# ADAPTHUAS

FLEXIBLE, SUSTAINABLE, AFFORDABLE

## Project Manual

## U.S. DEPARTMENT OF ENERGY SOLAR DECATHLON 2020

## ADAPTHAUS, TEAM ILLINOIS

Team Contact Information

| | | |
|---|---|---|
| Faculty Advisor : | Xinlei Wang | xwang2@illinois.edu |
| Project Manager : | Mayur Mistry | mmistry2@illinois.edu |
| President : | Jonah Messinger | jonahfm2@illinois.edu |
| Architecture Lead : | Akshay Srinivas | akshays5@illinois.edu |
| Construction Manager : | Chris Meilinger | cam11@illinois.edu |
| Health and Safety Officer : | Luke Lundstrum | lr2@illinois.edu |


## D4: Construction Specifications

## November 5th, 2019

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# Division 01 General

# SECTION 01 32 00
# CONSTRUCTION PROGRESS DOCUMENTATION

## PART 1 - GENERAL

### 1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections apply to this Section.

### 1.2 SUMMARY

A. Section includes administrative and procedural requirements for documenting the progress of construction during performance of the Work, including the following:

1. Daily construction reports.
2. Material and equipment delivery status reports.

B. Related Sections:

1. Division 01 Section “Construction Progress Schedule”.
2. Division 01 Section "Submittal Procedures" for submitting schedules and reports.
3. Division 01 Section "Quality Requirements" for submitting a schedule of tests and Inspections.

## PART 2 - PRODUCTS

### 2.1 REPORTS

A. Daily Construction Reports: Prepare a daily construction report recording the following information concerning events at Project site:

1. List of subcontractors at Project site.
2. List of separate contractors at Project site.
3. Approximate count of personnel at Project site, by trade and subcontractor.
4. Equipment at Project site.
5. Material deliveries.
6. High and low temperatures and general weather conditions, including the presence of rain or snow.
7. Accidents.
8. Meetings and significant decisions.
9. Unusual events (refer to special reports).
10. Stoppages, delays, shortages, and losses.
11. Orders and requests of authorities having jurisdiction.
12. Change Orders received and implemented.
13. Construction Change Directives received and implemented.

14. Services connected and disconnected.
15. Equipment or system tests and startups.
16. Partial completions and occupancies.
17. Substantial Completions authorized.

**PART 3 EXECUTION**

A. General: Take photographs using the maximum range of depth of field, and that are in focus, to clearly show the Work. Photographs with blurry or out-of-focus areas will not be accepted.

    1. Maintain key plan with each set of construction photographs that identifies each photographic location.

B. Digital Images: Submit digital images exactly as originally recorded in the digital camera, without alteration, manipulation, editing, or modifications using image-editing software.
C. Pre-Construction Photographs: Before starting construction take photographs of Project site and surrounding properties, including existing items to remain during construction, from different vantage points to accurately record physical conditions at the start of construction, and as required to record settlement or cracking of adjacent structures, pavements, and improvements.

    1. Photographs are to be used to ensure repair of site to original condition if damaged as a result of construction.
    2. Copies of photos shall be turned over to the Design-Builder.

D. Periodic Construction Photographs: Take a sufficient number of photographs to adequately describe sequence of construction through completion. Select vantage points to show status of construction and progress since last photographs were taken.

**END OF SECTION 01 32 00**

**SECTION 01 74 00**
**CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL**

## PART 1 - GENERAL

A. A Construction Waste Management Plan shall be developed and submitted to and approved by the Construction Manager and the Project Manager prior to commencement of the Work. This Plan shall include measures for diverting at least 99 % of materials from the landfill for composting, recycling or reuse. This Plan shall identify collection locations for various waste streams at the Construction Site.
B. A Construction Waste Management Plan shall be submitted by each supplier of materials that constitute more than 5% of the Work by weight or value. These Plans shall identify measures taken by the supplier to divert materials from the landfill.

## PART 2 – PRODUCTS – NOT USED

## PART 3 - EXECUTION – NOT USED

**END OF SECTION 01 74 00**

**SECTION 01 81 00**
**SUSTAINABLE CERTIFICATION DOCUMENTATION**

## PART 1 - GENERAL

A. The Project Manager, Construction Manager and Project Architect shall review the documentation requirements for the LEED v4 BD+C: Homes and Multifamily Low-rise certification system and shall try to identify measures to meet all prerequisites and sufficient credits to achieve a Platinum level of certification. All documentation requirements normally associated with LEED certification at this level shall be provided during the Construction, assembly, operation and disassembly of the Work and Competition.
B. The Project Manager, Construction Manager and Project Architect shall review the documentation and compliance requirements for Full Certification under the International Living Future Institute's (ILFI's) Living Building Challenge and Living Product Challenge systems. All documentation requirements normally associated with LBC and LPC Certification shall be provided during the Construction, assembly, operation and disassembly of the Work and Competition.
C. For each product and material used in the work, the manufacturers shall provide either: a) a comprehensive list of constituent chemicals sufficiently detailed to verify compliance with the ILFI Red List OR b) an ILFI Declare label for the product or material.

## PART 2 – PRODUCTS – NOT USED

## PART 3 - EXECUTION – NOT USED

**END OF SECTION 01 81 00**

# Division 03 Concrete

# SECTION 03 10 00
# CONCRETE FORMWORK

## PART 1- GENERAL

### 1.1 GENERAL

A. Work of this Section shall conform to the requirements of Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification sections.

### 1.2 SCOPE

A. Provide all labor, materials, equipment, services and transportation for formwork and related accessories required to complete all cast-in-place concrete work as shown on Drawings, as specified herein, and as required by the job conditions.

### 1.3 RELATED WORK SPECIFIED IN OTHER SECTIONS

A. See below for related work:

| | |
|---|---|
| Concrete Reinforcement and Embedded Assemblies | Section 032000 |
| Cast-in-Place Concrete | Section 033000 |
| Thermal and Moisture Protection | Division 7 |

### 1.4 CODES AND STANDARDS

A. Building Code: Concrete work shall conform to the requirements of the Building Code identified on the Structural General Notes, and OSHA requirements, except where more stringent conditions or criteria occur in the standards referenced below and on the Drawings.

B. Standards:

1. ACI 117 – Standard Specifications for Tolerances for Concrete Construction and Materials.
2. ACI 237 – Self Consolidating Concrete.
3. ACI 301 –Specifications for Structural Concrete.
4. ACI 318 – Building Code Requirements for Structural Concrete and Commentary.
5. ACI 347 – Guide to Formwork for Concrete.

### 1.5 SUBMITTALS

A. Required Submittals - Where the SUBMITTALS section of this Specification is in conflict with Division 1 Submittals, the more stringent requirements for the Contractor apply. Required submittal items are listed here; see below for detailed requirements.

1. **Shop Drawings**:

a. Submit for action: Formwork shop drawings sealed and signed by a Structural Engineer licensed in the state where the project is located. Shop drawings shall clearly indicate but not be limited to the following:

   i. Size, type and quality of form materials including conditions at tops and ends of walls. (If wood is used, indicate species.)
   ii. Form finish clearly indicating proper locations and full coordination with concrete finishes required by Contract Documents.
   iii. Layout, procedures, and sequencing of shoring and reshoring that correlates with the information contained in the shoring/reshoring calculations described below.

2. **Product Data**: Submit for action copies of manufacturers' product data and installation instructions for proprietary materials used in exposed concrete work, including form liners, release agents, manufactured form systems, ties, and accessories.
3. **Samples**: At request of Architect, submit for record samples of form ties and spreaders.
4. **Compatibility Certification**: Submit for record a written statement certifying that form release agent used is compatible with subsequent architectural finish materials applied to concrete surfaces. Submit along with manufacturer's data.
5. **Hazardous Materials Notification**: Submit for record. In the event no product or material is available that does not contain hazardous materials as determined by the Owner, a "Material Safety Data Sheet" (MSDS) equivalent to OSHA Form 20 shall be submitted for that proposed product or material prior to installation.

## 1.6 FORMWORK DESIGN

A. Design of Formwork, Shoring/Reshoring, and its removal is the Contractor's responsibility.
B. Design, erect, support, brace and maintain formwork so that it will safely support vertical and lateral loads per SEI/ASCE 37-02 that might be applied, until such loads can be supported by the concrete structure.
C. Design Requirements:

   1. Forms shall be designed for fabrication and erection in accordance with Design Professionals' requirements and recommendations of ACI 301, 318 and 347, and International Residence Code 2015.
   2. Design formwork in a manner such that the total construction load does not at any time exceed the total design load of new or existing construction and accounts for concrete age and relative strength at time of loading. See Section 3.2 for shoring/reshoring requirements.
   3. Design formwork for loads and lateral pressures outlined in Section 2.2, ACI 347, and wind and seismic loads as specified by SEI/ASCE 37-02 unless otherwise controlled by local building code.
   4. Design formwork to include loads imposed during construction, including weight of construction equipment, concrete mix, height of concrete drop, rate of filling of formwork, vibrator frequency, ambient temperature, foundation pressures, lateral stability, temporary imbalance or discontinuity of building components, and other factors pertinent to safety of structure during construction.

## 1.7 DELIVERY, STORAGE, AND HANDLING

A. Comply with General Conditions and Division 1, including the following:

1. Store forms and form materials clear of ground and protect from damage.

## 1.8 QUALITY ASSURANCE BY OWNER'S TESTING AGENCY

A. Field Quality Assurance General: The Owner's Testing Agency shall test and inspect concrete formwork as Work progresses. Failure to detect any defective work or material shall not in any way prevent later rejection when such a defect is discovered nor shall it obligate Design Professionals for final acceptance.
B. Testing Agency shall provide qualified personnel at site to inspect formwork using the latest Contract Documents and approved shop drawings as follows:

    1. Prior to placement of reinforcement, inspect formwork for grade, quality of material, absence of foreign matter, and other imperfections that might affect suitability of concrete placement and tolerances stated herein.
    2. Inspect forms for location, configuration, compliance with specified tolerances, block outs, camber, shoring ties, seal of form joints and compliance with Contract Documents.
    3. Verify condition of bond surfaces, locations and sizes of all accessories, embedment items, and anchorage for prevention of displacement.
    4. Verify proper use/application of form release agents.

C. Owner's Testing Agency shall submit for record inspection, observation, and/or test reports to the Owner and Design Professionals, as required herein and shall provide an evaluation statement in each report stating whether or not concrete formwork conforms to requirements of Specifications and Drawings and shall specifically note deviations therefrom.
D. Immediately notify the Contractor, Owner and Design Professionals of deficiencies.

# PART 2 - PRODUCTS

## 2.1 FORMWORK REQUIREMENTS

A. General Requirements:

    1. Formwork shall meet construction safety regulations for the state where the project is located.
    2. Forms shall be tight-fitting, designed and fabricated for required finishes and to withstand concrete weight and maintain tolerances as specified in ACI 117 for the following designations: (See architectural drawings for locations).

        a. Class D - Minimum quality surface where roughness is not objectionable, usually applied where surfaces will be concealed.

    3. Butt Joints: Shall be solid and complete with backup material to prevent leakage of cement paste.

## 2.2 FORM MATERIALS

A. General: Plywood, fiberglass, metal, metal-framed plywood faced, or other acceptable panel-type materials.

    1. Provide materials with sufficient strength to prevent warping.

B. Plywood: species and grade suitable for intended use, sound undamaged sheets with clean true edges, minimum 5/8" (16mm) thick, complying with U.S. Product Standard PS-1.

1. Other Acceptable Sheet Materials: 14 gauge (2.0mm) sheet steel or fibrous glass reinforced resin.

C. Lumber: Construction grade or better consistent with calculation requirements, without loose knots or other defects.

1. Use only where entire width can be covered with one board 11-1/4" (285mm) or less in width.

D. Form Ties:

1. Type: Factory-fabricated metal, adjustable length, designed to prevent form deflection and to prevent spalling concrete upon removal.
2. Snap-Off Ties: Use for concrete walls below grade and walls which will not remain exposed to view and are not scheduled for architectural finishes.
3. Wire Ties: Not acceptable.

E. Nails, Spikes, Lag Bolts, Thru-Bolts, Anchorages:

1. Type: Of size, strength and quality to meet the required quality of formwork.

F. Form Release Agent:

1. Type: Commercial formulation form release agent shall not impair subsequent treatment of concrete surfaces requiring bond or adhesion, or impede the wetting of surfaces to be cured with water or curing compounds. Apply in compliance with manufacturers' instructions.
2. Form release agent shall meet, at a minimum, all federal and state requirements for volatile organic compounds (VOC's).
3. For Steel Forms: Non-staining rust-preventative type.

## PART 3 - EXECUTION

### 3.1 FORMWORK

A. General:

1. Inspect areas to receive formwork.

    a. Immediately notify the Owner's Testing Agency and Design Professionals in writing of conditions that will adversely affect the Work.

2. Construct forms to sizes, shapes, lines, and dimensions shown on Contract Documents, and to obtain accurate alignment, location, grades, level and plumb work in finished structures.
3. Provide formwork sufficiently tight to prevent leakage of cement paste during concrete placement. Solidly butt joints and provide backup material at joints as required to prevent leakage and fins, and to maintain alignment.
4. Provide for openings, offsets, sinkages, keyways, recesses, moldings, rustications, reglets, drips, bevels, chamfers, blocking, screeds, bulkheads, anchorages and inserts and other features required in the Work.
5. Comply with shop drawings, ACI 301, 318, 347 and Contract Documents.
6. Maintain formwork and finished work construction tolerances complying with ACI 301 and 117.

7. Provide shore and struts with positive means of adjustment capable of taking up formwork settlement during concrete placing operations, using wedges or jacks or a combination thereof.
8. Erect forms for easy removal without hammering or prying against concrete surfaces.
9. Provide crush plates or wrecking plates where stripping may damage cast concrete surfaces.
10. Design, erect, support, brace and maintain formwork and shoring to support loads until such loads can be safely supported by the concrete structure.

B. Concrete Accessories and Embedded Items:

1. Install into forms concrete accessories, sleeves, inserts, anchor bolts, anchorage devices and other miscellaneous embedded items furnished by other trades or that are required for other work that is attached to or supported by cast-in-place concrete.

    a. Use setting drawings, diagrams, instructions and directions provided by suppliers of items to be attached.

2. Install dovetail anchor slots in concrete structures as indicated on drawings or required by other trades.
3. Coordinate with CONCRETE REINFORCEMENT AND EMBEDDED ASSEMBLIES Section in Specification 032000.
4. Install accessories and embedded items straight, level, plumb and secure in place to prevent displacement by concrete placement.

C. Provisions for Other Trades: Coordinate and provide openings in concrete formwork to accommodate work of other trades.

1. Determine size and location of openings, recesses, chases, offsets, openings, depressions, and curbs from information provided by trades requiring such items.
2. Accurately place and securely support items built into forms.

D. Cleaning:

1. Normal Conditions:

    a. Thoroughly clean forms and adjacent surfaces to receive concrete.
    b. Remove chips, wood, sawdust, dirt, standing water or other debris just before placing concrete.
    c. Flush with water or use compressed air to remove remaining foreign matter.
    d. Verify that water and debris can drain from forms through clean-out ports.

2. During Cold Weather:

    a. Remove ice and snow from within forms.
    b. Do not use de-icing salts.
    c. Do not use water to clean out completed forms, unless formwork and concrete construction will proceed within heated enclosure.
    d. Use compressed air or other means to remove foreign matter.

E. Form Release Agents

1. Before placing reinforcing steel and miscellaneous embedded items, coat contact surfaces of forms with an approved non-residual, low VOC form release agent in accordance with manufacturer's published instructions.
2. Do not allow release agent to accumulate in forms or come into contact with reinforcement or concrete against which fresh concrete will be placed.

    a. Coat steel forms with nonstaining, rust-preventative material.

3. Remove form release agent and residue from reinforcement or surfaces not requiring form coating.

F. Before Placing Concrete:

1. Inspect and check completed formwork, shoring and bracing to ensure that work is in accordance with formwork requirements of this section and Contract Documents, and that supports, fastenings, wedges, ties, and parts are secure.

    a. Make necessary corrections or adjustment to formwork to meet tolerance requirements.

2. Retighten forms and bracing before concrete placement to prevent mortar leaks and maintain proper alignment.
3. Notify Owner’s Testing Agency sufficiently in advance of placement of concrete to allow inspection of completed and cleaned forms.

G. During Concrete Placement:

1. Maintain a check on formwork to ensure that forms, shoring, ties and other parts of formwork have not been disturbed by concrete placement methods or equipment.
2. Use positive means of adjustment as required for formwork settlement during concrete placing operations.

H. Surface Defects:

1. Install forms that will not impair the texture of the concrete and are compatible with the specified finish type.

I. Formwork Loads on Grade

1. Where loads from formwork bear on grade, provide suitable load-spreading devices for adequate support and to minimize settlement. In no event shall frozen ground or soft ground be utilized directly as the supporting medium.

J. Footings and Grade Beams:

1. Provide forms for footings and grade beams if soil or other conditions are such that earth trench forms are unsuitable.

## 3.2 REMOVING FORMS

A. Formwork not supporting the weight of concrete, such as sides of beams, walls, columns, and similar parts of the work, may be removed after cumulatively curing at not less than 50°F (10°C) for 12 hours

after placing concrete (Comply with ACI 347R. Table 5.7.2.3.), provided concrete is sufficiently hard to avoid damage by form-removal operations, and provided curing and protection operations are maintained after removal of formwork.

B. Formwork supporting the weight of concrete, such as beam soffits, joists, slabs, and other structural elements, may not be removed until concrete has attained at least [75%] of design compressive strength.

C. Remove formwork progressively using methods to prevent shock loads or unbalanced loads from being imposed on structure. Comply with ACI 347.

D. Loosen forms carefully. Do not wedge pry bars, hammers, or tools against concrete surfaces.

E. Whenever formwork is removed during the curing period, the exposed concrete shall be cured.

F. All wood formwork, including that used in void spaces, pockets and other similar places shall be removed.

G. Form tie holes shall be filled as per approved samples submitted to the Design Professionals.

H. The Contractor shall assume responsibility for all damage due to removal of the forms.

### 3.3 RE-USING FORMS

A. Before forms can be re-used, surfaces that will be in contact with freshly poured concrete must be thoroughly cleaned, damaged areas repaired, and projecting nails withdrawn.

1. Split, frayed, delaminated or otherwise damaged form-facing material will not be acceptable.
2. Apply new form release agent on re-used forms.

B. When forms are extended for successive concrete placement, thoroughly clean surfaces, remove fins and laitance, and tighten forms to close joints. Align and secure joints to avoid offsets.

C. Forms for exposed concrete may be reused only if the surfaces have not absorbed moisture and have not splintered, warped, discolored, stained, rusted or peeled, subject to acceptance by the Design Professionals. The Design Professionals reserve the right to require the Contractor to remove and reconstruct such formwork as will produce subsequent areas that are acceptable. Do not use "patched" forms for exposed concrete surfaces, unless approved by the Design Professionals.

**END OF SECTION 03 10 00**

# SECTION 03 20 00
# CONCRETE REINFORCEMENT AND EMBEDDED ASSEMBLIES

## PART 1 - GENERAL

### 1.1 GENERAL

A. Work of this Section shall conform to requirements of Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification sections.

### 1.2 SCOPE

A. Provide all labor, materials, equipment, services and transportation for reinforcing steel, accessories, embedments and miscellaneous anchorage accessories, joint fillers, and waterstops for cast-in-place concrete work as shown on Drawings, as specified herein, and as required by the job conditions.

### 1.3 RELATED WORK SPECIFIED IN OTHER SECTIONS

A. See below for related work:

| | |
|---|---|
| Concrete Formwork | Section 031000 |
| Cast-in-Place Concrete | Section 033000 |
| Thermal and Moisture Protection | Division 7 |

### 1.4 CODES AND STANDARDS

A. Building Code: Concrete work shall conform to the requirements of the Building Code identified on the Structural General Notes, and OSHA requirements, except where more stringent conditions or criteria occur in the standards referenced below and on the Drawings.
B. Standards:

1. ACI 117 – Standard Specifications for Tolerances for Concrete Construction and Materials.
2. ACI 301 –Specifications for Structural Concrete.
3. ACI 315 – Details and Detailing of Concrete Reinforcement.
4. ACI 318 – Building Code Requirements for Structural Concrete and Commentary.
5. AWS D1.1 – Structural Welding Code-Steel.
6. AWS D1.4 – Structural Welding Code-Reinforcing Steel.
7. CRD C 572 – Specification for Polyvinylchloride Waterstops.
8. Concrete Reinforcing Steel Institute ”Manual of Standard Practice”

### 1.5 SUBMITTALS

A. Required Submittals - Where the SUBMITTALS section of this Specification is in conflict with Division 1 Submittals, the more stringent requirements for the Contractor apply. Required submittal items are listed here; see below for detailed requirements.

