the wall can deflect in order to develop an active condition. Use at-rest pressures for restrained or braced walls.

**TABLE 2**

**LATERAL EARTH PRESSURES**

<table>
<thead>
<tr>
<th>Wall Condition</th>
<th>Drained Equivalent Fluid Weight (pcf)</th>
</tr>
</thead>
<tbody>
<tr>
<td>At-rest</td>
<td>55</td>
</tr>
<tr>
<td>Active</td>
<td>35</td>
</tr>
</tbody>
</table>

Note:
pcf = pounds per cubic foot

If surface loads are closer than one-half of the wall height to the edge of the below-grade and/or retaining wall, increase the design wall pressure by \( q/2 \) over the whole area of the retaining wall. In this expression, \( q \) is the surface surcharge load in psf. Shannon & Wilson, Inc. should review anticipated surcharge loading to confirm that the appropriate design values are considered.

A uniform surface load of 200 to 300 psf is often used to approximate construction and vehicle loading on below-grade and/or retaining walls. However, these values should be reviewed by the designer to determine if they are adequate based on anticipated loads. To evaluate surcharge loads, use coefficients of active and at-rest lateral earth pressures, \( k_a \) and \( k_o \), equal to 0.31 and 0.47, respectively.

Retaining structures should include adequate back drainage to avoid buildup of hydrostatic pressures. Positive drainage for retaining walls should consist of a vertical layer of permeable material, such as a graded sand and gravel, pea gravel, or crushed rock (typically \( \frac{1}{2} \)- to \( \frac{3}{4} \)-inch crushed), at least 18 inches thick, positioned between the retaining wall and the backfill.

We recommend placing a nonwoven filter fabric (e.g., Mirafi 140N or equivalent) between the drainage material and the general backfill to prevent fines from migrating into the drainage material.

**Seismic Design Criteria**

Based on our subsurface conditions review, and in accordance with the 2009 International Building Code (IBC), we anticipate the constructed soil profile will likely be most consistent
with Site Class D (stiff soil profile). We present the recommended seismic design parameters, in accordance with the current IBC, in Table 3.

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Description</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>$S_v$</td>
<td>Spectral Response Acceleration for Short Periods</td>
<td>0.460g</td>
</tr>
<tr>
<td>$S_l$</td>
<td>Spectral Response Acceleration at 1-second Period</td>
<td>0.147g</td>
</tr>
<tr>
<td>$F_o$</td>
<td>Site Coefficient</td>
<td>1.432</td>
</tr>
<tr>
<td>$F_v$</td>
<td>Site Coefficient</td>
<td>2.211</td>
</tr>
<tr>
<td>$S_{MS}$</td>
<td>Adjusted MCE Spectral Response Acceleration for Short Periods</td>
<td>0.659g</td>
</tr>
<tr>
<td>$S_{ML}$</td>
<td>Adjusted MCE Spectral Response Acceleration at 1-second Period</td>
<td>0.326g</td>
</tr>
<tr>
<td>$S_{DS}$</td>
<td>Design Spectral Response Acceleration for Short Periods</td>
<td>0.440g</td>
</tr>
<tr>
<td>$S_{DL}$</td>
<td>Design Spectral Response Acceleration at 1-second Period</td>
<td>0.217g</td>
</tr>
</tbody>
</table>

Notes:
g = gravity
MCE = Maximum Considered Earthquake

**LIMITATIONS**

This letter report was prepared for the exclusive use of Meier Architecture Engineering and their team for specific application to the design and construction of the 105-KE Reactor Overbuild project as it relates to the geotechnical aspects discussed herein. Its purpose is to provide information on factual data only; it should not be construed as a warranty of subsurface conditions, such as those interpreted from the available well logs and subsurface conditions discussions in this letter report.

The analyses, conclusions, and recommendations contained in this letter report are based upon site conditions as they presently exist. We further assume that the assumed soil conditions are representative of the subsurface conditions throughout the site; that is, the subsurface conditions everywhere are not significantly different from those assumed from our data review. No
subsurface explorations were performed for this letter report. The design and construction recommendations contained within this letter report are not valid without Shannon & Wilson's construction phase review of site conditions for potential impacts to our recommendations.