1. **Submittal Schedule**: See Section 033000.
2. **Shop Drawings**: Submit for action shop drawings that shall clearly indicate, but not be limited to:

a. All details, dimensions and information required for fabrication and placement of concrete reinforcement in accordance with Contract Documents, prepared in accordance with ACI 315 recommendations.
b. Elevations, plans, sections, and dimensions of concrete work with required reinforcement clearances.
c. Ledges, brackets, openings, sleeves, anchor rods, embedments, prefabricated bent-in dowel keyway systems, electrical conduit and items of other trades including interference with reinforcing materials.
d. Sizes, grade designations, spacing, locations, and quantities of wire fabric, reinforcement bars, temperature and shrinkage reinforcement dowels.

    i. Do not use dimensions scaled from Contract Drawings to determine bar lengths.
    ii. Hooks and bends not specifically dimensioned shall be detailed per ACI 318.

e. Bending and cutting schedules, assembly diagrams, splicing and connection requirements, details, and laps.
f. Each type of supporting and spacing devices, including miscellaneous accessories.
g. Construction joint type, details, and locations. Contractor shall coordinate construction joint type, details, and locations with concrete pour schedule. Submittal shall include details for each type of construction joint in accordance with Contract Documents.
h. Concrete accessories and embedded items. See SUBMITTALS Section of Specification 033000.

3. **Product Data**: Submit for action for each type of product identified in Part 2. Product Data shall be clearly marked to indicate all technical information which specifies full compliance with this section and Contract Documents, including published installation instructions and I.C.C reports, where applicable, for products of each manufacturer specified in this section.
4. **Mill Reports**: Submit for record.
5. **Hazardous Materials Notification**: Submit for record. In the event no product or material is available that does not contain hazardous materials as determined by the Owner, a "Material Safety Data Sheet" (MSDS) equivalent to OSHA Form 20 shall be submitted for that proposed product or material prior to installation.

## 1.6 DELIVERY, STORAGE, AND HANDLING

A. Comply with General Conditions and Division 1, including the following:

1. Deliver reinforcing steel to Project site bundled, tagged and marked.

    a. Use weatherproof tags indicating bar sizes, lengths and other information corresponding to markings shown on placement diagrams.

2. Deliver welded wire fabric in sheets. Do not deliver in rolls.
3. During construction period, properly store reinforcing steel and accessories to assure uniformity throughout the Project.
4. Deliver and store welding electrodes in accordance with AWS D1.4.
5. Immediately remove from site materials not complying with Contract Documents or determined to be damaged.
6. Store reinforcing steel above ground so that it remains clean.

a. Maintain steel surfaces free from materials and coatings that might impair bond.
b. Keep covered.
c. Protect against corrosion or deterioration of any kind.

### 1.7 QUALITY ASSURANCE BY OWNER'S TESTING AGENCY

A. Field Quality Assurance General: The Owner's Testing Agency shall test and inspect concrete reinforcement and embedded assemblies as Work progresses. Failure to detect any defective work or material shall not in any way prevent later rejection when such defect is discovered nor shall it obligate the Design Professionals for final acceptance.
B. Owner's Testing Agency shall provide qualified personnel at the site to inspect reinforcement, embedments, and accessories using the latest Drawings and reviewed shop drawings, as follows:

1. Prior to placement, inspect reinforcement and embeds for grade, quality of material, absence of foreign matter, and for suitable storage.
2. Provide continuous inspection of reinforcement and embedded assemblies during placement and immediately prior to concreting operations for: size, quantity, vertical and horizontal spacing and location, correctness of bends and splices, mechanical splices, clearances, compliance with specified tolerances, security of supports and ties, concrete cover, and absence of foreign matter.

C. Owner's Testing Agency shall submit for record inspection, observation, and/or test reports to the Owner and Design Professionals, as required herein and shall provide an evaluation statement in each report stating whether or not concrete reinforcement, and embedded assemblies conforms to requirements of Specifications and Drawings and shall specifically note deviations therefrom.
D. Immediately notify the Contractor, Owner and Design Professionals of deficiencies.

## PART 2 - PRODUCTS

### 2.1 REINFORCEMENT

A. Reinforcing Steel:

1. Type: Deformed billet steel bars, ASTM A 706, Grade 60 or 75 as indicated on Drawings.
2. Size: As indicated on structural Drawings.
3. Where indicated on Drawings, reinforcing steel shall be hot-dipped galvanized after fabrication in accordance with ASTM A 767, Class II, with galvanizing material protected from embrittlement during galvanizing process in accordance with ASTM A 143.

a. Galvanized finish shall meet the bend and shear test requirements of ASTM A 615.

### 2.2 ACCESSORIES

A. Tie Wire:

1. Type: Minimum 16 gauge (1.5mm) annealed steel wire, ASTM A 510 and ASTM A 853.
2. Wire Bar Type: Comply with CRSI.

B. Mechanical Splicing Systems:

1. Mechanical tension and compression splicing systems shall be used where indicated on Drawings or at contractor's option.
2. Splices shall be installed in accordance with manufacturer's requirements.
3. Acceptable Products:

    a. Bartec Couplers by Dextra
    b. Griptec Couplers by Dextra
    c. Unitec Couplers by Dextra
    d. Lenton Couplers by Erico
    e. Lenton Cadweld by Erico
    f. Bar Lock Couplers by Dayton Superior
    g. Taper-Lock Couplers by Dayton Superior
    h. Grip-Twist by BarSplice
    i. ZAP Screwlok by BarSplice
    j. BPI Barsplicer by BarSplice
    k. BarGrip by BarSplice
    l. 400 and 500 Series by Headed Reinforcement Corp

4. Mechanical and welded tensile mechanical splicing systems shall be capable of developing 125% of the reinforcing steel ASTM specified minimum yield strength (Type 1) except where indicated as Type 2 (100% of specified tensile strength).
5. Mechanical compression splices shall be such that the compression stress is transmitted by end bearing held in concentric contact.

C. Headed Bars:

1. For bar sizes #11 (ø36) or smaller where specifically detailed on Drawings, mechanical bar terminators shall be used in lieu of standard hooks.
2. Headed bars shall meet the requirements of ASTM A970, Class HA.
3. Acceptable Products:

    a. Headed Bars by Dextra
    b. Lenton Terminator by Erico
    c. Grip-Twist Doughnut by Bar-Splice
    d. BPI ButtonHead by BarSplice
    e. Zap T-Lok by BarSplice
    f. Taper-Lock End Anchor Disc by Dayton Superior
    g. 100, 550 and 670 Series by Headed Reinforcement Corp

D. Supports for Reinforcement:

1. Types: Bolsters, chairs, spacers, clips, chair bars, and other devices for properly placing, spacing, supporting, and fastening the reinforcement, plastic, plastic protected steel, or epoxy coated to match supported reinforcement.
2. For Contact with Forms: Use types with not less than 3/32" (2.5mm) of plastic between metal and concrete surface.

    a. Plastic tips shall extend not less than ½" (12mm) on metal legs.

3. Individual and continuous slab bolsters and chairs shall be of type to suit various conditions encountered and must be capable of supporting 300 pound (1.5kN) load without damage or permanent distortion.
4. Unless otherwise indicated on Drawings, bottom reinforcing bars in footings shall be supported by precast concrete bricks or individual high chairs with welded sand plates on bottom.

E. Anchor rods and dowels:

1. Types and Sizes: Provide sizes and types of anchor rods and dowels as indicated on the Drawings. Each type of anchor shall be manufactured of structural quality steel, designed for cast-in-place concrete applications and be of sizes as indicated on Drawings, complete with washers, nuts, plates and miscellaneous accessories required to meet Contract Document requirements.

## 2.3 ANCHORAGE ACCESSORIES

A. General: Miscellaneous anchorage accessories for anchoring structural, architectural, electrical, and mechanical items to poured concrete shall include but not be limited to the following:

1. Concrete Anchors: Headed or bent studs ASTM A 108/Grade 1015 through 1020, minimum yield strength of 50,000 psi (345MPa), minimum tensile strength of 60,000 psi (415MPa).
2. Anchor Rods: ASTM F1554, Grade as noted on Drawings.
3. Shallow Embedment Internally Threaded Inserts with ¾" maximum embedment.
    a. Acceptable Products:
        i. Mini Undercut + by DeWalt (for post-tensioned slabs and precast hollow core slabs)
        ii. HDI-P TZ by Hilti (for post-tensioned slabs)
4. Welding Electrodes: AWS 5.5, Series E70.

## 2.4 WATERSTOPS

A. Preformed Swellable Waterproofing Strips especially formulated for concrete cold joints at footings, walls, or slabs.

1. Acceptable Products:
    a. Volclay Waterstop RX by CETCO Building Materials Group
    b. Adcor ES by GCP Applied Technologies
    c. Hydrotite by Sika
2. Size: 3/4" (20mm) by 3/8" (10mm) strips minimum, 25 ft. (7.5m) long, and weighing at least 0.165 lbs/ft (0.245kg/m).
3. Location of Use: Concrete cold joints at footings, walls and slab joints.
4. Comply with manufacturer product application and installation instructions.

B. Polyvinyl Chloride Waterstops:

1. Type: PVC Waterstops for embedding in concrete to prevent passage of fluids through joints. Factory fabricate corners, intersections and directional changes. U.S. Corp of Engineers Specification CRD C 572.
2. Acceptable Products:

    a. PVC Waterstops" by BoMetals
    b. Greenstreak by Sika
    c. Sealtight PVC Waterstops by W.R. Meadows

**PART 3 - EXECUTION**

**3.1 FABRICATION**

A. Reinforcing Steel Fabrication:

1. Fabricate in accordance with approved shop Drawings, ACI 315 and Contract Documents.
2. Heating of Reinforcement: Will be permitted only with specific prior approval of the SER.
3. Welding: Comply with ANSI/AWS D1.4; use E9018 electrodes or approved electrodes.
4. Tolerances: Comply with ACI 117.
5. Unacceptable Materials: Reinforcement with any of following defects will not be permitted in Work.

    a. Bar lengths, depths, and bends exceeding ACI fabrication tolerances.
    b. Bends or kinks not indicated on Drawings or final shop drawings.
    c. Bars with reduced cross-section due to excessive rusting or other cause.

B. Templates:

1. Required for all footing and column dowels, and where required for proper alignment of reinforcing.

C. Assemblies:

1. Fabricate and assemble structural steel items in shop in conformance with AISC and AWS D1.1. Shearing, flame cutting, and chipping shall be done carefully and accurately. Cut, drill, or punch holes at right angles to the surface of the metal. Do not make or enlarge holes by burning. Holes shall be clean-cut without torn or ragged edges.
2. Welding of reinforcement shall be done in accordance with AWS requirements. Welding shall be performed subject to the observance and testing by Owner's Testing Agency.
3. Galvanizing where required, shall be applied after fabrication and prior to casting concrete.
4. Welding of crossing bars (tack welding) for assembly of reinforcement is not permitted without use of weldable reinforcement and express written consent of SER.

**3.2 INSTALLATION OF REINFORCEMENT**

A. General:

1. Perform the work of this section in accordance with approved shop drawings, ACI 318 and CRSI recommended practice for "Placing Reinforcing Bars", for details and methods of reinforcement placement and supports, and as specified.

2. Before placing reinforcement steel, inspect forms for proper fitting and compliance with allowable tolerances.
3. Reinforcement shall be free of form coatings, sealers, powdered and scaled rust, loose mill scale, earth, ice, and other materials which will reduce or destroy bond with concrete.
4. Reinforcement steel is not permitted to be “floated into position”.
5. Bend bars cold.

    a. Do not heat or flame cut bars.
    b. No field bending of bars partially embedded in concrete is permitted, unless specifically approved by the SER and tested by Independent Testing Agency for cracks.

6. Weld only as indicated.

    a. Perform welding per ANSI/AWS D12.1 and/or ANSI/AWS D1.4.
    b. See structural Drawings for additional requirements.

7. Tag reinforcement steel for easy identification.

B. Placement of Reinforcement Bars:

1. Comply with approved shop drawings, ACI 318 and Contract Documents.
2. Accurately position, support and secure reinforcement in a manner to prevent displacement before and during placement of concrete.

    a. Place reinforcement bars within tolerances specified in ACI 117.
    b. Locate and support reinforcement by metal chairs, runners, bolsters, spacers, hangers and other accessories for fastening reinforcing bars and welded wire reinforcement in place.

3. If bars are displaced beyond specified tolerance when relocating the bars to avoid interference with other reinforcement or embedded items, immediately notify the Design Professionals for approval prior to concrete placement.
4. Avoid cutting or puncturing vapor retarder during reinforcement placement.

    a. Repair damages before placing concrete.

5. Concrete Coverage: Maintain concrete cover around reinforcement as indicated on Drawings.
6. Bar Supports: Use type specified in this section.
7. Tie Wires: After cutting, turn tie wires to the inside of section and bend so that concrete placement will not force ends to be exposed at face of concrete.

C. Placement of Wire Reinforcement:

1. Install in lengths as long as practicable.
2. Support in position adequately to prevent bending of reinforcement between supports before and during placement of concrete.
3. Overlap the wire reinforcement 6” (150mm) or one panel width + 2” (50mm), whichever is larger.

    a. Securely tie together with wire.

4. Offset laps of adjoining widths to prevent continuous laps in either direction.

5. Locate wire fabric in the top third of slabs, unless noted otherwise on structural Drawings.

D. At Construction Joints:

1. Reinforcement bars and wire reinforcement shall be continuous through construction joints, unless otherwise indicated on Drawings. See Drawings for scheduled lap splices.

E. Splicing:

1. Unless otherwise indicated on Drawings provide lap splices for bar sizes #11 (ø36) and smaller by lapping ends, placing bars in contact, and tying tightly with wire in accordance with requirements of ACI 318 for lap lengths indicated on Drawings.
2. Do not splice reinforcement except as indicated on structural Drawings.
3. Tension couplers may be used and installed per manufacturer's specifications where indicated on Drawings or as approved by Engineer.

## 3.3 INSTALLATION OF ACCESSORIES AND EMBEDDED ITEMS

A. Install concrete accessories in accordance with manufacturer's published instructions and Contract Documents.

1. Set and secure embedments, including embedded plates, bearing plates, and anchor rods, per approved setting drawings and in such a manner to prevent movement during placement of concrete and to allow removal of formwork without damage.
2. Tolerances: Anchor rod and other embedded items placement tolerances shall comply with AISC 303, "Code of Standard Practice", Section 7.5.
3. Inspect locations to receive concrete accessories.
4. Immediately notify the Design Professionals in writing of conditions that will adversely affect the Work or fail to meet Contract Document requirements.
5. Do not place concrete until reinforcement, accessories and other built-in items have been inspected and accepted by Owner's Testing Agency.

B. Coordinate the installation of pipes, bolts, hangers, anchors, flashing and other embedded items with the work of other trades.

**END SECTION 03 20 00**

**SECTION 03 30 00**
**CAST-IN-PLACE CONCRETE**

## PART 1 - GENERAL

### 1.1 GENERAL

A. Work of this Section shall conform to requirements of Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification sections.

### 1.2 SCOPE

A. Provide all labor, materials, equipment, services and transportation required to complete all concrete work as shown on Drawings, as specified herein, and as required by the job conditions. This Specification is not intended to address the particular requirements of Architectural Concrete.

### 1.3 RELATED WORK SPECIFIED IN OTHER SECTIONS

A. See below for related work:

| | |
|---|---|
| Concrete Formwork | Section 031000 |
| Concrete Reinforcement and Embedded Assemblies | Section 032000 |
| Thermal and Moisture Protection | Division 7 |

### 1.4 CODES AND STANDARDS

A. Building Code: Concrete work shall conform to the requirements of the Building Code identified on the Structural General Notes, and OSHA requirements, except where more stringent conditions or criteria occur in the standards referenced below and on the Drawings.
B. Standards:

1. ACI 117 – Standard Specifications for Tolerances for Concrete Construction and Materials.
2. ACI 237 – Self Consolidating Concrete.
3. ACI 301 – Specifications for Structural Concrete.
4. ACI 318 – Building Code Requirements for Structural Concrete and Commentary.
5. American Concrete Institute “Manual of Concrete Practice”, various committee reports as referenced herein.
6. American Society for Testing and Materials "ASTM Standards in Building Codes", various standards as referenced herein.
7. AASHTO T318 – Standard Method of Test for Water Content of Freshly Mixed Concrete Using Microwave Oven Drying.

C. Definitions:

1. The term “Contract Documents” in this Specification is defined as the design Drawings and the specifications.
2. The term “SER” in this Specification is defined as the Structural Engineer of Record for the structure in its final condition.

3. The term “Design Professionals” in this Specification is defined as the Owner’s Architect and SER.
4. The term “Contractor” in this Specification is defined to include any of the following: General Contractor and their sub-contractors, Construction Manager, Concrete Contractor and their sub-contractors.
5. The term “Testing Agency” in this Specification is defined as an independent testing and inspection service engaged by the Owner for quality assurance observation and testing of concrete construction in accordance with applicable building code provisions and any additional activities listed in the Contract Documents.
6. The terms “for record” and “submit for record” in this Specification are defined as Contractor submittals that do not require a response from the Design Professionals.
7. The term “Working Days” in this Specification is defined as Monday through Friday, excluding federal or state holidays.
8. The term “Delegated Design” in this Specification is defined as a scope of work that meets performance and design criteria established in the Contract Documents and is to be completed by the Contractor’s licensed engineer.

**1.5 SUBMITTALS**

A. Required Submittals - Where the SUBMITTALS section of this Specification is in conflict with Division 1 Submittals, the more stringent requirements for the Contractor apply. Required submittal items are listed here; see below for detailed requirements. Reproduction of structural drawings for shop drawings is not permitted.

1. **Submittal Schedule**: The contractor shall submit for action a schedule at least ten (10) working days prior to commencing submittals.

    a. This schedule shall include a list, in order of date to be submitted, of all drawings and other required submittal items scheduled to be submitted. The schedule shall list the proposed submittals for each week, as well as their formats. Once shop drawing submissions have commenced any modification or addition to this schedule must be submitted for action at least ten (10) working days before the modification or addition is proposed to take place.
    b. For the purposes of developing a schedule, assume the following review rate, Shop drawings – 10 full size sheets per week.

2. **Mix Designs**: Submit for action concrete mix designs for each type and strength of concrete required for this Project at least twenty (20) days before placing concrete.

    a. Mix designs shall be prepared or reviewed by an approved independent Testing Agency retained by the Contractor in accordance with requirements of ACI 301 and ACI 318, sealed and signed by a Professional Engineer licensed in the state where the project is located, and shall be coordinated with design requirements and Contract Documents.
    b. Before submitting to Owner's Testing Agency, submit complete mix design data for each separate mix to be used on the Project in a single submittal.
    c. Mix materials shall be from the same production facility that will be used for this Project.
    d. Mix Design data shall include but not be limited to the following:

        i. Locations on the Project where each mix design is to be used corresponding to Structural General Notes on the Drawings.
        ii. Design Compressive Strength: As indicated on the Drawings.

iii. Proportions: ACI 301 and ACI 318.
iv. Gradation and quality of each type of ingredient including fresh (wet) unit weight, aggregates sieve analysis.
v. Water/cementitious material ratio.
vi. Evaluation and classification fly ash in accordance with ASTM D 5759.
vii. Report of chemical analysis of fly ash in accordance with ASTM C 618.
viii. Classification of blast furnace slag in accordance with ASTM C 989.
ix. Slump: ASTM C 143.
x. Air content of freshly mixed concrete by the pressure method, ASTM C 231, or the volumetric method, ASTM C 173.
xi. Unit Weight of Concrete: ASTM C 138.
xii. Design strength at 28, 56 or 90 days, as indicated on Contract Documents: ASTM C 39.

(1) Document strength based on basis of previous field experience or trial mixtures per ACI 301. Proportioning by Water-Cement Ratio is not permitted.
(2) Submit strength test records, mix design materials, conditions, and proportions for concrete used for record of tests, standard deviation calculation, and determination of required average compressive strength. Test records to support proposed mixtures shall be no more than 24 months old and use current cement aggregate sources. Test records to establish standard deviation may be older if necessary to have the required number of samples.
(3) If early concrete strengths are required, Contractor shall submit trial mixture results as required.

xiii. Manufacturer's product data for each type of admixture.
xiv. Manufacturer's certification that all admixtures used are compatible with each other.
xv. All information indicating compliance with Contract Documents including method of placement and method of curing.
xvi. Normal weight Concrete: Density per ASTM C 138. Design the mix to produce the strength, modulus of elasticity and density as indicated on the Contract Documents.

3. **Concrete Travel Times to the Project Site:** Submit for record.
4. **Hot and Cold Weather Procedures**: Submit for record written procedures for placement of concrete in hot and cold weather conditions. Hot and Cold weather are as defined in the Concrete Placement section of this Specification.
5. **Product Data**: Submit for action product data clearly marked to indicate locations to be used and all technical information which specifies full compliance with this section and Contract Documents, including published application instructions, product characteristics, compatibility, and limitations for each of the following:

a. Bonding agents.
b. Absorptive covers and moisture retaining covers.
c. Vapor Retarder: See Division 7, Thermal and Moisture Protection.
d. Self-leveling concrete topping.

e. Grout: Submittal of grout by manufacturers not listed herein must be accompanied by independent certification of ASTM C 1107 compliance without modification of standard methods.
f. Other products proposed by Contractor

6. **Concrete Joint Locations**: Submit for action plans indicating locations and details of construction joints, contraction joints, waterstops, sleeves, embedments, etc. that interact with the joints. Contractor to coordinate joint location with reinforcement shop drawings. Reinforcement shop drawings shall indicate additional reinforcement bars where required at construction joints.

7. **Comprehensive Layout Drawings:** Submit for action comprehensive layout drawings (a single drawing per area/element):

   a. Drawings shall show openings in structural members, including floor slab, shear walls, and footing walls.
   b. Drawings shall consolidate the work of all trades and shall be coordinated by the Contractor.
   c. Drawings shall show concrete accessories and embedded items, including fabrication details of items to be placed (exclusive of reinforcement).
   d. Submit with or prior to reinforcement and formwork submittals for same element/area.

8. **Preconstruction Survey**: Submit for record. Where interface with existing construction occurs, before related shop drawings are prepared survey the existing construction and submit the survey prepared by a professional surveyor employed by the Contractor to the Design Professionals.
9. **Structural Repairs**: Submit for action procedures, intended locations, and product information. Alterations to design shall be sealed and signed by a Structural Engineer licensed in the state where the project is located.
10. **Patching Defective Concrete Finishes**: Submit for action procedures, intended locations, and product information.
11. **Hazardous Materials Notification**: Submit for record. In the event no product or material is available that does not contain hazardous materials as determined by the Owner, a "Material Safety Data Sheet" (MSDS) equivalent to OSHA Form 20 shall be submitted for that proposed product or material prior to installation.

B. Submittal Process

1. Submittal of shop drawings and other submittals by the Contractor shall constitute Contractor's representation that the Contractor has verified all quantities, dimensions, specified performance criteria, installation requirements, materials, catalog numbers and similar data with respect thereto and reviewed or coordinated each drawing with other Drawings and other trades. The Contractor shall place their shop drawing stamp on all submittals confirming the above.
2. Shop drawings: Submit in complete packages so that individual parts and the assembled unit may be reviewed together. This Specification Section and the applicable Drawings used in the development of the shop drawings shall be referenced on each shop drawing to facilitate checking.
3. The Contractor shall submit to the Design Professionals one (1) electronic copy for shop drawing review.
4. The Contractor shall allow at least ten (10) working days between receipt and release by the SER for the review of shop drawings and submittals.

5. Resubmittals: Completely address previous comments prior to resubmitting a drawing. Resubmit only those drawings that require resubmittal. Do not include new content not previously reviewed.
6. The Contractor shall deliver to the Design Professionals at the completion of the job two (2) copies of the electronic version of the final as-built shop drawings on a CD-ROM or other media acceptable to the Design Professionals.

C. SER Submittal Review

1. The Design Professionals' review and approval of shop drawings and other submittals shall be for general conformance with the design intent of the work and with the information given in the Contract Documents only and will not in any way relieve the Contractor or the Contractor's Engineer from:

    a. Conforming to the Contract Documents.
    b. Coordination with other trades.
    c. Responsibility for all required detailing and proper fitting of construction work.
    d. The necessity of furnishing material and workmanship required by Drawings and Specifications which may not be indicated on the shop drawings.
    e. Control or charge of construction means, methods, techniques, sequences or procedures, for safety precautions and programs in connection with the work.

D. Substitution Request

1. Requests for any departure from Contract Documents must be submitted in writing by the Contractor and accepted in writing by the Design Professionals, prior to receipt of submittals.
2. Contractor must submit shop drawings reflecting accepted substitutions for review in accordance with this Specification.
3. Accepted substitutions or modifications shall be coordinated and incorporated in the work at the sole expense of the Contractor.
4. The acceptance by the Design Professionals of a specific and isolated request by the Contractor to deviate from these requirements does not constitute a waiving of that requirement for other elements of, or locations in the project, unless specifically addressed as such and permitted by the Design Professionals in writing.
5. Contractor is responsible for means and methods and any impacts on other portions of the work that may arise from this substitution.

## 1.6 DELIVERY, STORAGE, AND HANDLING

A. Comply with General Conditions and Division 1.
B. Storage:

1. Store materials in accordance with ACI 304R.
2. Store cement in weather-tight buildings, bins or silos that will exclude moisture and contaminates.
3. Store admixtures to avoid contamination, evaporation, damage, and in accordance with manufacturer's temperature and other recommendations.
4. Keep packaged material in original containers with seals unbroken and labels intact until time of use.

C. Handling:

1. Handle fine and coarse aggregates as separate ingredients.
2. Arrange aggregate stockpiles to avoid excessive segregation, and prevent contamination with other materials or with other sizes of like aggregates.
3. Do not use frozen or partially frozen aggregates.
4. Allow sand to drain until it has reached relatively uniform moisture content before use.
5. Protect liquid admixtures from freezing and temperature changes that would adversely affect characteristics, and in accordance with manufacturer's recommendations.

## 1.7 QUALITY ASSURANCE BY OWNER'S TESTING AGENCY

A. Quality assurance is testing and inspection to assist the Owner in evaluating the Contractor's performance and quality control.
B. Cost: Except as specifically noted otherwise, the testing agencies for quality assurance shall be engaged and paid by the Owner.
C. Coordination with Owner's Testing Agency: The Contractor shall have sole responsibility for coordinating their work with the Owner's Testing Agency to assure that all test and inspection procedures required by the Contract Documents and Public Agencies are provided. The Contractor shall cooperate fully with the Owner's Testing Agency in the performance of their work and shall provide the following:

1. Information as to time of starting field construction and concrete placement schedule, one week prior to the beginning of the work
2. Site File: At least one copy of each approved shop drawing shall be kept available in the Contractor's field office. Drawings not bearing evidence of approval and release for construction by the Design Professionals shall not be kept on the job.
3. Full and ample means of assistance for testing and inspection of material
4. Proper facilities, including scaffolding, temporary work platforms, safety equipment etc., for inspection of the work in shop and field

D. Field Quality Assurance

1. General: The Owner's Testing Agency shall test and inspect concrete materials and operations as Work progresses. Failure to detect any defective work or material shall not in any way prevent later rejection when such defect is discovered nor shall it obligate the Design Professional for final acceptance.

## 1.8 QUALITY CONTROL BY CONTRACTOR

A. The Contractor shall provide a program of quality control to ensure that the minimum standards specified herein are attained.
B. The Owner's general review during construction and activities of the Owner' Testing Agency are undertaken to inform the Owner of performance by the Contractor but shall in no way replace or augment the Contractor's quality control program or relieve the Contractor of total responsibility for quality control.
C. The Contractor shall immediately notify the Design Professionals of any deficiencies in the work which are departures from the Contract Documents. The Contractor shall propose corrective actions and their recommendations in writing and submit them for review by the Design Professionals. After proposed corrective action is accepted by the Design Professionals and Owner, the Contractor shall correct the deficiency at no cost to the Owner. Where the Contractor requests that the Design Professionals develop

the corrective actions or review corrective actions developed by others, the Design Professional shall be compensated as outlined in the OBSERVATIONS AND CORRECTIONS BY DESIGN PROFESSIONALS section of this Specification.

D. Where SCC is used, the Ready Mix Producer shall have a Quality Control Representative on site during placements until mix consistency and stability is established.

## 1.9 OBSERVATIONS AND CORRECTIONS BY DESIGN PROFESSIONALS

A. Observations: The Design Professionals will observe the construction for general compliance with the provisions of the Contract Documents during various phases of construction.
B. Corrections by Design Professionals: See Part 3 - CORRECTIVE MEASURES section of this specification.

## 1.10 PERMITS AND WARRANTY

A. Permits: The Contractor shall apply for, procure, renew, maintain, and pay for all permits required by City, State, or other governing authorities, necessary to execute work under this Contract. Contractor shall furnish copies of all permits to the Owner and Design Professionals.

# PART 2 - PRODUCTS

## 2.1 CONCRETE MATERIALS AND PRODUCTION

A. Portland Cement:

1. ASTM C150, Type I or Type II
2. ASTM C150, Type III, High-early Strength Portland Cement may be used subject to review and approval of the SER. The specified 28-day concrete compressive strength shall occur within 7 days for concrete using Type III Portland Cement.
3. ASTM C150, Type V
4. Provide the same brand of Portland Cement from a single source throughout the project, as required to meet Design Professionals' requirements.

B. Aggregates for Normal-weight Concrete:

1. ASTM C 33
2. Fine Aggregate: Natural sand, or sand prepared from stone or gravel, clean, hard, durable, uncoated and free from silt, loam and clay.
3. The acceptability of aggregates for the work will depend on proof that their potential alkali reactivity is not deleterious to the concrete.
4. Do not use fine or coarse aggregates that contain substances that cause spalling.
5. Maximum coarse aggregate size shall conform to the requirements as specified in ACI 301 but shall not exceed the following:

   Size no. 57 (25mm max) for footings, drilled piers and caissons

   Size no. 67 (20mm max) for all other locations

   Size no. 467 or 457 for non-reinforced concrete at locations noted on Drawings.

6. Contractor shall furnish concrete with maximum 3/8" (10mm) aggregate at no additional cost to the Owner if areas of high reinforcement density require it for placement and consolidation.

C. Water: ASTM C 94. Clean, and free from injurious amounts of oil, acids, alkali, salts, organic material, or other deleterious materials.
D. Supplementary Cementitious Material

1. Fly Ash:

    a. ASTM C 618, Class C or Class F.
    b. Shall not be used unless part of an approved mix design.
    c. Limit Loss on Ignition to 2.5%

2. Ground Granulated Blast-furnace Slag (GGBFS)

    a. ASTM C 989.
    b. Shall not be used unless part of an approved mix design.

3. Silica Fume (Microsilica):

    a. ASTM C 1240
    b. Acceptable Product: W. R. Grace “Force 10,000 D”
    c. Acceptable Product: Euclid Chemical Company “Eucon MSA”
    d. Acceptable Product: BASF “MasterLife SF 100”
    e. Acceptable Product: Sika Corporation “Sikacrete 950 DP”

4. For concrete subject to Exposure Class F3 conditions as defined in ACI 318, Table 4.2.1, limit the maximum content of supplementary cementitious materials to values shown in ACI 318, Table 4.4.1.
5. The exact percentages used shall be based on successful test placement on site. Resubmit mix design if percentages change based on test placement.
6. The fly ash or natural pozzolan supplier shall have an effective quality control program in place to guard against contamination of the fly ash and assure compliance with Specifications.
7. Fly ash and GGBFS used shall be from one source throughout the project. Substitution of sources will be acceptable only if testing of concrete mixes containing the substituted material show similar test results and if the color of concrete produced with the substituted material matches the color of previously poured concrete to the satisfaction of the Architect.

E. Ready Mixed Concrete:

1. Shall be batch-mixed and transported in accordance with ASTM C 94.

## 2.2 CONCRETE MIX DESIGN

A. Concrete Strength:

1. Shall be as indicated on the Structural Drawings

B. Concrete Density (Unit Weight):

1. Shall be as indicated on the Structural Drawings

C. Air Entrainment

1. For concrete exposed to freeze/thaw cycles and/or deicing chemicals (Exposure Classes F1, F2, F3), and concrete intended to be watertight, provide entrained air content of 6% ± 1.5%, unless specified otherwise. This includes, but is not limited to, concrete at the following locations:

    a. Concrete at the exterior of the structure with at least one surface exposed to weather, such as exterior face of grade beams, foundation walls, exterior walls and parapets, exposed columns and edge beams.
    b. Concrete in parking garages.
    c. Ramps and loading docks.
    d. Balconies and terraces with no waterproof membrane.

2. Entrained air content noted above shall occur at point of delivery.
3. No entrained air content is required in concrete placed in the foundation with no surface exposed to weather.

D. Water-Cementitious Materials (W/cm) Ratio for Normalweight Concrete

1. Unless lower limits are stated in the Contract Documents, all concrete exposed to freezing and thawing in moist condition (Exposure Classes F1 and F2) and/or required to be watertight shall have a maximum W/cm ratio of 0.45 and a minimum f'c=4500 psi .
2. All concrete exposed to deicing salts, brackish water seawater or spray from these sources (Exposure Class F3) shall have a maximum W/cm ratio of 0.40 and a minimum f'c=4500 psi.
3. Absent the above conditions, all concrete with required strength of 4000 psi (28MPa) or higher shall have a maximum W/cm ratio of 0.50.
4. The water-cementitious materials ratio shall not exceed values indicated, including any water added to meet specified slump in accordance with the requirements of ASTM C 94.
5. Weight of fly ash or pozzolanic admixtures shall be included with the weight of cementitious materials used to determine the water-cementitious materials ratio.

E. Slump

1. Concrete design mixes shall be proportioned to meet the following slump limitations. Slump should be measured as described in the Owner's testing agency responsibilities:

    a. Concrete with high range or mid range water-reducing admixture: Concrete slump prior to addition of high range water-reducing admixture shall not exceed 3" (75mm) for normalweight concrete and 4" (100mm) for lightweight concrete. After addition of water-reducing admixture, the concrete shall have a maximum slump of 9" (225mm) unless otherwise approved by the SER.
    b. Concrete without a water-reducing admixture: Slump shall not exceed 4".

F. Chloride Ion Content

1. The total water-soluble chloride ion content of the mix including all constituents shall not exceed the limits defined in ACI 318 4.3 unless corrosion inhibiting admixtures are added to the mixture to offset the additional chloride.
2. If the specified level of water-soluble chloride ion content cannot be maintained, appropriate level of corrosion inhibiting admixture shall be added to the mix in accordance with the manufacturer's recommendation to offset the excess amount of chloride at no additional cost to the Owner.

## 2.3 MISCELLANEOUS CONCRETE PRODUCTS

A. Nonshrink Grout

1. Provide pre-packaged natural aggregate grout, high-precision, nonshrink, ready-to-use, complying with the following requirements:

    a. See General Notes for grout minimum compressive strength.
    b. Grout shall conform to ASTM C 1107

2. All material used including water, mixer and pre-packaged grout must be initially at the 45°F (7°C) and 90°F (32°C ) limits when testing is initiated.
3. Acceptable Product: BASF "MASTERFLOW 928"
4. Acceptable Product: Euclid Chemical Company “HI-FLOW GROUT”
5. Acceptable Product: Five Star Products “Five Star Grout”
6. Acceptable Product: Sika Corporation “Sikagrout 328”

## 2.4 MISCELLANEOUS PRODUCTS

A. Evaporation Retarder:

1. Acceptable Product: BASF "Masterkure ER50”
2. Acceptable Product: Euclid Chemical Company “Eucobar”
3. Acceptable Product: Sika Corporation “Sika Film”

B. Moisture-Retaining Covers:

Conforming to ASTM C171. A naturally colored, non-woven polypropylene fabric with a 4-mil non-perforated reflective (white) polyethylene coating containing stabilizers to resist degradation from ultraviolet light. Fabric shall exhibit low permeability and high moisture retention.

1. Hydracure S-16 by PNA Construction Technologies, Inc., Matthews, NC
2. Transguard 4000 by Reef Industries (Armorlon Division), Incorporated, Houston TX

C. Sand Cushion: Clean, manufactured or natural sand.
D. Vapor Retarder: See Division 7, Thermal and Moisture Protection

1. Minimum 15-mil thick polyolefin geomembrane
2. Manufactured with prime virgin resins
3. Water Vapor Retarder: ASTM E 1745, meets or exceeds Class A
4. Water Vapor Transmission Rate: ASTM E 96, 0.008 gr./ft2/hr. (0.086 gr./m²/hr) or lower
5. Permeance Rating: ASTM E 96, 0.03 Perms or lower for new material and after conditioning tests in accordance with applicable sections of ASTM E 154
6. Puncture Resistance: ASTM E 1745,minimum 2400 grams
7. Tensile Strength: ASTM E 1745, minimum 45.0 lbs./in (8.0 kg/cm).
8. Acceptable product: W.R.Grace, “Florprufe 120”
9. Acceptable product: W. R. Meadows, “Perminator”
10. Acceptable product: Stego Industry LLC, “Stego Wrap”
11. Acceptable product: Raven Industries, “Raven Vapor Block 15”.

## 2.5 CONCRETE REPAIR MATERIALS

A. Polymer Repair Mortar

1. The following patching mortars may be used when color match of the adjacent concrete is not required. Prior approval by the Design Professionals is required.
2. Acceptable Products (Horizontal Repairs): Euclid Chemical Company “Thin Top Supreme or Tammspatch II” (for 1/16” (2mm) to 3/8” (10mm) thickness), or “Concrete Top Supreme” (for 3/8” (10mm) to 2” (50mm) thickness).
3. Acceptable Products (Horizontal Repairs): Sika Corporation “Sikatop 121 Plus” or "Sikatop 122 Plus”.
4. Acceptable Products (Vertical and Overhead Repairs): Euclid Chemical Company “Verticoat”, “Verticoat Supreme”, or “Duraltop Gel”
5. Acceptable Products (Vertical and Overhead Repairs): Sika Corporation, “Sikatop 123 Plus”.
6. Acceptable Products (Horizontal, Vertical and Overhead Repairs): BASF, “EMACO 100”

B. High Strength Flowing Repair Mortar

1. For forming and pouring structural members, or large horizontal repairs, provide the flowable one-part, high strength microsilica modified repair mortar with 3/8” (10mm) aggregate.
2. The product shall achieve 9000 psi (62MPa) @ 28-days at a 9-inch (225mm) slump.
3. Prior approval by the Design Professionals is required for cold weather applications
4. Acceptable Product: Euclid Chemical Company “Eucocrete”
5. Acceptable Product: BASF “EMACO S” Series
6. Acceptable Product: Sika Corporation “Sika Repair 211 SCC Plus”

C. Epoxy Injection:

1. ASTM C881, moisture insensitive maximum viscosity 350 cps at 77°F (25°C).
2. Acceptable Product: BASF “Concresive 1380”
3. Acceptable Product: Euclid Chemical Company “Eucopoxy Injection Resin”
4. Acceptable Product: Sika Corporation “Sikadur 35, LV, LPL”

D. Sealant:

1. Silicone or Polyurethane Sealant (as selected based on project requirements such as loading, traffic, bond, coatings, etc.).
2. Joint to be routed and cleaned per manufacturer’s written directions.

# PART 3 - EXECUTION

## 3.1 PREPARATION

A. Subgrade:

1. Dampen subgrades not covered with membrane by sprinkling immediately before placing concrete.
    a. Omit when subgrade is already damp.

2. Do not place on water-saturated subgrade unless placing can be done without damage to subgrade (surface is stable) and loading the subgrade does not drive free water to the surface.
3. Do not place concrete on frozen ground.

B. Forms:

1. Coordinate with Section 031000 Concrete Formwork.
2. Remove dirt, sawdust, nails and other foreign material from formed space.
3. Dampen wood forms by sprinkling immediately before placing.
4. Cool metal forms by sprinkling immediately before placing.

C. Concrete Accessories:

1. Coordinate with Section 031000 Concrete Formwork.

D. Dewatering:

1. Remove water from concrete formwork.
2. Divert any flowing water to sump and remove by pumping.
3. Refer to Division 1 for additional dewatering requirements.

E. Vapor Retarder Placement: See Division 7, Thermal and Moisture Protection.

1. Vapor retarder installation shall be in accordance with manufacturer's instructions and ASTM E 1643.
2. Place vapor retarder under slabs-on-grade in position with longest dimension parallel with direction of pour.
3. Joints: Lap 6" (150mm) minimum and seal with manufacturer's recommended mastic or pressure-sensitive tape.
4. Prevent damage to moisture barrier.
5. If moisture barrier is damaged, place a piece of moisture barrier over damaged area (6" (150mm) larger all around) and tape in place with type of tape recommended by moisture barrier manufacturer.
6. Seal laps and intersections of walls with compatible trowel mastic or pressure-sensitive sealing tape.
7. Seal around pipes and other penetrations with compatible trowel mastic.
8. The vapor barrier must be approved prior to concrete placement.

**3.2 JOINTS IN CONCRETE**

A. Locate construction and contraction joints as indicated on Drawings and on approved joint location submittal.

1. Locate and install construction joints so they do not impair strength or appearance of the structure, as acceptable to Design Professionals.

B. Construction Joints:

1. Construction joints shall be located within the central third of the span. Any concrete spilling over or through the bulkhead shall be removed at the completion of the pour. All surfaces of the concrete shall have reinforcing extending through the joint.