Within the limitations of scope, schedule, and budget, the conclusions and recommendations presented in this letter report were prepared in accordance with generally accepted professional geotechnical and geological principles and practice in this area at the time this letter report was prepared. We make no other warranty, either expressed or implied.

Our scope of services did not include an evaluation regarding the presence or absence of wetlands, or an evaluation regarding the presence or absence of hazardous or toxic materials in the soil, surface water, groundwater, or air on or below or around this site. If such contamination exists, it would not be possible to determine it within this limited scope of work.

Shannon & Wilson, Inc. prepared the enclosed “Important Information About Your Geotechnical/Environmental Report” to assist you and others in understanding the use and limitations of our reports.

Sincerely,

SHANNON & WILSON, INC.

Clinton A. Wilson, P.E.
Principal Engineer

CAW:LJR:DJB/caw

Enc:  Figure 1 – Vicinity Map
      Figure 2 – Site Plan
      Figure 3 – Bearing Resistance Versus Footing Width
      Important Information About Your Geotechnical/Environmental Report
NOTES

1. We recommend using the following safety factors for Allowable Strength Design of footings; the plotted resistances use the bearing capacity safety factors.

<table>
<thead>
<tr>
<th>Limit State</th>
<th>Sliding Shear</th>
<th>Passive Press.</th>
<th>Bearing Capacity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Settlement Limited</td>
<td>N/A</td>
<td>N/A</td>
<td>1.0</td>
</tr>
<tr>
<td>Allowable</td>
<td>0.8</td>
<td>0.5</td>
<td>0.333</td>
</tr>
<tr>
<td>Ultimate</td>
<td>1.0</td>
<td>1.0</td>
<td>1.0</td>
</tr>
</tbody>
</table>

2. The bearing resistances are based on a soil friction angle of 33 degrees, a soil cohesion of 0 psf, a total unit weight of 125 psf, a Poisson's ratio of 0.2, and a soil elastic modulus of 260 ksf. We assume the bottom of the footing is 4 feet below the ground surface.

3. psf - pounds per square foot;pcf - pounds per cubic foot; ksf - kips per square foot (1 kip = 1000 pounds)
IMPORTANT INFORMATION ABOUT YOUR GEOTECHNICAL/ ENVIRONMENTAL REPORT

CONSULTING SERVICES ARE PERFORMED FOR SPECIFIC PURPOSES AND FOR SPECIFIC CLIENTS.

Consultants prepare reports to meet the specific needs of specific individuals. A report prepared for a civil engineer may not be adequate for a construction contractor or even another civil engineer. Unless indicated otherwise, your consultant prepared your report expressly for you and expressly for the purposes you indicated. No one other than you should apply this report for its intended purpose without first conferring with the consultant. No party should apply this report for any purpose other than that originally contemplated without first conferring with the consultant.

THE CONSULTANT’S REPORT IS BASED ON PROJECT-SPECIFIC FACTORS.

A geotechnical/environmental report is based on a subsurface exploration plan designed to consider a unique set of project-specific factors. Depending on the project, these may include: the general nature of the structure and property involved; its size and configuration; its historical use and practice; the location of the structure on the site and its orientation; other improvements such as access roads, parking lots, and underground utilities; and the additional risk created by scope-of-service limitations imposed by the client. To help avoid costly problems, ask the consultant to evaluate how any factors that change subsequent to the date of the report may affect the recommendations. Unless your consultant indicates otherwise, your report should not be used: (1) when the nature of the proposed project is changed (for example, if an office building will be erected instead of a parking garage, or if a refrigerated warehouse will be built instead of an unrefrigerated one, or chemicals are discovered on or near the site); (2) when the size, elevation, or configuration of the proposed project is altered; (3) when the location or orientation of the proposed project is modified; (4) when there is a change of ownership; or (5) for application to an adjacent site. Consultants cannot accept responsibility for problems that may occur if they are not consulted after factors which were considered in the development of the report have changed.

SUBSURFACE CONDITIONS CAN CHANGE.

Subsurface conditions may be affected as a result of natural processes or human activity. Because a geotechnical/environmental report is based on conditions that existed at the time of subsurface exploration, construction decisions should not be based on a report whose adequacy may have been affected by time. Ask the consultant to advise if additional tests are desirable before construction starts; for example, groundwater conditions vary seasonally.