2. Joint Preparation: Forms shall be removed in time to permit roughening of construction joints of structural members by chipping and wire brushing to remove all loose and foreign material and roughen as indicated on the Drawings. The existing concrete at joints shall either be (a) dampened to the point that the surface is saturated, but all standing water has been removed, promptly followed by placement and vibration of fresh concrete, or (b) not required to be dampened, with one of the specified bonding compounds applied as appropriate for the joint condition, following manufacturer recommendations, with placement and vibration of fresh concrete to follow while the epoxy bonding agent is still tacky. Joints without epoxy bonding agent require fresh concrete with slump 7 inches (180mm) or greater at horizontal joints, and fresh concrete confined to maintain pressure against the joint at vertical joints. Where such conditions are not present, or where applying water to dampen the surface is impractical, use epoxy bonding agent suitable for dry surfaces.

**3.3 MIXING**

A. Measurement of Materials: Conforming to ASTM C 94
B. Mixing: All concrete shall be ready-mixed conforming to ASTM C 94 except as follows:

1. Provide concrete materials, proportions and properties as herein specified in lieu of ASTM C 94.
2. Water, beyond that required by the mix design, shall not be added at the Project site. Addition of water at the Project site shall be made only in the presence of the Owner's Testing Agency.
3. Furnish delivery ticket with each load of concrete delivered to the site to the Contractor conforming to the requirements of ASTM C 94.

C. High range water reducing agents (superplasticizer), if added at the batch plant, may be added again at the Project site.

1. If superplasticizers are added at the batch plant, the concrete mix design must account for the delivery time, workability, finishability, and setting time required on the jobsite for proper placing and finishing procedures.

D. Discharge of the concrete shall be completed within 1-1/2 hours or before the drum has revolved 300 revolutions, whichever comes first, after the introduction of the mixing water to the cement and aggregates or the introduction of the cement to the aggregates.

**3.4 CONCRETE PLACEMENT**

A. Prior to Concrete Placement:

1. Mechanical vibrators are required and must be available for placing concrete.
2. Remove debris from space to be occupied with concrete.
3. Notify Design Professionals and Owner’s Testing Agency 48 hours prior to starting concrete placement.
4. Approved mix designs must be maintained on file in Contractor's Field Office.
5. Reinforcement and accessories shall be in proper locations, clean, free of loose scale, dirt or other foreign coatings that may reduce bond to concrete, and in accordance with Section 032000 and Drawings.
6. Fog spray forms, reinforcing steel, and subgrade just before pouring concrete.
7. Do not place concrete having a slump outside of allowable slump range.

8. Place concrete before initial set has occurred, but in no event after it has been discharged from the mixer more than 30 minutes. All concrete shall be placed upon clean, damp surfaces, free from puddled water, or upon properly consolidated fills or upon Controlled Low-Strength Material with a strength between 50 and 1200 psi. Placement upon soft mud or dry earth is not permitted.
9. Unless adequate protection is provided, concrete shall not be placed during rain.
10. Rain water shall not be allowed to increase mixing water or to damage the surface finish.
11. At surfaces left exposed to view, do not use equipment in placing and finishing concrete that contain aluminum in the finishing edges that come in contact with the concrete surface.
12. Keep subgrade moisture uniform without puddles or dry areas.
13. Place vapor retarder directly below slabs on grade as specified in Contract Documents.

B. Pumping: Pumping shall be done in strict accordance with ACI 304.2R.

C. Placing Concrete in Forms:

1. Clean and prepare forms as specified in Section 031000/Concrete Formwork.
2. Place concrete continuously without interruption between predetermined construction and contraction joints in walls.
3. Deposit concrete in forms in horizontal layers no deeper than 24” (600mm) and in a manner to avoid inclined construction joints.
4. Where placement consists of several layers, place each layer while preceding layer is still plastic to avoid cold joints.
5. Consolidate placed concrete by mechanical vibrating equipment supplemented by hand-spading, rodding or tamping.

    a. Use equipment and procedures for consolidation of concrete in accordance with ACI 309R.

6. Do not use vibrators to move fresh concrete laterally inside forms from discharge point; shift discharge point as needed.
7. Insert and withdraw vibrators vertically at uniformly spaced locations no farther than the visible effectiveness of the machine.
8. Place vibrators to rapidly penetrate placed layer and at least 6" (150mm) into preceding layer.
9. Do not insert vibrators into lower layers of concrete that have begun to set.
10. At each insertion, limit duration of vibration to time necessary to consolidate concrete and complete embedment of reinforcement and other embedded items without causing segregation of mix.
11. Do not vibrate Self-Consolidating Concrete (SCC).

D. Placing Concrete at Construction Joints:

1. To secure full bond at construction joints, surfaces to receive concrete in a subsequent placement shall be left in a roughened state or intentionally roughened by raking while plastic or brushing and chipping immediately after removal.
2. Before new concrete is placed in contact, surfaces of hardened concrete already placed shall be thoroughly cleaned of foreign materials and laitance.
3. At hardened concrete at joints where no bonding agents are used, dampen concrete to achieve a saturated surface dry condition. Leave no standing water. Place and vibrate concrete (slump 7

inches (180mm) or greater) against horizontal joints. Place and vibrate flowing concrete (slump 8 to 10 inches (200 to 250mm)) while maintaining pressure against vertical joints by confinement.
4. At hardened concrete with joints not meeting conditions required for no bonding agents, apply appropriate specified bonding agent for conditions present including age and moisture per manufacturer's specifications. Place new concrete while the bonding agent is still tacky.

E. Cold-Weather Placement:

1. Protect concrete work from physical damage or reduced strength which could be caused by frost, freezing actions, or low temperatures, in compliance with ACI 306R and as specified in this section.
2. When air temperature has fallen to or is expected to fall below 40°F (4°C), uniformly heat water and aggregates before mixing to obtain a concrete mixture temperature of not less than 50°F (10°C), and not more than 80°F (27°C), at point of placement.
3. Do not use frozen materials or materials containing ice or snow.

    a. Do not place concrete on frozen subgrade or on subgrade containing frozen materials.

4. Remove frost, snow and ice from forms, reinforcement and other embedments immediately prior to concrete placement.
5. Use only the specified non-corrosive accelerating admixture previously approved as part of the cold weather mixture. Addition of calcium chloride, salt, thiocyanates or admixtures containing more than 0.05 percent chloride ions is not permitted.

F. Hot-Weather Placement:

1. Hot weather is defined as air temperature which exceeds 90°F (32°C) or any combination of high temperature, low humidity and/or high wind velocity which causes a rate of evaporation in excess of 0.2 pounds per square feet per hour (1.0 kg/m² per hour) as determined by ACI 305R.
2. When hot weather conditions exist that would impair quality and strength of concrete, place concrete in compliance with ACI 305R and as specified in this section.
3. Cool ingredients before mixing to maintain concrete temperature at time of placement below 90°F (32°C).
4. Mixing water may be chilled, or chopped ice may be used to control temperature, provided water equivalent of ice is calculated to total amount of mixing water.
5. Use of liquid nitrogen to cool concrete is Contractor's option.
6. When concrete placement will occur late in the day and reinforcing steel will be heated by the sun, cover reinforcing steel with water-soaked burlap so that steel temperature will not exceed ambient air temperature immediately before embedding in concrete.
7. When concrete operations must be performed in direct sun, wind, high temperatures, low relative humidity, or other adverse placing conditions, the specified evaporation retarder shall be applied one or more times during the finishing operation to prevent plastic cracking.

## 3.5 CONCRETE FINISHES

A. General:

1. Comply with recommendations for concrete finishing established by ACI 302.1R and ACI 304R.
2. Comply with dimensional tolerance limitations given by ACI 117.
3. See architectural Drawings for locations of the various finishes listed below.

B. Rough Formed Finish:

1. Acceptable for formed concrete surfaces not exposed-to-view in the finish work or by other construction, unless otherwise indicated.
2. Concrete surface shall have texture imparted by form-facing material used, with tie holes and defective areas repaired and patched, and fins and other projections exceeding 1/4" (6mm) in height rubber down or chipped off.

C. Smooth Formed Finish:

1. Required for formed concrete surfaces exposed to view, or scheduled to be covered with a coating material applied directly to concrete, or a covering material applied directly to concrete, such as waterproofing, dampproofing, veneer plaster, painting, or other similar system, as indicated on architectural Drawings:
2. Surface is an as-cast concrete surface obtained with selected form-facing material, arranged in an orderly and symmetrical manner with a minimum of seams.
3. Repair and patch tie holes and defects. Remove fins and other projections completely.

D. Grout-Cleaned Finish:

1. Provide grout-cleaned finish on scheduled concrete surfaces, as indicated on architectural Drawings, that have received smooth-formed finish treatment.
2. Combine one part Portland Cement to one and one-half parts fine sand by volume, and a 50:50 mixture of acrylic or styrene butadiene-based bonding admixture and water to form the consistency of thick paint.
3. Blend standard Portland Cement and white Portland Cement in amounts determined by trial patches so that final color of dry grout will match adjacent surfaces.
4. Thoroughly wet concrete surfaces, apply grout to coat surfaces, and fill small holes.
5. Remove excess grout by scraping and rubbing with clean burlap.
6. Keep surface damp by fog spray for at least 36 hours after rubbing.

E. Unformed Surfaces:

1. 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.
2. Continue final surface treatment of formed surfaces uniformly across adjacent unformed surfaces, unless otherwise indicated.

**3.6 CURING AND PROTECTION**

A. Normal Conditions:

1. Protect concrete from premature drying, excessive hot or cold temperature, and damage.
2. Concrete shall be kept continuously moist and above 50°F (10°C) for seven days (ASTM C 150 Type I cement) or for 10 days (ASTM C 150 Type II cement). High early strength concrete usage shall be maintained over 50°F (10°C) for three days.
3. Concrete and concrete patching materials shall be cured according to manufacturers published recommendations.
4. Begin curing as soon as free water has disappeared from concrete surface and finishing has been completed.

5. Curing Methods: Cure concrete by curing compound, by moist curing, by moisture-retaining cover curing, or by combining these methods, as specified.

    a. Apply curing compound on exposed interior slabs and on exterior slabs, walks, and curbs as follows:

        i. Apply curing compound to concrete slabs as soon as final finishing operations are complete (within 2 hours and after surface water sheen has disappeared).
        ii. Apply uniformly in continuous operation by power spray or roller according to manufacturer's directions.
        iii. Recoat areas subjected to heavy rainfall within 3 hours after initial application.
        iv. Maintain continuity of coating and repair damage during curing period.

    b. Provide moist curing by the following methods:

        i. Keep concrete surface continuously wet by covering with water.
        ii. Use continuous water-fog spray.
        iii. Cover concrete surface with specified absorptive cover, thoroughly saturate cover with water, and keep continuously wet. Place absorptive cover to provide coverage of concrete surfaces and edges, with a 4” (100mm) lap over adjacent absorptive covers.

    c. Provide moisture-retaining cover curing as follows:

        i. Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width with sides and ends lapped at least 3” (75mm) and sealed by waterproof tape or adhesive.

            (1) Immediately repair any holes or tears during curing period using cover material and waterproof tape

6. Curing Formed Surfaces: Cure formed concrete surfaces, including underside of beams, supported slabs, and other similar surfaces, by leaving forms in place for the full curing period (equivalent to moist curing).

    a. If forms are removed prior to completion of full curing period, continue curing by methods specified above for Unformed Surfaces, as applicable.

B. Cold-Weather Protection:

1. When concrete is placed under conditions of cold weather concreting (defined as a period when the mean daily temperature drops below 40°F (4°C) for more than 3 successive days), take additional precautions as specified in ACI 306R when placing, curing, monitoring and protecting the fresh concrete.

C. Hot-Weather Protection:

1. When concrete is placed under conditions of hot weather concreting, provide extra protection of the concrete against excessive placement temperatures and excessive drying throughout the placing and curing operations with an evaporation retarder.

a. Apply according to manufacturer's instructions after screeding and bull floating, but before power floating and troweling.

2. Hot weather curing is required if hot weather conditions occur within a 24-hour period after completion of concrete placement.

**3.7 CONCRETE REPAIRS**

A. Perform patching and repairs in accordance with ACI 301.
B. Apply all patching and repair materials in accordance with manufacturer's specifications.
C. Repairing Formed Surfaces

1. Immediately after stripping forms, patch all honeycombing, defective joints, voids, etc. before the concrete is thoroughly dry.
2. Remove all burrs, fins, and ridges before the concrete is thoroughly dry.
3. Remove stains from rust, grease and oils, from release agents, etc.
4. Repair concealed formed surfaces, where possible, containing defects that affect the durability of concrete. If defects cannot be repaired, remove and replace concrete.
5. Clean out form tie holes and fill with dry pack mortar or precast cone plugs secured in place with bonding agent.
6. If honeycombing exposes reinforcement, chip to provide clear space at least 3/4" (20mm) wide all around steel to allow proper bond.

D. Repairing Unformed Surfaces:

1. High and Low areas in concrete surfaces which are in excess of specified tolerances shall be leveled or ground-smooth.

a. Correct high areas by grinding after concrete has cured at least 14 days.
b. Correct low areas by applying leveling material. Finish leveling material as specified in this section.

2. Repair surfaces containing defects that affect durability of concrete.

a. Surface defects include crazing, cracks as defined above, spalling, popouts, honeycombs, rock pockets, and other objectionable conditions.

3. Repair defective areas, except random cracks and single holes not exceeding 1" (25mm) in diameter, by cutting out and replacing with fresh concrete.

a. Remove defective areas with clean, square cuts and expose reinforcing steel with at least 3/4" (20mm) clearance all around.

E. Filling In: Fill in holes and openings left in concrete for passage of work by other trades, unless otherwise shown or directed, after work of other trades is in place.

**3.8 EVALUATION AND ACCEPTANCE OF CONCRETE**

A. In accordance with ACI 301, except where otherwise specified.

B. If, at any time during construction, the concrete resulting from the approved mix design deviates from Specification requirements for any reason, such as lack of workability, or insufficient strength, the Contractor shall have his laboratory verify the deficiency and modify the mix design, until the specified concrete is obtained. Modified mix to be submitted for approval per Part 1 - SUBMITTALS.

## 3.9 CORRECTIVE MEASURES

A. Conflicts: The Contractor shall be solely responsible for errors of detailing, fabrication, and placement of reinforcement steel; placement of inserts and other embedded items; and the structural adequacy of all formwork.

**END SECTION 03 30 00**

# Division 05 Metals

**SECTION 05 12 00**
**STRUCTURAL STEEL FRAMING**

## PART 1 - GENERAL

### 1.1 SUBMITTALS

A. Shop Drawings.

### 1.2 SUBMITTALS

A. Product data. Unless otherwise indicated, submit the following for each type of product provided under work of this Section:

1. Recycled Content:

a. Indicate recycled content; indicate percentage of pre-consumer and post-consumer recycled content per unit of product.
b. Indicate relative dollar value of recycled content product to total dollar value of product included in project.
c. If recycled content product is part of an assembly, indicate the percentage of recycled content product in the assembly by weight.
d. If recycled content product is part of an assembly, indicate relative dollar value of recycled content product to total dollar value of assembly.

## PART 2 - PRODUCTS

### 2.1 PERFORMANCE REQUIREMENTS

A. Connections: Provide details of connections required by the Contract Documents to be selected or completed by structural-steel fabricator.

1. Use ASD; data are given at service-load level.

B. Comply with applicable provisions of the following:

1. AISC 303.
2. AISC 341 and AISC 341s1.
3. AISC 360.
4. RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."

### 2.2 STRUCTURAL STEEL

A. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of preconsumer recycled content minimum 25 percent.
B. Hot-Formed Hollow Structural Sections: ASTM A 500, Grade C structural tubing.

### 2.3 ACCESSORIES

A. High-Strength Bolts, Nuts, and Washers: ASTM A 325 (ASTM A 325M), Expansion bolts; BA-LHBM20-2EG HOLLO BOLT LYNDAPTER, Type 1, heavy-hex steel structural bolts; ASTM A 563, Grade C, (ASTM A 563M,

Class 8S) heavy-hex carbon-steel nuts; and ASTM F 436 (ASTM F 436M), Type 1, hardened carbon-steel washers.

B. Anchor Rods: ASTM F 1554, Grade 36.

    1. Configuration: Straight
    2. Nuts: ASTM A 563 (ASTM A 563M) heavy-hex carbon steel.
    3. Plate Washers: ASTM A 36/A 36M carbon steel.
    4. Washers: ASTM F 436 (ASTM F 436M), Type 1, hardened carbon steel. C. Primer: Fabricator's standard lead- and chromate-free, nonasphaltic, rust-inhibiting primer.

C. Plates: ASTM A572 Grade 50

**2.4 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. Weld Connections: Comply with AWS D1.1/D1.1M and AWS D1.8/D1.8M for tolerances, appearances, welding procedure specifications, weld quality, and methods used in correcting welding work.
C. Shop Priming: Prepare surfaces according to SSPC-SP 2, "Hand Tool Cleaning"; or SSPC-SP 3, "Power Tool Cleaning." Shop prime steel to a dry film thickness of at least 1.5 mils (0.038 mm). Do not prime surfaces to be embedded in concrete or mortar or to be field welded.
D. Uncoated ferrous metal surfaces indicated as ‘weathered steel’ shall have all oil removed by application of degreaser as required. No further surface treatment required.

**PART 3 - EXECUTION**

**3.1 ERECTION**

A. Structural Steel Frames are built integrated to module and allow bearing surface for lifting by under straps/transportation.
B. Set structural steel accurately in locations, to elevations indicated, and according to AISC 303 and AISC 360.
C. Base Bearing and Leveling Plates: Clean concrete- and masonry-bearing surfaces of bond-reducing materials, and roughen surfaces prior to setting plates. Clean bottom surface of plates.

    1. Set plates for structural members on wedges, shims, or setting nuts as required.
    2. Weld plate washers to top of base plate.
    3. 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 packing with grout.
    4. Promptly pack grout solidly between bearing surfaces and plates so no voids remain. Neatly finish exposed surfaces; protect grout and allow to cure.

D. Align and adjust various members forming part of complete frame or structure before permanently fastening. Before assembly, clean bearing surfaces and other surfaces that will be in permanent contact with members. Perform necessary adjustments to compensate for discrepancies in elevations and alignment.
E. Do not use thermal cutting during erection unless approved by Architect. Finish thermally cut sections within smoothness limits in AWS D1.1/D1.1M.

F. 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. Joint Type: Snug tightened
G. Weld Connections: Comply with AWS D1.1/D1.1M and AWS D1.8/D1.8M for tolerances, appearances, welding procedure specifications, weld quality, and methods used in correcting welding work.

**END SECTION 05 12 00**

# SECTION 05 40 00
# COLD-FORMED METAL FRAMING

## PART 1 - GENERAL

### 1.1 GENERAL

A. Work of this Section shall conform to the requirements of Drawings and general provisions of the Contract, including General Conditions, Supplementary General Conditions and Division 1 Specification sections.

### 1.2 SCOPE

A. The work covered by this Section shall include all labor, material, equipment, permits, engineering and other services necessary for the installation of light gauge steel stud and joist framing as required for a complete installation in accordance with the Drawings and as specified herein. Work includes, but is not necessarily limited to the following:

1. Load-bearing steel stud framing at exterior walls.
2. Interior stud wall and ceiling framing with studs.
3. Framing accessories.

### 1.3 RELATED WORK SPECIFIED IN OTHER SECTIONS:

A. See below for related work:

| | |
|---|---|
| Structural Steel | Section 051200 |
| Metal Fabrications | Section 055000 |
| Fireproofing | Division 7 |

### 1.4 CODES AND STANDARDS

A. Building Code: Cold-Formed Metal Framing work shall conform to the requirements of the Building Code identified on the Structural General Notes, and OSHA requirements, except where more stringent conditions or criteria occur in the standards referenced below and on the Drawings.
B. Standards:

1. International Residence Code (IRC), with Champaign IL amendments, 2015 Edition.
2. American Society for Testing and Materials "ASTM Standards in Building Codes", various standards as referenced herein, latest edition.
3. Federal Specifications (FS).
4. American Welding Society (AWS) D1.3: “Structural Welding Code - Sheet Steel.”
5. American Iron and Steel Institute (AISI): “Specifications for the Design of Cold-Formed Steel Structural Members”, latest edition.
6. Steel Stud Manufacturer’s Association (SSMA), latest edition.
7. Society of Protective Coatings (SSPC).

## 1.5 QUALITY ASSURANCE

A. Regulatory Requirements:

1. Provide materials, accessories, and application procedures which have been listed by an approved testing agency or tested according to ASTM E119 for the type of construction shown.
2. Comply with IRC Section R505.2 and AISI requirements for design and identification of cold-formed steel.
3. Framing shall conform to the ICC Report for stud gauge and spacing for all wall conditions.

B. Steel stud system shall conform to referenced AISI documents.
C. Installer: Company specializing in performing the work of this Section with minimum 3 years' documented experience.
D. Welders: Qualified in accordance with AWS D1.3 for welding process, position, type of weld and type of steel.

## 1.6 SUBMITTALS

A. Submit in accordance with provisions of Section 013000, "Submittals."
B. Product Data: Manufacturer's ICC report, specifications and installation instructions for steel studs, fasteners, and accessories.
C. Experience of installer if requested by Architect.

## 1.7 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Procedures: In accordance with Section 016000, "Materials & Equipment."
B. Protect framing from rusting and damage.
C. Deliver in manufacturer's unopened containers or bundles fully identified with name, brand, type and grade.
D. Store inside a dry, ventilated space, and protect framing from rust and damage.

## 1.8 JOB CONDITIONS

A. Coordinate stud sizes and layouts with the work of the various trades. Where ductwork, conduit, piping, casework, and other such items exceed indicated available space, increase stud sizes or make other minor modifications as necessary to accommodate the work at no change in cost of the Work.

# PART 2 - PRODUCTS

## 2.1 MANUFACTURERS

A. Acceptable Manufacturers: Any member of Steel Stud Manufacturer's Association (ICC ER-3064P).

## 2.2 MATERIALS

A. Sheet Steel: ASTM A1003 or A653.
B. Studs and tracks:

1. See drawings for size and gauge.
2. Galvanization per ASTM A653 with G60 minimum.

C. Sliptrack: as indicated on approved drawings. Acceptable Manufacturers: Sliptrack Systems (ICC ESR-2049) or engineer approved equal.
D. Clip Angles: Steel Stud Connectors as indicated on approved drawings. Acceptable Manufacturers: Simpson Strong Tie or engineer approved equal.
E. Partition Stiffeners or Bridging: Spacer Bracer as indicated on approved drawings for wall assemblies. Acceptable Manufacturers: Simpson Strong Tie or engineer approved equal. Unpunched channel shape, formed to required dimensions for floor and ceiling assemblies.
F. Welding Electrodes: AWS low hydrogen, rod number and diameter as approved by the Owner's Testing Agency.
G. Touch-up Primer for Galvanized Surfaces: SSPC Paint 20 zinc rich.
H. Metal Screws: Screws shall be self-drilling and self-tapping. Screws shall penetrate substrate by a minimum of three full threads exposed. Use low profile heads as required by architectural finish.

    1. Sheet Metal Screw (SMS): No. 8 and larger as noted on Drawings per ASTM 1513-13.

        a. The minimum spacing between centers of fasteners shall not be less than 3 times the fastener diameter. The minimum edge distance from the center of fastener to the edge of any part shall not be less than 1.5 times the fastener diameter.

    2. Heavy Gauge Screws: Size as noted on Drawings. Use "TEKS" screws by ITW Buildex (ICC ESR-1976) or equal product substituted per Section 016300.
    3. Hex Head Screws: Size as noted on Drawings. Use "Kwik-Flex" screws by Hilti or equal product substituted per Section 016300.

**PART 3 - EXECUTION**

**3.2 PREPARATION**

A. Coordinate details and requirements of other Work which adjoins or fastens to studs and requires backing or special support framing included in this Section.

    1. Items requiring backing or support include, but are not necessarily limited to casework, wall-specialties, and similar items.
    2. Obtain Architect's approval of backing method proposed to satisfy requirements of this Section which differs from methods noted or shown.

**3.3 EXAMINATION**

A. Examine all parts of the supporting structure and the conditions under which studs will be installed.
B. Notify the Architect, in writing, of any conditions detrimental to the proper and timely completion of the Work.
C. Do not proceed with the installation of steel studs until unsatisfactory conditions have been corrected.

**3.4 INSTALLATION**

A. Tracks shall be securely anchored to supporting structure, with fasteners specified at not more than 24-inches on center.
B. Complete, uniform, and level bearing support shall be provided for the bottom track at each bearing-stud location. Install full metal shims below bottom track at stud locations as needed, or set bottom track in high-strength grout.

C. Abutting or intersecting pieces or track shall be securely anchored to a common structural element or spliced together.

    1. Splices or butt welds shall be used at all butt joints in the runner track.
    2. Do not splice studs.

D. Wall studs shall sit in top and bottom track with 1/16" maximum gap between wall stud and track web.

    1. Studs shall be aligned or plumbed and securely fastened to the flanges of both top and bottom track.
    2. Space studs 24-inches on center maximum unless otherwise noted on Drawings.

E. Isolate non-load-bearing steel framing from building structure to prevent transfer of vertical loads while providing lateral support.

    1. Connect vertical (and/or drift) deflection clips to studs and anchor to primary building structure in accordance with manufacturer's recommendations.

F. Framed wall openings shall include a header and multiple studs at each edge of opening as indicated on Drawings. Contractors option to built-up jambs, headers, and sills: JamStud® by The Steel Network, Inc. ASTM A653/A653M, Grade 50 (340) 50ksi (340MPa), minimum yield strength 65ksi (450MPa), minimum tensile strength, G-60 (Z180) hot-dipped galvanized coating.
G. Install bridging as indicated on Drawings.
H. Form corners and intersections of partitions with three studs as shown on Drawings. Provide additional studs as indicated or required.
I. Joining of members shall be made with welding; wire tying of framing members shall not be permitted.
J. Welded connections shall be made by resistance spot fusion welding, fillet welding, or plug welding and shall be done in accordance with the latest recommended procedures and practices of the American Welding Society.
K. Do not cut or notch stud flanges.
L. Erection Tolerances: Install cold formed metal framing to a maximum allowable tolerance variation from plumb, level, and true to line of 1/8-inch in 10 feet 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.

M. Provide all angles, clips and other miscellaneous pieces necessary to attach light gauge framing to building structure or to attach other materials to light gauge framing.
N. Do not bridge building expansion and control joints with cold formed metal framing. Independently frame both sides of joints.

**3.5 BACKING IN STUD PARTITIONS**

A. Securely weld or screw cut sections of unpunched stud to at least three stud or furring supports, leaving flat surface of backing stud web to receive attachment of object to be secured.
B. Verify that any pre-drilling of backing and attachment of spacers to prevent crushing of collateral material is done prior to application of collateral material.

C. If it is determined by the Architect that backing was not provided for any items as required, the Contractor shall remove the finish material and install backing. The Contractor shall patch and refinish surface to match adjacent area and finish.

## 3.6 FIELD QUALITY CONTROL

A. The Owner's Testing Agency will:

1. Provide continuous inspection during installation as required to establish conformity of Work requirements.

**END SECTION 05 40 00**

# Division 06 Wood, Plastics, and Composites

# SECTION 06 15 00
# WOOD DECK

## PART 1 - GENERAL

### 1.1 SUMMARY

A. Section Includes: Wood Deck Flooring
B. Related Requirements:

    1. Section 09 64 00 Wood Flooring
    2. Section 09 62 00 Cork Flooring

## PART 2 - PRODUCTS

### 2.1 WOOD DECK

A. Fabricated planks constructed from reclaimed wood.
B. For LEED certification, the wood must be nontropical, reused or reclaimed, or certified by the Forest Stewardship Council, or USGBC-approved equivalent.

    1. A tree species is considered tropical if it is grown in a location that lies between the Tropic of Cancer and the Tropic of Capricorn.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

A. Examine substrates for conditions affecting performance of wood decking. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 INSTALLATION

A. Owner shall install wood deck at locations indicated on architect's drawings.

**END SECTION 06 15 00**

# SECTION 06 42 00
# WOOD PANELING

## PART 1 - GENERAL

### 1.1 SUMMARY

A. Section Includes: Wood Paneling
B. Related Requirements:

    1. Section 09 90 50 Wall Coverings

## PART 2 - PRODUCTS

### 2.1 WOOD PANELING

A. Fabricated panels constructed from reclaimed wood.
B. For LEED certification, the wood must be nontropical, reused or reclaimed, or certified by the Forest Stewardship Council, or USGBC-approved equivalent.

    1. A tree species is considered tropical if it is grown in a location that lies between the Tropic of Cancer and the Tropic of Capricorn.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

A. Examine areas for conditions affecting performance of wood paneling. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 INSTALLATION

A. Owner shall install wood panels at locations indicated on architect's drawings.

**END SECTION 06 42 00**

# SECTION 06 40 10
# MILLWORK

## PART 1 - GENERAL

### 1.1 SUMMARY

A. Section Includes: Millwork in Kitchen, Toilet, Livingroom

### 1.2 SUBMITTALS

A. Product Data: For each type of product.
B. Samples: Submit duplicate clearly labelled samples of each sliding door component.
C. Shop Drawings: Submit manufacturer's shop drawings.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURER

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

    1. Eco Supply

### 2.2 MILLWORK IN KITCHEN, TOILET, LIVING ROOM

A. Follow the specifications of the products chosen from manufacturer for type of millwork:

    1. Richlite

B. For LEED certification, the product must contain at least 25% reclaimed and postconsumer content; however, the product could instead contain 50% preconsumer content.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

A. Install millwork in accordance with manufacturer's instructions at locations indicated on the architect's drawings.

**END OF SECTION 06 40 10**

# Division 07 Thermal And Moisture Protection

**SECTION 07 21 00**

**THERMAL INSULATION**

## PART 1 – GENERAL

### 1.1 SUMMARY

A. Section Includes

1. Continuous Insulation for Walls

## PART 2 – PRODUCTS

### 2.1 MANUFACTURERS

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

1. Rmax - A Business Unit of the Sika Corporation.
2. Owens Corning
3. Kingspan

### 2.2 CONTINUES INSULATION FOR WALLS

A. Durasheath-3: Closed-cell polyisocyanurate insulation with an inorganic polymer coated glass fiber mat facer on each side.

1. Thickness: 2.5 inches (64mm).

a. Thermal Resistance (R): 15.3.

B. FOAMULAR ® 250: Extruded polystyrene (XPS) rigid foam insulation.

1. Thickness: 2.5 inches (64mm).

a. Thermal Resistance (R): 12.5.

C. Green Guard ® Type IV 25 psi XPS insulation board.

1. Thickness: 2.5 inches (64mm).

a. Thermal Resistance (R): 12.5.

D. Equivalent products with R value greater than R-5/in and permeance equal or greater than 1.5 perms are considered acceptable.

## PART 3 – EXECUTION

### 3.1 EXAMINATION AND PREPARATION

A. Do not begin installation until substrates have been properly prepared.
B. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.
C. Clean surfaces thoroughly prior to installation.
D. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

### 3.2 INSTALLATION, GENERAL

A. Install in accordance with manufacturer's instructions and in proper relationship with adjacent construction.
B. Insulation shall be installed vertically or horizontally with all edges tightly butted. Vertical joints must be backed by framing or structural sheathing. Taping the joints is acceptable, although not required.
C. Fasteners: The insulation is recommended a minimum of eight fasteners per 4’x8’ board.

    1. Screw Length: Screws should be at least 1” longer than the total thickness of interior sheathing components. The maximum distance between framing and washer of 5 inch requires screw length of 6 inch corresponding to #10 in screw size.
    2. Additional fasteners may be required in locations expected to experience additional loading (heavy wind drafts/gusts, accelerated wear and tear, etc.) prior to attachment of covering material (cladding, furring, thermal barrier, etc.) or when not being covered.
    3. Exact number of fasteners also depends on the type being used and the capacity, consult fastener manufacturer.
    4. Fasten to metal framing using self-tapping screws and plastic washers. The fasteners shall be long enough to penetrate metal framing a minimum of four threads.
    5. Secure to concrete surfaces using plastic masonry fasteners with washer or a quality grade construction adhesive.
    6. Head should be flush with insulation, do not countersink.
    7. Other materials, such as gypsum, should be fastened separately per manufacturer’s instructions

D. Protect installed products until completion of project.
E. Touch-up, repair or replace damaged products before Substantial Completion.

**END OF SECTION 07 21 00**

# SECTION 07 22 00
# ROOF AND DECK INSULATION

## PART1 – GENERAL

### 1.1 SUMMARY

A. Section Includes:

1. Continuous Insulation for Roofs

## PART 2 – PRODUCTS

### 2.1 MANUFACTURERS

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

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

1. Rmax
2. Owens Corning
3. Kingspan

### 2.2 CONTINUOUS INSULATION FOR ROOF

A. Multi-Max FA-3: Closed-cell polyisocyanurate roof insulation with glass fiber / organic mat facer on each side.

1. Thickness: 2.0 inches (51mm).

B. Green Guard ® Type IV 25 psi XPS insulation board.

1. Thickness: 2.0 inches (51mm).

C. Equivalent products with R value greater than R-5/in and permeance equal or greater than 1.5 perms are considered acceptable.

## PART 3 – EXECUTION

### 3.1 EXAMINATION AND PREPARATION

A. Do not begin installation until substrates have been properly prepared.

B. If substrate preparation is the responsibility of another installer, notify the Architect of unsatisfactory preparation before proceeding.
C. Clean surfaces thoroughly prior to installation.
D. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

### 3.2 INSTALLATION, GENERAL

A. Install in accordance with manufacturer's instructions and in proper relationship with adjacent construction.
B. General:

1. No more insulation shall be laid than can be covered with the completed membrane system by the end of the work for the day.
2. Do not shave, rasp or carve facers off any insulation panel. Removal of any portion of the insulation facer may cause the panel to warp or curl. Adhesives and hot bitumens used to assemble the roofing system may attack the exposed foam core.
3. Do not force rigid insulation to bend over roof ridges, deck irregularities or conform to deck low points such as drainage swales. Cut insulation panels around such details. Rmax does not recommend scoring or cutting the back side of an insulation panel to allow the board to conform to roof deck shapes or irregularities.
4. Place tapered edge strips for completion of roof edge details on top of the Rmax insulation product. Placing the Rmax insulation panel over the tapered edge strip can cause undue stress through bending of the panel and delamination of the facing from the insulation panel.
5. Rmax does not recommend the cutting or trimming of insulation panels with the “score and snap” method. Specifically, Rmax does not recommend that one side of a panel be scored with a sharp knife and then completing the “cut” by breaking the panel along the scored line. Polyisocyanurate will not break cleanly or evenly. Instead, Rmax recommends the use of a sharp, fine-toothed saw for cutting or trimming insulation panels.
6. Furnish all labor, material, tools, equipment and services for all preformed roofing as indicated, in accord with the provisions of the Contract Documents. The manufacturer will provide all components required for a complete roofing system to include trim/flashing, facades, ridge, closures, sealants, fillers and any other required items.

C. Mechanical Fasteners:

1. Rmax recommends that any insulation which is laid over a wood or steel roof deck be attached with screw and plate type mechanical fasteners. This type of fasteners must be approved for use by FM Global in a Class 1 roof deck assembly.
2. Fasteners must also be acceptable to the membrane supplier. The selection and use of any fastener is the responsibility of the roofing contractor.

D. Installation Details for Mechanically Attached Single-Ply Membranes:

1. Insulation shall be pre-attached to steel decks with one (1) mechanical fastener every eight (8) square feet. The attachment of the membrane shall provide the additional fastening required to restrain the system. Consult membrane supplier specifications for any additional fastener requirements for the insulation.
2. Fully adhered portions of the mechanically attached membrane shall be installed as outlined.
3. Certain design applications may call for the use of vapor and/or air barriers between the roofing insulation and the roof deck when installing a mechanically fastened single-ply. The use of such sheets or films may cause the system to behave as a fully adhered roofing system and thus require significantly more fasteners in the insulation. Please consult the membrane supplier for recommendations when using air and/or vapor barriers with mechanically fastened single-plies.

E. Multi-Layer Insulation Systems: Rmax recommends two layers of insulation whenever the total insulation requirement exceeds 3.0” to reduce thermal bridging, moisture migration, and system movement. Joints should be offset between the insulation layers as well as between the insulation and cover board.

F. Protect installed products until completion of the project.

G. Touch-up, repair or replace damaged products before Substantial Completion.

**END OF SECTION 07 22 00**

# SECTION 07 27 26
# FLUID APPLIED MEMBRANE AIR BARRIERS

## PART1 – GENERAL

### 1.1 SUMMARY

A. Section Includes
   1. Materials and installation methods for a liquid-applied 100% silicone vapor permeable air and water-resistive barrier system

## PART 2 – PRODUCTS

### 2.1 MANUFACTURERS

A. Manufacturer: Momentive Performance Materials, Inc., 260 Hudson River Rd., Waterford, NY 12188. Phone: +1 877-943-7325, www.ge.com/silicones

### 2.2 FLUID APPLIED AIR BARRIER

A. Fluid Applied Air Barrier: GE Elemax* 2600.
**B.** Liquid Flashing (Detail Sealant/Adhesive): GE Elemax 5000 Liquid Flashing, GE SCS2000 SilPruf*, GE SCS2700 SilPruf* LM, GE SCS9000 SilPruf* NB or GE SWS.

## PART 3 – EXECUTION

### 3.1 SURFACE PREPARATION

A. All surfaces must be clean, dry and free of contaminants that may interfere with proper bonding of the materials.
B. Clean loose mortar and other contaminants where necessary by wire brush or similar abrasion to provide a stable clean surface for application.
C. Mask off adjoining surfaces not covered by air barrier to prevent spillage and overspray affecting other construction.
D. Remove grease, oil, bitumen, form release agents, paints, curing compounds and other penetrating containments or film forming coatings from concrete.
E. Masonry joints shall be struck flush and cracks greater than crack bridging ability shall be filled (routed and filled where necessary) with a trowel application of GE liquid flashing prior to application of the liquid membrane to the surface. The membrane coating can be spray, power roller, roller or brush applied immediately after the application of the GE liquid flashing.
F. Sheathing joints must be treated per manufacturer's installation details.
G. Spot all over and under drive fasteners with GE liquid flashing or GE Elemax 2600.

### 3.2 INSTALLATION

A. Transition/Detailing treatment: Install appropriate materials to treat sheathing joints, expansion joints, drift joints, rough openings, transitions, terminations, penetrations and similar surface irregularities. Transitions and detailing can be performed before or after air barrier membrane application. Ensure installation is performed in accordance with manufacturers written installation instructions and details.
B. GE Elemax 2600 Fluid Applied Air Barrier

1. GE Elemax 2600 can be applied by spraying, power roller, roller and/or brush. Contact Momentive Technical Services for information on pump spraying and power rolling equipment useful to spray this material.
2. GE Elemax 2600 shall be applied at a rate of approximately 80 $ft^2$ (7.4 $m^2$)/gal and can be done with a single coat application (a site verification mock-up is recommended to verify coverage rates which will vary with substrate and method of application). A wet applied 19 wet mil (480 µ) thickness will yield a 17 mil (430 µ) dry film thickness.
3. Spray or roller apply the coating in an appropriate manner to ensure a uniform and seamless application.
4. Touch up or damage repair can be accomplished using spray, power roller, roller or brush and can proceed at anytime after application; while coating is still wet or while coating is dry (cured).
5. GE Elemax 2600 application is not recommended when the temperature is below 0° F (-18° C) or if frost or moisture is present on the surfaces to be coated.
6. Application of GE Elemax 2600 is not recommended to surfaces above 150° F (66° C).
7. The ultimate cure and tack-free of this product is dependent upon temperature and humidity. Under standard conditions [72 °F (22° C) and 50%RH] this material can attain a tack-free surface in 1-2 hours and with full cure overnight. As temperatures decrease, the tack-free and cure rate slows down (and vice versa as temperatures increase).

## 3.2 CLEANING AND PROTECTION

A. Protect air barrier system from damage during application and remainder of construction period.
B. If damage occurs repair per manufacturers' installation details.
C. Clean spills, stains and soiling from construction that would be exposed in the completed work using cleaning agents and procedures recommended in writing by manufacturer of affected construction.
D. Remove masking materials after installation.

**END OF SECTION 07 27 26**

**SECTION 07 50 00**
**MEMBRANE ROOFING**

## PART 1 – GENERAL

### 1.1 DESCRIPTION

A. Work in this section includes:

1. Roofing protection board
2. Roof insulation protection board

## PART 2 – PRODUCTS

### 2.1 Gypsum Roof Board:

A. USG Securock® Brand UltraLight Glass-Mat Roof Board

1. 5/8" thickness—Meets requirements of Type X per ASTM C1177 and may be used in P series designs as a thermal barrier.

### 2.2 MISCELLANEOUS MATERIALS

A. FM-approved plates and fasteners: Provide size and type in accordance with FM requirements, local code requirements, and roof system manufacturer's written recommendations. Stress plates shall be configured for application over hard surfaces.
B. Adhesives: As recommended by roof system manufacturer.

## PART 3 – EXECUTION

### 3.1 ROOF BOARD INSTALLATION

A. Refer to roof system manufacturer's written instructions, local code requirements and Factory Mutual Global (FMG) and/or Underwriters Laboratories (UL) requirements for proper installation techniques.
B. Use fasteners specified in accordance with the above requirements. Install approved fasteners with plates into the roof board, flush with the surface. Fasteners should be installed in strict compliance with the roof system manufacturer's installation recommendations and FMG Loss Prevention Data Sheet 1-29.
C. A qualified architect or engineer should review and approve calculations, framing and fastener spacing for all projects.
D. Locate edge joints on, and parallel to, deck ribs. Stagger end joints of adjacent lengths of USG Securock UltraLight Glass-Mat Roof Board.
E. All board edges should be loosely abutted and never kicked in tight in typical installations.
F. Roof boards should never be installed if they exhibit frost or are below 32°F.
G. See product data above in 2.1 section for maximum flute span when panels are applied directly over metal decking.