Construction operations at or adjacent to the site and natural events such as floods, earthquakes, or groundwater fluctuations may also affect subsurface conditions and, thus, the continuing adequacy of a geotechnical/environmental report. The consultant should be kept apprised of any such events, and should be consulted to determine if additional tests are necessary.

MOST RECOMMENDATIONS ARE PROFESSIONAL JUDGMENTS.

Site exploration and testing identifies actual surface and subsurface conditions only at those points where samples are taken. The data were extrapolated by your consultant, who then applied judgment to render an opinion about overall subsurface conditions. The actual interface between materials may be far more gradual or abrupt than your report indicates. Actual conditions in areas not sampled may differ from those predicted in your report. While nothing can be done to prevent such situations, you and your consultant can work together to help reduce their impacts. Retaining your consultant to observe subsurface construction operations can be particularly beneficial in this respect.
A REPORT'S CONCLUSIONS ARE PRELIMINARY.

The conclusions contained in your consultant's report are preliminary because they must be based on the assumption that conditions revealed through selective exploratory sampling are indicative of actual conditions throughout a site. Actual subsurface conditions can be discerned only during earthwork; therefore, you should retain your consultant to observe actual conditions and to provide conclusions. Only the consultant who prepared the report is fully familiar with the background information needed to determine whether or not the report's recommendations based on those conclusions are valid and whether or not the contractor is abiding by applicable recommendations. The consultant who developed your report cannot assume responsibility or liability for the adequacy of the report's recommendations if another party is retained to observe construction.

THE CONSULTANT'S REPORT IS SUBJECT TO MISINTERPRETATION.

Costly problems can occur when other design professionals develop their plans based on misinterpretation of a geotechnical/environmental report. To help avoid these problems, the consultant should be retained to work with other project design professionals to explain relevant geotechnical, geological, hydrogeological, and environmental findings, and to review the adequacy of their plans and specifications relative to these issues.

BORING LOGS AND/OR MONITORING WELL DATA SHOULD NOT BE SEPARATED FROM THE REPORT.

Final boring logs developed by the consultant are based upon interpretation of field logs (assembled by site personnel), field test results, and laboratory and/or office evaluation of field samples and data. Only final boring logs and data are customarily included in geotechnical/environmental reports. These final logs should not, under any circumstances, be redrawn for inclusion in architectural or other design drawings, because drafters may commit errors or omissions in the transfer process.

To reduce the likelihood of boring log or monitoring well misinterpretation, contractors should be given ready access to the complete geotechnical engineering/environmental report prepared or authorized for their use. If access is provided only to the report prepared for you, you should advise contractors of the report's limitations, assuming that a contractor was not one of the specific persons for whom the report was prepared, and that developing construction cost estimates was not one of the specific purposes for which it was prepared. While a contractor may gain important knowledge from a report prepared for another party, the contractor should discuss the report with your consultant and perform the additional or alternative work believed necessary to obtain the data specifically appropriate for construction cost estimating purposes. Some clients hold the mistaken impression that simply disclaiming responsibility for the accuracy of subsurface information always insulates them from attendant liability. Providing the best available information to contractors helps prevent costly construction problems and the adversarial attitudes that aggravate them to a disproportionate scale.

READ RESPONSIBILITY CLAUSES CLOSELY.

Because geotechnical/environmental engineering is based extensively on judgment and opinion, it is far less exact than other design disciplines. This situation has resulted in wholly unwarranted claims being lodged against consultants. To help prevent this problem, consultants have developed a number of clauses for use in their contracts, reports and other documents. These responsibility clauses are not exculpatory clauses designed to transfer the consultant's liabilities to other parties; rather, they are definitive clauses that identify where the consultant's responsibilities begin and end. Their use helps all parties involved recognize their individual responsibilities and take appropriate action. Some of these definitive clauses are likely to appear in your report, and you are encouraged to read them closely. Your consultant will be pleased to give full and frank answers to your questions.

The preceding paragraphs are based on information provided by the ASFE/Association of Engineering Firms Practicing in the Geosciences, Silver Spring, Maryland