### 3.2 ROOF BOARD PROTECTION AND LIMITATION

A. Keep roof board panels dry before, during and after installation. Roof board should not be installed during rain, heavy fog and any other conditions that deposit moisture on the surface of the board. Apply

only as much roof board that can be covered by final roof membrane system in the same day. Avoid exposure to moisture from leaks or condensation.

B. Moisture from inside the building can be as big a risk for the roof system as moisture from outside. The contractor installing the roof and the design professional should protect the roof assembly not only from excessive moisture during the construction of the building (new concrete, paint, plaster materials) but also after the building is dried in.
C. The HVAC system must properly manage moisture generated by the occupants of the building to make sure it is vented to the outside and does not migrate into the roof system.
D. Plastic or poly packaging applied at the plant to protect board during rail or other transit should be removed upon receipt to prevent condensation or trapping of moisture, which may cause application problems.
E. Roof board should be stored flat and off the ground with protection from the weather. If stored outdoors, a breathable waterproof covering should be used.

**END OF SECTION 07 50 00**

**SECTION 07 53 23**
**EPDM ROOF**

## PART 1 - GENERAL

### 1.1 SUMMARY

A. Section Includes: EPDM Roof

### 1.2 ACTION SUBMITTALS:

A. Product Data: Manufacturer's data sheets on each product to be used.
B. Samples: For each finish product specified, two complete sets of chips representing manufacturer's full range of available colors, membranes, and thicknesses.
C. Shop Drawings: Submit manufacturer's shop drawings.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURER

A. Available manufacturers that may be incorporated into the Work include, but are not limited to, the following:
    1. Lauts Exteriors
    2. Becker Construction
    3. WaterpROOFessional Roofing Company
    4. Legacy Roofing & Restoration

### 2.2 EPDM ROOF

A. Follow the specifications of the EPDM Roof product chosen from the above manufacturers.
B. For LEED certification, the product must contain at least 25% reclaimed and postconsumer content; however, the product could instead contain 50% preconsumer content.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

A. Do not begin installation until substrates have been properly prepared.

### 3.2 INSTALLATION

A. Install EPDM in accordance with manufacturer's instructions at locations indicated on architect's drawings.

**END SECTION 07 53 23**

# Division 08 Openings

# SECTION 08 10 00
# DOORS AND FRAMES

## PART 1 - GENERAL

### 1.1 SUMMARY

A. Section Includes:

1. Single shutter metal frame hinge door with DGU paneling
2. Single shutter wooden frame flush door

### 1.2 SUBMITTALS

A. Product Data: For each type of product.
B. Samples: Submit duplicate clearly labelled samples of each sliding door component.
**C.** Shop Drawings: Submit manufacturer's shop drawings.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURER

A. Subject to compliance with requirements, available manufacturers that may be incorporated into the Work include, but are not limited to, the following:
   1. Feldco Door
   2. Pella Door

### 2.2 DOORS

A. Follow the specifications of the products chosen from either manufacturer for both types of doors:

   1. Single shutter aluminum frame hinge door with DGU paneling
   2. Single shutter wooden frame flush door

B. For LEED certification, the product must contain at least 25% reclaimed and postconsumer content; however, the product could instead contain 50% preconsumer content.

## PART 3 - EXECUTION

### 3.1 INSTALLATION:

A. Install doors in accordance with manufacturer's instructions at locations indicated on the architect's drawings.

**END OF SECTION 08 10 00**

**SECTION 08 50 20**
**ALUMINUM WINDOWS**

## PART 1 - GENERAL

### 1.1 SUMMARY

A. Section Includes: Aluminum Windows.

### 1.2 SUBMITTALS

A. Product Data: For each type of product.
B. Samples: Submit duplicate clearly labelled samples of each window component.
C. Shop Drawings: Submit manufacturer's shop drawings.

## PART 2 - PRODUCTS

### 2.1 FIXED WINDOW

A. Intus Window, W2 (2No.)

1. Al Frame
2. DGU Window
3. Product Dimensions: 2 feet x 4 feet

B. For LEED certification, the product must contain at least 25% reclaimed and postconsumer content; however, the product could instead contain 50% preconsumer content.

### 2.2 SLIDING WINDOW

A. Intus Window, W1 (2No.)

1. Al Frame
2. DGU Siding Window
3. Product Dimensions: 7 feet x 5 feet

B. For LEED certification, the product must contain at least 25% reclaimed and postconsumer content; however, the product could instead contain 50% preconsumer content.

## PART 3 - EXECUTION

### 3.1 INSTALLATION:

A. Install windows in accordance with manufacturer's instructions at locations indicated on architect's drawings.

**END OF SECTION 08 50 20**

# Division 09 Finishes

# SECTION 09 10 00
# PAINTING

## PART 1 - GENERAL

### 1.1 SUMMARY

A. Section Includes: Field application of paints and coatings.
B. Related Requirements:

1. Section 09 90 50 Wall Coverings
2. Section 06 42 00 Wood Paneling

### 1.2 SUBMITTALS

A. Product Data: For each type of product.
B. Samples: Submit duplicate clearly labelled samples of each color, texture and sheen.
C. Information to be added: LEED Certification:

## PART 2- PRODUCTS

### 2.1 MANUFACTURER

A. Green Building Supply

### 2.2 PAINT

A. AFM SafeCoat, Zero VOC Paint
B. Color: Eggshell White Paint

## PART 3- EXECUTION

### 3.1 EXAMINATION

A. Examine areas and conditions under which painting work is to be applied. Do not paint over conditions detrimental to a durable paint life.

### 3.2 INSTALLATION

A. Apply paint in accordance with manufacturer’s instructions at locations indicated on architect's drawings.

**END OF SECTION 09 10 00**

**SECTION 09 29 00**
**GYPSUM BOARD**

## PART1 – GENERAL

### 1.1 SUMMARY

A. Section Includes

1. Materials and installation methods for Type X wall and ceiling gypsum panels for interior applications

## PART 2 – PRODUCTS

### 2.1 MANUFACTURERS

A. Manufacturer: USG gypsum board plants

### 2.2 SUSTAINABLE INTERIOR TYPE X GYPSUM BOARD

A. Gypsum Board: ASTM C1396/C1396M, Type X

1. Thickness: 5/8 inch (15.9 mm)
2. Length: [8’-0” (2438 mm)]Width: [4’-0” (1219 mm)]
3. Weight: 1.8 lb./sq. ft. (8.8 kg/sq. m.)
4. Long Edges: Tapered

## PART 3 – EXECUTION

### 3.1 INSTALLATION

A. Planning the Job

1. Marking

    a. Place panel with light-colored face paper side up. Measure and mark panel size desired.

2. Cutting

    a. Line up straightedge or T-square with the marks and hold firmly against the panel. Draw a pencil line as a guide for scoring. Score through paper and lightly into the core. Wear a glove on your holding hand to protect you from cutting your hand.
    b. To break the panel core, securely grasp the board edges on both sides of the score line and snap board with a quick, fi rm movement.
    c. Use utility knife with a sharp blade for scoring. Complete cutting by running knife through back paper for the length of the panel and snapping back to face.

d. After cutting the panel, smooth the cut edge with a drywall rasp or sandpaper wrapped around a block of wood such as a piece of 2" x 4" lumber. Be sure to keep edge as square as possible. Always wear a dust mask when sanding.
e. Gypsum panels are heavy and may bend or snap under their own weight. Be sure panels are properly supported prior to scoring.

3. Cutouts

a. For openings such as an electrical outlet or switch box, measure across from the point where the side edge of the panel will rest to the near and far sides of the installed box. Then measure from the point where the top or bottom edge of the panel will fall to the top and bottom of the box.
b. Trace the outline of the electrical box at the appropriate position on the gypsum panel.
c. Cut with keyhole saw, jab saw or rotozip. Wear a dust mask if excessive dust is produced and the area cannot be ventilated.

4. Framing

a. Prior to panel attachment, inspect the kiln-dried studs to ensure that the face of the the kiln-dried studs is straight and aligned. Warped or crooked framing should be repaired or replaced.

5. Nail Attachment

a. Panel must be held tight to framing. Nail center of panel first, perimeter last. Space nails maximum of 7" apart on ceilings, 8" on walls and at least 3/8" from ends and edges of the panels.
b. Seat nail so head is in a shallow dimple formed by last blow of drywall hammer.

6. Screw Attachment

a. Space screws a maximum of 12" apart on ceilings, 16" on walls and at least 3/8" from ends and edges of the panels. Sink screws to just below the panel surface, leaving the paper intact.
b. Use an electric screw gun equipped with an adjustable screw depth control head and Phillips bit. If an electric drill is used, be careful not to overdrive screws.

7. Adhesive Attachment

a. Select the proper adhesive for specific job requirements. Make sure that framing is clean, sound and free from oil, dirt or contamination. Apply adhesive and nails per instructions on adhesive cartridge. Do not use adhesive to secure panels. Use either nails or screws. Make sure adhesive is fully cured before finishing to avoid screw pops.

B. Attaching the Panels

1. Ceilings

    a. Apply ceilings first. Because panels are difficult to maneuver over one's head, it's best to have a helper or two. Fasten panels to all joists and perimeter framing. Space nails maximum 7" apart along framing, screws 12" apart, starting in the center of the panel and working toward the perimeter. Double-nailing is recommended to reduce nail pops.

2. Wall

    a. Apply panels horizontally or vertically to framing. If applied horizontally, install top row fi rst. Position first panel tight against the installed ceiling panel and fasten to studs. Space nails maximum 8" apart along framing, screws 16" apart, starting in the center of the panel and working toward the perimeter. Cut panels accurately so they do not have to be forced into place. Continue around the room.
    b. Apply lower row of panels so tapered edges meet with those of top row. Vertical joints should be staggered. Avoid vertical joints directly above or below a window, door or other opening for best decorating results.

3. Corners

    a. Using USG Sheetrock® Brand Dur-A-Bead® Corner Bead reinforcement, apply it to all exterior corners of walls, so ts and window returns. Hold bead firmly against corner and nail bead through small holes every 9" on each flange. Make sure that nails penetrate framing members. Drive all nails below nose of corner bead and tightly into flange so joint compound will cover smoothly and evenly. Be careful not to dent the metal. Screw attachment is not recommended.
    b. Install USG Metal Trim where gypsum panels butt windows or concrete block. Nail trim every 9" through small holes in flange. Make sure that nails penetrate framing members.

C. Finishing the Panels

1. Sanding

    a. Allow third coat to dry overnight (drying time may vary, depending on temperature, humidity and jobsite conditions). Lightly sand imperfections in finished joints, corners and over fastener heads. Carefully remove sanding dust with damp sponge. Use a dust collection with a HEPA filter with power sanding. Wear a dust mask if excessive dust is produced and the area cannot be ventilated.

2. Storage and cleanup

    a. Before storing unused joint compound, clean sides and lid of container so no dried compound falls into the mixture. Level joint compound surface with knife and cover container tightly. If storing for an extended period, cover surface of joint compound with

approximately 1/2" of clean water and cover container. Do not store in direct sunlight or where freezing conditions may occur. Pour o water before reusing joint compound. Clean tools with warm, soapy water.

D. Decorating the Panels

1. Priming

a. Prior to painting, apply USG Sheetrock® Brand First Coat™ Primer or a high quality, high solids flat latex paint. Follow the manufacturer's recommendations. For best results, use a high-quality roller with 1/8" to 1/4" nap.

**END OF SECTION 09 29 00**

**SECTION 09 30 13**
**TILES**

## PART 1 - GENERAL

### 1.1 SUMMARY

A. Section Includes:

1. Vitrified anti-skid tiles
2. Vitrified dado tiles

### 1.2 SUBMITTALS

A. Product Data: For each type of product.
B. Manufacturer's maintenance instructions.
C. Warranty.

## PART 2 - PRODUCTS

### 2.2 VITRIFIED ANTI-SKID TILES AND DADO TILES

A. Follow the specifications of all products chosen from manufacturer.
B. For LEED certification, the product must contain at least 25% reclaimed and postconsumer content; however, the product could instead contain 50% preconsumer content.

## PART 3 - EXECUTION

### 3.1 INSTALLATION:

A. Install tiles in accordance with manufacturer's instructions at locations indicated on the architect's drawings.

**END OF SECTION 09 30 13**

# SECTION 09 51 13
# ACOUSTICAL CEILING PANELS

## PART 1 - GENERAL

### 1.1 SUMMARY:

A. Section Includes: Acoustical Ceiling Panels.

### 1.3 SUBMITTALS

A. Product Data: For each type of product.
B. Samples: Submit duplicate clearly labelled samples of ceiling panels.
C. Shop Drawings: Submit manufacturer's shop drawings.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURER

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

    1. Armstrong

### 2.2 ACOUSTICAL CEILING PANELS

A. Follow the specifications of the product chosen from manufacturer for either type of ceiling panels:

    1. Mineral Fiber Ceiling
    2. Veneer Ceiling

## PART 3 - EXECUTION

### 3.1 INSTALLATION

A. Install ceiling panels in accordance with manufacturer's instructions at locations indicated on architect's drawings.

**END OF SECTION 09 51 13**

# SECTION 09 62 29
# CORK FLOORING

## PART 1 - GENERAL

### 1.1 SUMMARY

A. Section Includes: Cork Flooring
B. Related Requirements:

1. Section 09 64 00 Wood Flooring

### 1.2 ACTION SUBMITTALS:

A. Product Data: For each type of product.
B. Samples: Submit duplicate clearly labelled samples of cork flooring.
C. Shop Drawings: Submit manufacturer's shop drawings.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURER

A. EcoSupply

### 2.2 FLOORING

A. Cork Tile Flooring: [23.81" x17.5"] x 0.4" thick thick cork tile with square edges and site sealed finish with pattern and colour as selected to match pre-approved sample.
B. For LEED certification, the product must contain at least 25% reclaimed and postconsumer content; however, the product could instead contain 50% preconsumer content.

### 2.3 FINISHING MATERIALS:

A. Colour: Natural factory applied colour in accordance with manufacturers requirements.
B. Sealer / Finish: Matte finish

## PART 3 - EXECUTION

### 3.1 EXAMINATION

A. Examine substrates for conditions affecting performance of cork flooring. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 INSTALLATION

A. Follow manufacturer's instructions and architect's drawings to properly install cork flooring.

**END OF SECTION 09 62 29**

# SECTION 09 64 00

# HARDWOOD FLOORING

## PART 1 - GENERAL

### 1.1 SUMMARY

A. Factory-finished hardwood flooring

### 1.2 RELATED SECTIONS

A. Section 09 62 29: Cork Flooring

### 1.3 SUBMITTALS

A. Product Data: For each type of product.
B. Samples: Submit duplicate clearly labelled samples of factory-finished hardwood flooring.
C. Shop Drawings: Submit manufacturer's shop drawings.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURER:

A. Eco supply or Green Building Supply.

### 2.2 FACTORY-FINISHED WOOD FLOORING

A. Follow the specifications of the hardwood floor product chosen from either manufacturer.
B. For LEED certification, the product must contain at least 25% reclaimed and postconsumer content; however, the product could instead contain 50% preconsumer content.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

A. Examine substrates for conditions affecting performance of wood flooring. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 INSTALLATION

A. Install hardwood flooring in accordance with manufacturer's instructions at locations indicated on architect's drawings.

**END OF SECTION 09 64 00**

# SECTION 09 90 50
# WALL COVERINGS

## PART 1 - GENERAL

### 1.1 SUMMARY

A. Section Includes: Cork Wall Coverings
B. Related Requirements:

    1. Section 06 42 00 Wood Paneling

### 1.2 ACTION SUBMITTALS:

A. Product Data: For each type of product.
B. Samples: Submit duplicate clearly labelled samples of cork wall coverings.
C. Shop Drawings: Submit manufacturer's shop drawings.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURER

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

    1. Eco Supply: Thermacork or Onyx Solar / PV Spandrel
    2. Eco Supply: Richlite or Equitone

### 2.2 CORK WALL COVERING

A. Follow the specifications of the wall coverings product chosen from Eco Supply.
B. For LEED certification, the product must contain at least 25% reclaimed and postconsumer content; however, the product could instead contain 50% preconsumer content.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

A. Examine areas for conditions affecting performance of wall coverings. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 INSTALLATION

A. Install wall coverings in accordance with manufacturer's instructions at locations indicated on architect's drawings.

**END OF SECTION 09 90 50**

# Division 11 Equipment

# SECTION 11 30 13
# RESIDENTIAL APPLIANCES

## PART 1 - GENERAL

### 1.1 SUMMARY

A. Section Includes: Residential Appliances.

### 1.2 SUBMITTALS

A. Product Data: For each type of product.
B. Manufacturer's maintenance instructions.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURER

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

    1. Kohler Accessories

B. For LEED certification, at least one of the following appliances must be ENERGY STAR certified and installed in each dwelling unit:

    1. Refrigerator;
    2. Dishwasher; or,
    3. Clothes washer.

### 2.2 BATHROOM AND KITCHEN APPLIANCES

A. Follow the specifications of all products chosen from manufacturer.

## PART 3 - EXECUTION

### 3.1 INSTALLATION:

A. Install appliances in accordance with manufacturer's instructions at locations indicated on the architect's drawings.

**END OF SECTION 11 30 13**

# Division 22 Plumbing

# SECTION 22 11 00
# PLUMBING PIPING

## PART 1 - GENERAL

### 1.1 RELATED DOCUMENTS

A. Construction drawings P001, P101, P102, P103, P104, P105, and P501.

### 1.2 SUMMARY

A. Section includes general information and direction on piping.

### 1.3 QUALITY ASSURANCE

A. All grooved joint couplings, fittings, valves, and specialties shall be the products of Sharkbite.
B. Comply with governing codes and regulations.
C. Standards:

1. Materials, Installation, Inspection: ASME B31.9., 77 IAC 890.930. 77 IAC 890.920
2. Plastic piping components: ANSI 14., 77 IAC 890.320, NSF 61, NSF 372
3. Accessibility: AADAG

## PART 2 - PRODUCTS

### 2.1 MATERIALS

A. Plumbing Fixtures:

1. Manufacturers: Sharkbite for PEX
2. Sustainability Design: Graywater Mulch Basins, water efficiency, rainwater reuse, irrigation
3. PEX Tubing (½”, ¾”, 1”)

    a. Pipe and fittings shall be installed as outlined in the SharkBite PEX installation manual.

### 2.2 UNDERGROUND WATER SERVICE CONNECTIONS TO BUILDINGS

A. From inside face of exterior wall to a distance of 5” outside of building and underground inside building, material to be the same for the size specified inside the building.
B. Sharkbite PEX 1” to connect to interior water piping. Install below the freeze line (30” below). Insulate pipe when above the freeze line.

### 2.3 ABOVE GROUND (INTERIOR) WATER PIPING

A. Fittings for Piping:

1. PEX Pipe and fittings shall be installed as outlined in the SharkBite PEX installation manual.
2. PVC Schedule 40 shall be installed in accordance with local codes and regulations.

**PART 3 - EXECUTION**

**3.1 INSTALLATION**

A. General: Comply with the Illinois Plumbing Code, Manufacturer's instructions, and the following:

1. Install branch piping for water from the piping system and connect to all fixtures, valves, cocks, outlets, casework, cabinets and equipment.
2. All pipe runs shall be laid out to avoid interference with other work/trades.
3. Install union and shut-off valve on pressure piping at connections to equipment.

**END OF SECTION 22 11 00**

**SECTION 22 13 00**
**FACILITY SANITARY WASTE AND VENT PIPING**

## PART 1 - GENERAL

### 1.1 RELATED DOCUMENTS

A. Construction drawings P001, P101, P102, P103, P104, P105, and P501.

### 1.2 SUMMARY

A. This section pertains to sanitary sewer and vent systems, including piping, equipment and all necessary accessories as designated in this section.

## PART 2 - PRODUCTS

### 2.1 MATERIALS

A. Polyvinyl Chloride (PVC) Schedule 40

1. Polyvinyl chloride (PVC) pipe and fittings are permitted where the waste temperature is below 140°F.
2. Polyvinyl chloride sanitary waste, drain, and vent pipe and fittings shall be solid core sewer piping conforming to ASTM D2665, sewer and drain series with ends for solvent cemented joints.
3. Fittings: PVC fittings shall be solvent welded socket type using solvent cement conforming to ASTM D2564.

## PART 3 - EXECUTION

### 3.1 PIPE INSTALLATION

A. The pipe installation shall comply with the requirements of the Illinois Plumbing Code and these specifications.
B. Branch piping shall be installed for waste from the respective piping systems.
C. Pipe shall be round and straight. Cutting shall be done with proper tools. Pipe shall be reamed to full size after cutting.
D. All pipe runs shall be laid out to avoid interference with other work.
E. The piping shall be installed above accessible ceilings where possible.
F. The piping shall be installed to permit valve servicing or operation.
G. The piping shall be installed free of sags and bends.
H. Seismic restraint shall be installed where required by code.
I. Changes in direction for soil and waste drainage and vent piping shall be made using appropriate branches, bends and long sweep bends. Sanitary tees and short sweep quarter bends may be used on vertical stacks if change in direction of flow is from horizontal to vertical. Long turn double wye branch and eighth bend fittings shall be used if two fixtures are installed back to back or side by side with common drain pipe. Straight tees, elbows, and crosses may be used on vent lines. Do not change direction of flow more than 90 degrees. Proper size of standard increaser and reducers shall be used if pipes of different sizes are connected. Reducing size of drainage piping in direction of flow is prohibited.

J. Buried soil and waste drainage and vent piping shall be laid beginning at the low point of each system. Piping shall be installed true to grades and alignment indicated with unbroken continuity of invert. Hub ends shall be placed upstream.
K. Underground PEX piping must be installed according to manufacturer's manual.
L. Aboveground PVC piping shall be installed according to ASTM D2665. Underground PVC piping shall be installed according to ASTM D2321.
M. If an installation is unsatisfactory, it shall be corrected at no cost to Illinois Solar Decathlon.

**3.2 JOINT CONSTRUCTION**

A. For threaded joints, thread pipe with tapered pipe threads according to ASME B1.20.1. The threads shall be cut full and clean using sharp disc cutters. Threaded pipe ends shall be reamed to remove burrs and restored to full pipe inside diameter. Pipe fittings and valves shall be joined as follows:

    1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is required by the pipe service.
    2. Pipe sections with damaged threads shall be replaced with new sections of pipe.

B. Solvent cement joints shall be used for PVC joints. All surfaces shall be cleaned and dry prior to applying the primer and solvent cement. Installation practices shall comply with ASTM F402. The joint shall conform to ASTM D2855 and ASTM D2665 appendixes.

**3.3 SPECIALTY PIPE FITTINGS**

A. Will be using Sharkbite PEX Piping and fittings, so refer to their specifications.

**3.4 PIPE HANGERS, SUPPORTS AND ACCESSORIES**

A. All piping shall be supported according to the Illinois Plumbing Code.
B. Illinois Plumbing Code (IPC), Section 22 05 11, COMMON WORK RESULTS FOR PLUMBING. Where conflicts arise between these the code and Section 22 05 11, COMMON WORK RESULTS FOR PLUMBING the most restrictive or the requirement that specifies supports with highest loading or shortest spacing shall apply.
C. Hangers, supports, rods, inserts and accessories used for pipe supports shall be painted according to Section 09 91 00, PAINTING. Electroplated copper hanger rods, hangers and accessories may be used with copper tubing.
D. Horizontal piping and tubing shall be supported within 32 inches of each fitting or coupling.
E. Vertical piping and tubing shall be supported at the base, at each floor, and at intervals no greater than 5 feet.
F. Penetrations:

    1. Water proofing: At floor penetrations, clearances shall be completely sealed around the pipe and make watertight with sealant as specified in Section 07 92 00, JOINT SEALANTS.

**END OF SECTION 22 13 00**

**SECTION 22 14 53**
**RAINWATER STORAGE SYSTEM**

## PART 1 - GENERAL

### 1.1 RELATED DOCUMENTS

A. Construction drawings P001, P101, P102, P103, P104, P105, and P501.

### 1.2 SUMMARY

A. Custom rainwater harvesting system consisting of manufactured components integrated into automated system. The system shall collect rainwater from the roof and convey rainwater through roof drains, downspouts and conveyance piping, self-cleaning, gravity fed pre-filters. Filtered rainwater will travel through the pre-filter and into an underground irrigation system.
B. Design Requirements: Filter and distribute harvested rainwater.

## PART 2 - PRODUCTS

### 2.1 COMPONENTS

A. Rainwater pre-filters: gravity-fed self-cleaning

    1. Gutter shields to prevent contamination
    2. First flush on top of downspouts

B. Below ground gravity powered irrigation system out of Sharkbite PEX Piping

    1. System shall be plumbed using SharkBite Pipe cross-linked polyethylene pipe and all joints shall be made using SharkBite push-to-connect fittings, brass SharkBite barb fittings or polymer SharkBite barb fittings used with copper crimp rings or stainless steel clamps. Pipe and fittings shall be installed as outlined in the SharkBite PEX installation manual.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

A. Install system components in accordance with manufacturer's instructions and approved Construction Drawings.
B. Arrange equipment so that components requiring removal or maintenance are readily accessible without disturbing other components. Arrange for clear passage between components.
C. Ground components in accordance with component manufacturer's instructions.

**END OF SECTION 22 14 53**

# SECTION 22 14 00
# DRAINAGE

## PART 1 - GENERAL

### 1.1 RELATED DOCUMENTS

A. Construction drawings P001, P101, P102, P103, P104, P105, and P501.

### 1.2 SUMMARY

A. This section describes the requirements for storm drainage systems, including piping and all necessary accessories as designated in this section.

## PART 2 - PRODUCTS

### 2.1 STORM WATER DRAIN PIPING

A. Polyvinyl Chloride (PVC):

1. PVC storm sewer pipe and fittings shall be schedule 40 solid core piping conforming to ASTM D1785 and ASTM D2665, Sewer and Drain Series, with ends for solvent cemented joints.
2. PVC joints shall be solvent welded socket type using solvent cement conforming to ASTM D2564 and adhesive primer conforming to ASTM F656. Bio-based materials shall be utilized when possible.

B. Roof drain piping and body of drain in locations where the outdoor conditions are subject to freezing shall be insulated.

## PART 3 - EXECUTION

A. Refer to 22 13 00 Part 3.

**END OF SECTION 22 14 00**

**SECTION 22 34 13**
**TANKLESS WATER HEATER**

## PART 1 - GENERAL

### 1.1 RELATED DOCUMENTS

A. Construction drawings P001, P101, P102, P103, P104, P105, and P501.

### 1.2 SUMMARY

A. Section includes EcoSmart electric tankless water heater 27 kW 4 gpm.

### 1.3 QUALITY ASSURANCE

A. Source Limitations: Obtain electric tankless water heaters through EcoSmart (single manufacturer).
B. Electrical Components: Listed and labeled per NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction.
C. Lead-Free Construction: Comply with NSF 372 for fixture components in contact with potable water.
D. Standard Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of electric, domestic-water heaters that fail in materials or workmanship within specified warranty period.

## PART 2 - PRODUCTS

### 2.1 MATERIALS

A. EcoSmart Eco 27 Electric Tankless Water Heater

1. Flow rate capacity of 3.5 - 4.3 GPM depending on inlet water temperature and for a set output temperature of 105F. Copper heating elements with brass top. ¾" NPT water connectors. Limited lifetime warranty for residential use when registered properly and installed within 30 days of purchase by a licensed professional. 27 kW, 240 V, single phase, 3 elements at 9kW @ 240 V, self-modulating. 112.5 amperage draw, 3 required 40 A breakers, 3 required 8 AWG wires. 14.7 lb weight, copper heat exchanger, thermal auto protection. Flow activated at 0.25 GPM. Minimum operating pressure is 25 psi, maximum operating pressure is 150 psi. Recommended: mixing valve complying with Standard for Temperature Actuated Mixing Valves for Hot Water Distribution Systems, ASSE 1017.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

A. Electric, Tankless, Domestic-Water Heater Mounting:

1. Secure water heater to mounting surface with 4 screws (minimum 1-inch long) using the built-in mounting brackets on each side. Install upright with inlet and outlet water connections at the

bottom of the unit. Recommended clearance: 12 inches above and below the heater, 6 inches on all other sides. Connect HOT WATER LINE to the water heater OUTLET located on the left side of the heater when facing unit. Connect COLD WATER LINE to the water heater marked INLET. After tightening both fittings at the water heater, open several hot water faucets and allow water to run through the water heater for AT LEAST 2 TO 3 MINUTES, to purge air from water lines (BEFORE turning on power at the unit), and prevent PERMANENT DAMAGE TO THE HEATING ELEMENTS. Use a temperature pressure relief valve if connecting to a flex or high temperature CPVC pipe (for safety), or if required by local codes.

2. All wiring and circuit protection must comply with the U.S. National Electrical Code (NEC). DO NOT attempt to install, repair or disassemble this water heater without first shutting off all power to the unit directly at the fuse or breaker box (see owners manual for wiring diagram). Each set of wires must be connected to its own individual double pole breaker. Take each wire pair and connect them to one breaker. Each breaker should be connected to one black and one red wire. Run the correct sets of wire from the home's main breaker panel to the tankless water heater. Use a separate ground conductor for each incoming circuit. Confirm the correct breaker size and wire gauge. Connected the unit to a ground in accordance with applicable codes. Confirm that all the air has been purged from the water lines prior to turning on power to the unit.
3. Install water supply piping to each water heater, and from heater to fixture requiring hot water supply connection.

    a. Install stop valves on water supply and outlet piping. Provide stop valve on each supply in readily-serviced location. Lock stop valve in OPEN position.
    b. Comply with Division 22 Section, General-Duty Valves for Plumbing Piping, for stop valve requirements.

**3.2 FIELD QUALITY CONTROL**

A. Do not energize water heater until hydrostatic testing of domestic water lines is complete. See Division 22 Section "Domestic Water Piping."
B. Test and adjust installation.

    1. Set field-adjustable temperature set point of temperature-actuated controls. Adjust set point within allowable temperature range.
    2. Replace defective or malfunctioning controls and equipment.

C. Clean unit surfaces, test fixtures, and leave in ready-to-use condition.

**END SECTION 22 34 13**

**SECTION 22 41 00**
**RESIDENTIAL PLUMBING FIXTURES**

## PART 1 - GENERAL

### 1.1 RELATED DOCUMENTS

A. Construction drawings P001, P101, P102, P103, P104, P105, and P501.

### 1.3 QUALITY ASSURANCE

A. Water flow and consumption rates for plumbing fixtures:

1. Comply with requirements in Public Law 102-486, Energy Policy Act.
2. Provide WaterSense labeled products for:

    a. High-Efficiency Lavatory Faucets.
    b. High-Efficiency Shower Heads.

## PART 2 - PRODUCTS

### 2.1 MATERIALS

A. Fixtures:

1. LG Top Control Dishwasher with QuadWash (LDP6797ST/WW/BB)

    a. Product dimensions (in) (W x H x D): 23.75” x 33.6” x 24.6”. Electrical requirement: 120 V, 60 Hz AC only, minimum 15 A circuit breaker. Water pressure: 20-80 psi. Inlet water temperature: 120F minimum, 149F maximum. Net weight: 72-89 lbs. The appliance must be installed and electrically grounded by qualified service personnel and in compliance with local codes. Disconnect the power supply line, house fuse or circuit breaker before installing or servicing the appliance.

2. Ecocirc B 23-5 ACT Pump

    a. The pumps shall be of the high efficiency type specifically designed for quiet operation.
    b. Pump to be suitable for 203º F (110º C) operation at 150 psig working pressure and 115V, 60Hz, 1Phase power.
    c. The pumps shall have a shaft-less, wet rotor design with a ceramic ball bearing lubricated by the system fluid.
    d. Pump to have built-in temperature sensor and 24-hour, adjustable timer. 6. Motor shall be spherical with an electronically commutated, permanent magnet motor (ECM/PM).

3. Compact Front Load Washer & Dryer Combo (WM3499HVA)

    a. Product Dimensions: 24”x 33.5” x 25.25” (WxHxD). Electrical Requirements: 120V, 10 Amps. Water Pressure: 20psi-120psi. Inverter Direct Drive Motor (Horizontal Axis). Max RPM: 1400. Weight: 156.5 lbs.

**PART 3 - EXECUTION**

A. Resource Management:

1. LG Top Control Dishwasher with QuadWash (LDP6797ST/WW/BB)

a. Install the dishwasher no more than 12 ft from the sink. Installation location must have sufficient space for the dishwasher door to open easily and provide at least 0.1" between dishwasher and cabinet sides. Refer to dishwasher owner's manual (from manufacturer website) for instructions on drilling holes for water and electrical connections. Run water supply line along floor 6 ½ - 7 ¾" from the left side of the opening and tape in place in front of the opening. Run electrical cable along the floor 14-16" from the water supply line and tape it in place. Electrical outlet must be within 4 ft. of either side of the dishwasher. Reroute the electrical cable before installation if the electrical conduit pipe is longer than 3" and is centered on the back wall. For the electrical connection, use a time-delay fuse or circuit breaker. Connect appliance using 3-wires, including a ground wire. Do not use an extension cable or adapter with this dishwasher. Use 16AWG wire nuts (included). When connecting dishwasher water supply line to the house water supply, sealing tape or compound should be used on pipe threads to avoid leaks. Tape or compound should not be used on compression fittings.

b. Do not remove safety cover on dishwasher. To release the drain hose, remove the twist tie holding the drain hose to the back of the shipping brace. Remove shipping brace, lower cover, and packing materials from the interior. For countertops made of wood or materials that will not be damaged by drilling, use metal installation brackets provided. For countertops that could be damaged by drilling, use the wood screws to attach the dishwasher to the cabinet. Refer to owners manual for further instructions.

c. To slide dishwasher into cabinet opening, do not pull or lift dishwasher using the handle, push the door of the dishwasher with knees, or push the top of the dishwasher, in order to prevent damaging the dishwasher. Open the door and grab the body frame and the top front opening of the tub to move or lift the dishwasher. Smooth out or pad the edges of the hole drilled for the water supply to avoid damaging the drain hose. Feed drain hose through the hole for the water supply.

d. Turn off home water supply. Connect the water supply line to the inlet valve on the left front of the dishwasher. Tighten the compression nut. Slide the water supply line back through the channel. Dishwasher should have dedicated properly grounded branch circuit to connect the 3 wire setup which includes the ground wire. If a 3-prong power supply is used, it should be in an accessible location adjacent to the dishwasher within 4 ft. of the dishwasher side and not behind the dishwasher. Slide a strain relief onto the end of the electrical cable. Insert the strain relief and the electrical cable through the hold in the junction box. Tighten the ring nut to secure them in place. Pair the white, black, and green wires to the matching colored wires from the dishwasher. Then twist on the provided wire nuts tightly to connect the corresponding wires. Verify that the black wire is hot (120 V).

e. If the end of the drain hose does not fit the drain line, use a heat and detergent resistant adapter. Cut the adapter so the end matches the size of the drain connection. For drain hose, follow local codes and ordinances. Do not exceed 12 ft. distance to drain. Refer to owners manual for other notes. The height of the drain hose end must be at least 12" and within 40" from the base of the dishwasher to avoid water being siphoned from the tub. Level dishwasher and secure to cabinet opening using either provided brackets or wood screws, depending on if countertop can be safely drilled into. Turn on circuit breaker and house water supply. Power on dishwasher and check for leaks at the drain hose and water supply connection.

2. Ecocirc B 23-5 ACT Pump

    a. Refer to manufacturer's installation manual.

3. Compact Front Load Washer & Dryer Combo (WM3499HVA)

    a. Connecting Water Lines: The use of LG hoses is recommended for connecting water lines. A water supply pressure of between 20 psi and 120 psi must be maintained. A pressure reducing valve should be used if necessary. Inspect the threaded fittings of each hose to ensure a rubber seal in place in both ends of the hose. Connect the water supply hoses to the HOT and COLD water faucets tightly by hand and then tighten another ⅔ turn with pliers. At least a gallon of water should be run through each inlet to flush any debris within the water lines. Attach the hot water line to the hot water inlet on the back of the washer. Then attach the cold water line to the cold inlet on the back of the washer. Tighten these fittings securely and turn on both faucets to check for leaks.
    b. Connecting the Drain Hose: The drain must be installed in accordance with local codes and regulations. Check that the drain hose is not stretched, pinched, crushed, or kinked before placing the end of the hose approximately 35"-47" from the floor. The end of the drain hose should be installed somewhere between 29in and 96in above the bottom of the washer or more than 60in away from the washer. Never create an airtight seal between the hose and the drain with tape or any other material. Do not insert the drain hose into the standpipe more than 8 inches. The end of the drain hose must be at least 29 inches above the floor for proper draining to occur.

**END OF SECTION 22 41 00**

# Division 23 Heating, Ventilating, And A/C

**SECTION 23 00 00**
**HVAC**

## PART 1 - GENERAL

### 1.1 SUMMARY

A. Section includes:

1. Ductwork
2. Filters

### 1.2 QUALITY ASSURANCE

A. Energy efficiency: Meet or exceed ASHRAE 90.1;
B. Indoor Environmental Quality:

1. Ventilation: Meet or exceed ASHRAE 62; Meet ISD 2020 Build code 7-2, 7-3, 7-4; meet PHIUS code 3.5.3;
2. Filtration: Meet or exceed ASHRAE 52.2 – 1999;
3. Thermal comfort: Meet or exceed ASHRAE 55;
4. Maintain positive pressure within the building.

### 1.3 SUBMITTALS

A. Product Data: Submit manufacturer's product data and installation instructions for each material and product used.
B. Operation and Maintenance Data: Submit manufacturer's operation and maintenance data, including operating instructions, list of spare parts and maintenance schedule.

## PART 2 - PRODUCTS

### 2.1 MATERIALS

A. Ductwork

1. Manufacturer: Skender.
2. Recycled Content: Minimum 5 percent post-consumer recycled content, or minimum 20 percent pre-consumer recycled content at contractor’s option.
3. Toxicity/IEQ:

a. Mold/mildew growth management: Unfaced fiberglass and mineral fiber insulation will not be permitted in contact with airstream. Duct liner will not be permitted. Provide duct liner with durable surface in contact with airstream.
b. Acoustical performance: Provide one-third full octave bands of airflow generated noise for each rate and direction of airflow of design performance in accordance with ASTM

E477 ARI 260 (ducted equipment) ARI 300 (terminal equipment). Indicate pressure drop across the silencing element for each airflow rate.

B. Filters

1. Manufacturer: Build Equinox.
2. Toxicity/IEQ: Provide filtration media with a Minimum Efficiency Reporting Value (MERV) of 6 as determined by ASHRAE 52.2.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

A. Install materials and systems in accordance with manufacturer's instructions and approved submittals. Install materials in proper relation with adjacent construction and with uniform appearance for exposed work. Coordinate with the work of other sections. Comply with applicable regulations and building code requirements.

### 3.2 RESOURCE MANAGEMENT

A. Indoor Air Quality

1. Temporary ventilation: as specified in Section 01 57 19.11 (01352) – Indoor Air Quality (IAQ) Management, and as follows:

    a. Degrease sheet metal air ducts.
    b. Seal air ducts to prevent HVAC system air leakage.
    c. Install duct insulation so that unfaced fiberglass and mineral fiber insulation are not in contact with airstream.
    d. Clean ductwork in accordance with manufacturer’s recommendations and the NAIMA Guide on Cleaning Fibrous Glass Insulated Air Duct Systems.

2. Energy efficiency: Verify equipment is properly installed, connected, and adjusted. Verify that equipment is operating as specified.

**END OF SECTION 23 00 00**

# Division 26 Electrical

**SECTION 26 20 00**

**LOW-VOLTAGE ELECTRICAL DISTRIBUTION**

## PART 1 - GENERAL

### 1.1 RELATED DOCUMENTS

A. Section 26 31 00 (Photovoltaic Collectors)
B. Section 26 33 00 (Battery Equipment)
C. Section 26 36 23 (Automatic Transfer Switch)
D. Section 48 19 16 (Electrical Power Generation Inverters)

### 1.2 SUMMARY

A. Section Includes:

1. AWG Cabling
2. DC Disconnect from PV
3. Main Breaker Panel
4. AFCI Outlet
5. GFCI Outlet
6. Power Optimizer

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

A. Southwire
B. Coleman
C. Siemens
D. Leviton
E. SolarEdge

### 2.2 MATERIALS

A. Southwire 14-Gauge Solid Romex SIMpull CU NM-B W/G Wire

1. Rated Current: 15 Amps
2. Length 15 feet

B. Southwire 12-Gauge White Solid CU THHN Wire

1. Rated Current: 20 Amps
2. Length 50 feet

C. Coleman 10 Gauge AWG Cabling

1. Rated Current: 30 Amps
2. Length: 15 feet

D. Siemens Solar Safety Disconnect Switch (DC Disconnect from PV)

1. Protection Method: Fusible
2. Duty: Heavy
3. Amps: 100 Amps
4. Voltage: 600VAC/DC
5. Phase: 3
6. NEMA Enclosure Type: 3R
7. IP Rating: 20
8. Indoor/Outdoor: Outdoor
9. Material of Construction: Aluminum Alloy
10. Contact Form: 3PST
11. Number of Wires: 3
12. Number of Poles: 3
13. Height: 16.30”
14. Width: 9.20”
15. Depth: 5.10”
16. For Use With: Class H, J, K R, T Fuse
17. Standards: UL Listed (File E335018), UL 1741

E. Siemens P3030B1150CU (Main Breaker Panel)

1. Maximum Amperage: 225 A
2. Phase: Single-Phase
3. Weight: 44 lb.
4. Spaces: 42
5. Dimensions: 16 in. x 41.38 in. x 5.75 in.
6. Voltage: 120/240

F. Leviton 15 Amp Tamper Resistant AFCI Outlet

1. Outlet Depth: 2.25 in.
2. Outlet Height: 6.188 in.
3. Outlet Width: 4.0 in.
4. Max Amperage: 15 A
5. Grounding: Self-Grounding
6. Voltage: 125 V
7. Outlet Material: Nylon
8. Number of Outlets: 2

G. Leviton 15 Amp Self-Test SmartlockPro Slim Duplex GFCI Outlet

1. Outlet Depth: 1.6875 in.
2. Outlet Height: 4.25 in.

3. Outlet Width: 2.25 in
4. Max Amperage: 15 A
5. Grounding: Self-Grounding
6. Voltage: 125 V
7. Outlet Material: Nylon
8. Number of Outlets: 2

H. SolarEdge Power Optimizer P400

1. Rate Input DC Power: 400 W
2. Absolute Maximum Input Voltage: 80 Vdc
3. MPPT Operating Range: 8-80 Vdc
4. Maximum Short Circuit Current: 10.1 Adc
5. Maximum DC Input Current: 12.5 Adc
6. Maximum Efficiency: 99.5%
7. Maximum Output Current: 15 Adc
8. Maximum Output Voltage: 60 Vdc
9. Maximum Allowed System Voltage: 1000 Vdc
10. Dimensions: 5.1 in. x 6 in. x 1.3 in.
11. Weight: 1.7 lbs.
12. Input Wire Length: 0.52 ft.

**PART 3 - EXECUTION - NOT USED**

**END OF SECTION 26 20 00**

# SECTION 26 31 00

# PHOTOVOLTAIC COLLECTORS

## PART 1 - GENERAL

### 1.1 RELATED DOCUMENTS

A. Section 26 20 00 (Low-Voltage Electrical Distribution)
B. Section 26 33 00 (Battery Equipment)
C. Section 48 19 16 (Electrical Power Generation Inverters)

### 1.2 SUMMARY

A. Section Includes:

1. Roof mounted Monocrystalline photovoltaic panels

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

A. Panasonic

### 2.2 MATERIALS

A. Panasonic HIT Solar Panel | N330
1. Nominal Power (Pnom): 330 W
2. Cell Efficiency: 22.09%
3. Panel Efficiency: 19.7%
4. Rated Voltage (Vmpp): 58 V
5. Rated Current (Impp): 5.7 A
6. Open-Circuit Voltage (Voc): 69.7 V
7. Short-Circuit Current (Isc) 6.07 A
8. Max System Voltage: 600 V
9. Panel Dimensions : 62.6 in. x 41.5 in. x 1.6 in.
10. Weight: 40.81 lbs

## PART 3 - EXECUTION - NOT USED

## END OF SECTION 26 31 00

**SECTION 26 33 00**

**BATTERY EQUIPMENT**

## PART 1 - GENERAL

### 1.1 RELATED DOCUMENTS

A. Section 26 20 00 (Low-Voltage Electrical Distribution)
B. Section 26 31 00 (Photovoltaic Collectors)
C. Section 48 19 16 (Electrical Power Generation Inverters)

### 1.2 SUMMARY

A. Section Includes:

1. LG Chem Resu10H

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

A. LG Chem

### 2.2 MATERIALS

A. LG Chem Resu10H

1. Total Energy: 9.8 kWh
2. Usable Energy: 9.3 kWh
3. Capacity: 6.3 Ah
4. Voltage Range: 350-450
5. Max Power: 5.0 kW
6. Peak Power (for 10 seconds): 7.0 kW
7. Dimensions: 29.3 in. x 35.7 in. x 8.1 in.
8. Weight: 214 lb

## PART 3 - EXECUTION - NOT USED

**END OF SECTION 26 33 00**

# SECTION 26 50 00
# LIGHTING

## PART 1 - GENERAL

### 1.1 DESCRIPTION OF WORK

A. Provide complete and fully operational lighting system per Contract Drawings and Specifications.
B. Luminaires shall be provided complete with necessary accessories for proper installation.
C. Provide lamps for luminaires as recommended by luminaire manufacturer, unless noted otherwise.
D. Specifications and drawings convey the features and functions of luminaires only and do not show every item or detail not necessary for the work.
E. Work includes final aiming and focusing of luminaires under direction of the Architect/Engineer/Lighting Designer.

### 1.2 REFERENCE

A. Work under this Section is subject to requirements of Contract Documents including General Conditions, Supplementary Conditions, and sections under Division 01 General Requirements.

### 1.3 REFERENCE STANDARDS

A. NECA/IESNA 500 - Standard for Installing Indoor Commercial Lighting Systems (ANSI)
B. NECA/IESNA 501 - Standard for Installing Exterior Lighting Systems (ANSI)
C. NECA/IESNA 502 - Standard for Installing Industrial Lighting Systems (ANSI)
D. NECA 503 – Standard for Installing Fiber Optic Lighting Systems
E. NEMA LE 4 - Recessed Luminaires, Ceiling Compatibility
F. UL 496 – Lamp Holders
G. UL 542 – Fluorescent Lamp Starters
H. UL 676 – Underwater Luminaires and Submersible Junction Boxes
I. UL 773 - Plug-in Photocontrols for use with area lighting
J. UL 924 - Emergency Lighting and Power Equipment
K. UL 935 - Fluorescent Lamp Ballasts
L. UL 1029 - High Intensity Discharge Lamp Ballast
M. UL 1574 – Track Lighting
N. UL 1598 – Luminaires
O. UL 1838 – Low Voltage Landscape Lighting Systems
P. UL 2108 – Low Voltage Lighting Systems
Q. UL 2388 – Flexible Lighting Products
R. UL 2562 – Pendant Cable
S. UL 8750 – LED Light Sources for use in Lighting Products
T. ANSI C78.377 – Chromaticity
U. IESNA LM-79 – Approved Method: Electrical and Photometric Measurements of Solid-State Lighting Products
V. IESNA LM-80 - Approved Method: Testing Lumen Maintenance of LED Light Sources
W. IESNA TM21-11 - Projecting Long Term Lumen Maintenance of LED Light Sources including Addendum A

## 1.4 SUBMITTALS

A. After award of Contract, submit complete list of lighting products to be furnished, with manufacturer and catalog designations, including currently quoted lead times for product delivery. Should Electrical Contractor anticipate delivery schedule of any specified product may adversely impact construction schedule, they shall bring it to the attention of Owner/Architect/Lighting Designer at this time.

B. In addition to complying with requirements of Section 26 0000 - General Electrical Requirements, submittals shall include the following:

1. Manufacturer's product data
2. Installation instructions
3. Maintenance data
4. Parts list for each luminaire accessory
5. Photometric Data: photometric data for luminaire, including optical performance as follows:

    a. Coefficients of utilization
    b. Luminance table
    c. Candela distribution data
    d. Zonal lumens
    e. Area and roadway luminaires shall include Isocandela Charts, IES Roadway Distribution Classification and IES BUG (Backlight – Uplight – Glare) ratings.

6. Lamp schedule indicating manufacturer, type, and catalog number for each luminaire

C. Shop Drawings for equipment provided under this Section shall include the following:

1. Overall submittal drawings indicating luminaire size, mounting (including ceiling type), light source, shielding, and voltage attributes, as well as manufacturer's product data, installation instructions, maintenance data, and parts list for each luminaire.
2. Detailed drawings of linear pendant mounted and suspended luminaires including dimensions, support spacing, suspension type, power feed type and locations, lamp combinations, ballast/driver locations, wiring and controls configuration, luminaire joint locations and end plates. Provide canopy details that indicate coordination with the ceiling system provided.
3. Detailed drawings for each cove and linear wall system configuration including dimensions, power feed locations, ballast or driver locations, luminaire joint locations, extension plates for end and corner sections and end plates.
4. Detailed drawings for LED systems including LED color, color consistency, rated life, warranty, and scale plans with luminaire layout, number, type and location for drivers, and a complete bill of materials.
5. Photometric Data: Where indicated on luminaire schedule and Contract Drawings, supply complete photometric data for luminaire, including optical performance rendered by independent testing laboratory developed according to methods of the Illuminating Engineering Society of North America as follows:

    a. Coefficients of utilization
    b. Luminance table with data presented numerically, showing maximum luminaire luminance at shielding angles. Readings should be taken both crosswise and lengthwise in case of fluorescent luminaire or luminaire with an asymmetric distribution.

D. Provide luminaires with factory or field finish as directed by Architect/Engineer/Lighting Designer. Verify final finish requirements before releasing luminaires for fabrication.

**PART 2 - PRODUCTS**

**2.1 MANUFACTURERS AND TYPES**

E. Pendant
F. Ceiling and wall mount
G. Tape light
H. Wall sconce
I. Bathroom sconce
J. Inground

**PART 3 - EXECUTION**

**1.5 INSTALLATION**

A. Marking:

1. Voltage identification: Luminaires designed for voltages other than 110-125 Volt circuits shall be clearly marked with rated voltage.
2. Markings must be clear and shall be located to be readily visible to service personnel but invisible from normal viewing angles when lamps are in place.

B. Installation of Luminaires:

1. Lamps, glassware, reflectors and refractors shall be clean and free of chips, cracks and scratches.
2. Install decorative luminaires, reflector cones, baffles, aperture plates, lenses, trims, and decorative elements of recessed luminaires after completion of ceiling tile, plastering, painting, and general cleanup is completed. Where luminaire location or construction does not permit sequential installation, all reflectors, lenses, flanges and other visible surfaces shall be carefully protected.
3. Light leaks between ceiling trim of recessed luminaires and ceiling are not allowed.
4. Locations

    a. Install luminaires at locations and heights as indicated.
    b. Architectural reflected ceiling plans show locations of luminaires.
    c. Where noted on the drawings, the exact location of luminaires shall be confirmed (in the field) with the Architect/Engineer prior to installation.
    d. Mount all luminaires to maintain full range of motion.
    e. Install luminaires plumb, square, and level with ceilings and walls.

5. Support

    a. Support surface mount luminaires from building structure.
    b. Metal decking shall not be pierced for luminaire support.
    c. Provide luminaires and/or luminaire outlet boxes with hangers to support luminaire weight.
    d. Fluorescent and LED troffers shall be held in place by support clips.
    e. Provide plaster frames for recessed luminaires in plaster ceilings.

f. Rigid metallic pipe stems shall be utilized for the support of pendant mounted luminaires, unless otherwise noted.
g. Yokes, brackets and supplementary supporting members needed to mount luminaires to suitable ceiling members shall be furnished and installed by Contractor. Verify mounting hardware required prior to installation.

6. Conduit and Wiring

a. Wire for connections to lamp sockets and auxiliaries shall be suitable for temperature, current, and voltage conditions.

C. Installation of Outdoor Pole Bases

1. Contractor shall provide bases for luminaires.
2. Pole base details shall be provided by the project structural engineer.
3. Provide handhole for electrical connection within 4'-0" of pole base.
4. Contractor shall:

a. Rough-in conduits
b. Coordinate spacing, base dimensions, heights, orientation of bases, etc. as necessary.

5. Where square or rectangular poles or luminaire heads are used, Contractor shall verify orientation with Architect/Engineer/Lighting Designer.

D. Pole Installation:

1. Install luminaires, poles, hardware, etc., for complete system.
2. Use web fabric slings (not chain or cable) to raise and set poles.

E. Lamps:

1. Provide new lamps delivered in original manufacturer's cartons.
2. Fluorescent, LED and metal halide lamps shall be energized continuously for not less than 100 hours for proper seasoning.

F. Grounding:

1. Ground luminaires and metal poles according to Division 26 Section "Grounding and Bonding for Electrical Systems".
2. Poles:

a. Install 3m (10ft) driven ground rod at each pole.

3. Nonmetallic Poles:

a. Ground metallic components of lighting unit and foundations. Connect luminaires to grounding system with #10 AWG conductor.

## 1.6 SUBSTANTIAL COMPLETION

A. Quality Control:

1. At Date of Substantial Completion, replace lamps/LED modules/LED luminaires which are not operating properly.
2. Replace any lamps used as work lights during construction phase.
3. Protection wrapping on lensed or louvered luminaires shall be removed before installation of furniture, but after finish work is complete.
4. Deliver spare equipment to Owner's representative.

B. Tests:

1. Give advance notice of dates and times for field tests.
2. Provide instruments to make and record test results.
3. Verify normal operation of each luminaire after luminaires have been installed and circuits have been energized.
4. Verify operation of luminaires with lighting control system and daylight harvesting systems. Any dimmed fixtures shall exhibit no signs of flickering.
5. Replace or repair malfunctioning luminaires and components, then retest. Repeat procedure until all units operate properly.
6. Report results of tests.

C. Adjusting and Cleaning:

1. Clean luminaires of handling marks, dust and dirt.
2. Cleaning and touch-up work shall be performed in accordance with luminaire manufacturer's recommendations.
3. Damaged luminaires or components shall be replaced with new.
4. Keep luminaires clean and protected for remainder of construction period.
5. Verify orientation of directional luminaires prior to installation.

    a. This includes wall washers, cove lighting, floodlights, exterior area lights and adjustable accent luminaires. Contractor shall provide electrician's services to aim, adjust, and focus luminaires, as required, at direction of Architect/Engineer. These electricians shall be available at times designated by Architect/Engineer and shall be provided at no extra charge to Owner over base bid. Contractor shall provide equipment for luminaries' focus including ladders and mechanical lifting systems.

6. Program preset dimming system lighting levels.
7. Program ambient light sensors integral to luminaires for appropriate illumination levels as indicated in control narrative or in lighting control specifications.
8. Program occupancy sensors integral luminaires for appropriate time delay as indicated in control narrative or in lighting control specifications.
9. Exterior poles, bollards, bases and other exterior luminaires shall be painted to match factory color where finish has been damaged.
10. No light leaks shall be permitted at ceiling line from any visible part or joint.

D. Training

1. Contractor shall provide Owner with 3 complete copies of Operations and Maintenance manuals.

    a. Each manual shall contain specific information pertaining to the equipment installed. Each manual shall contain at a minimum:

i. Detailed as built shop drawings for all lighting equipment installed.
ii. Manufacturer's product cut sheets for all equipment installed keyed by type as to as built drawings.
iii. Manufacturer's complete installation instructions for all equipment installed keyed by type to as built drawings.
iv. Equipment maintenance requirements and schedules.
v. Equipment manufacturer contacts.

2. Contractor shall provide qualified personnel onsite to provide a minimum of three days of training to Owner's representatives.

**END OF SECTION 26 50 00**

# Division 31 Earthwork

**SECTION 31 00 00**
**EXTERIOR LANDSCAPE WORKS**

## PART 1 - GENERAL

### 1.1 VEGETATION

A. General

1. Plants shall be nursery grown unless otherwise specifically depicted in each instance. The **American Association of Nurseymen Standard ASA Z. 60.1** shall apply.

2. Upon completion of the Project and prior to the final acceptance invoices or written statements from the suppliers showing the name of the specified materials received or shipped, shall be presented to the ENGINEER for final checks to confirm to these Specifications.

3. Plant materials incorporated into the site shall conform to state and federal laws relating to inspection for diseases and insect infestation, and shall conform to the American Standard for Nursey Stock. Plant materials shall be prime representatives of their species or variety.

4. Plant materials shall have normal, well-developed structures. Plants shall be vigorous and free from defects, diseases, insect pests, eggs or larvae, sun-scaled, injuries and abrasions of the bark. Plants shall have well-developed root systems.

5. Plants shall be container grown or burlap balled, Freshly dug plants, heels in plants or plants from cold storage shall not be accepted. Trees that have their leader cut, or are so damaged that cutting is necessary, shall not be accepted.

## PART 2 - PRODUCTS

A. Trees

1. Measurements of trees and other plantations shall be taken when their branches are in normal position. Height and spread dimensions specified refer to the main body of the plant, not from branch or root tip to tip. Caliper of trees shall be taken 12 inches above ground level.

B. Ground Cover

1. Ground cover plants, identified in the Plant Schedule in L000, shall be funished in pots unless otherwise specified. The plants shall be at least one year old, and have been growing in the pot long enough to ensure sufficient root growth to hold soil in place when removed from the pot.

C. Plant Size

1. Plant sizes shall conform to the measurements specified in the plant list. Exceptions are as follows:

    a. Any plant larger than specified in plant list may be used if approved. Use of such plants shall not increase the Contract Price. If larger plants are approved, the spread of roots or ball of earth shall be increased in proportion to the increased size of the plant.

b. Up to 15% of undersized plants in any one variety or species may be used, given that there are sufficient plants above size to make the average equal or above specified grade. Acceptable undersized plants shall be larger than the average size of the net smaller grade.

D. Substitutions

1. Substitutions will only be permitted should there be proof submitted that such specific plants or sizes are unobtainable. A proposal will be considered for the nearest equivalent size or variety with equitable adjustment of the Contract Price.

E. Planting Soil

1. Planting soil shall be composed of mixture of one part topsoil, and one part compost/manure or peat.

F. Mulch

1. Mulch shall be as specified by the nursery, and free from weed seeds, tannin, or other compounds harmful to plant life. Mulch shall have a size range of one-fourth to one inch.

**PART 3 - EXECUTION**

**3.1 INSTALLATION**

A. Planting Season

1. All planting shall be performed between April 10 and May 15, unless otherwise authorized in writing by the ENGINEER.

B. Layout of Plant Material

1. The planting pits and distances are specified in the Plant Schedule (see L000).

C. Inspection of Plant Material

1. Plants shall be subject to inspection and approval upon delivery as to size, quality, species and variety. Approval shall not impair the right of inspection and rejection upon delivery at the site, or during the progress of the WORK, for reasons of condition of plant material, diseases, insects, injuries, latent defects or size. Plants that meet the measurements specified, but do not possess a normal balance between height and spread shall be rejected. Rejected plants shall be removed from the site immediately.

D. Planting Pits

1. Excavated circular pits with vertical sides to a diameter at least one inch greater than the root ball, and at least half-an-inch greater in depth. Before any planting is done, the ENGINEER shall be notified of any soil conditions detrimental to the growth of the plant materials that are encountered when excavating planting pits.

E. Placement and Backfill

1. Place plant in center of pit in upright position unless specified.

F. Planting Soil

1. Planting soil shall be composed of mixture of one part topsoil, and one part compost/manure or peat.

G. Guarantee

1. The CONTRACTOR shall provide 100% replacement guarantee for a period of six months, beginning at the date of initial acceptance by the ENGINEER. At the end of the guarantee period and upon written request from the CONTRACTOR, the ENGINEER with make final inspection. The ENGINEER with ensure the plants are in good health, showing satisfactory growth, and show signs of developing into healthy representatives of their species. The CONTRACTOR shall remove and replace promptly any plant material that is dead or not showing satisfactory growth.

**END OF SECTION 31 00 00**

# Division 48 Electrical Power Generation

**SECTION 48 19 16**

**ELECTRICAL POWER GENERATION INVERTERS**

## PART 1 - GENERAL

### 1.1 RELATED DOCUMENTS

A. Section 26 20 00 (Low-Voltage Electrical Distribution)
B. Section 26 31 00 (Photovoltaic Collectors)
C. Section 26 33 00 (Battery Equipment)

### 1.2 SUMMARY

A. Section Includes:

1. Inverters

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

A. Solar Edge

### 2.2 MATERIALS

A. Solar Edge SE10000H

1. Output

a. Rated AC Power Output: 10000 VA
b. Maximum AC Power Output: 10000 VA
c. AC Output Voltage (Nominal): 220/230 Vac
d. AC Output Voltage Range: 184-264.5 Vac
e. AC Frequency (Nominal): 50/60 +/-5 Hz
f. Maximum Continuous Output Current: 45.5 A
g. Power Factor: 1, adjustable -0.8 to 0.8

2. Input

a. Maximum DC Power: 15500 W
b. Maximum Input Voltage: 480 Vdc
c. Nominal DC Input Voltage: 400 Vdc
d. Maximum Inverter Efficiency: 99.2%

3. Installations Specifications

a. AC Output - Supported Cable Diameter: 9-16 mm
b. AC - Supported Wire Cross Section: 1-13 $mm^2$
c. Inverter Dimensions: 360 x 370 x 185 mm
d. Weight: 16.5 kg

e. Noise: < 50 dBA

**PART 3 - EXECUTION - NOT USED**

**END OF SECTION 48 1916**