

## PART 1 – GENERAL

### 1.1 SUMMARY

- A. This Section includes the administrative and procedural requirements for Contractor progress payment and release of retainage as herein specified and further described in Part 6 of the General Conditions.
- B. Owner's forms referenced in this Section include (See Appendix A):
  - 1. Application and Certificate for Payment on Contract (Application for Payment)
  - 2. Construction Invoice Voucher
  - 3. Retainage Invoice Voucher
  - 4. Monthly Subcontractors List and Certifications
  - 5. Certificate of Payment of Labor and Materials
  - 6. Apprentice and Journey Level Worker Utilization Report

### 1.2 PREREQUISITES FOR FIRST APPLICATION FOR PAYMENT

- A. Prevailing Wage Forms: Submit Statement of Intent to Pay Prevailing Wages form, approved by the Department of Labor and Industries, prior to commencing the Work (see Part 5.04B of the General Conditions). The Owner will not make payment on an Application for Payment until the Contractor has filed with the Owner an approved copy of the form for the Contractor and every Subcontractor of every tier that performed work during the payment period and are included in an Application for Payment. The form shall list every classification of laborer, worker, or mechanic employed by the Contractor and Subcontractors. THERE ARE NO EXCEPTIONS TO THIS REQUIREMENT.
  - 1. The website address link to the prevailing wage forms is included in Appendix A.
  - 2. The website address link to the "Washington State Prevailing Wage Rates for Public Works Contracts" is included in Appendix B.
- B. Schedule of Values: Before submitting the first Application for Payment, submit and receive approval of the Schedule of Values allocating the detail of the Total Contract Cost, in a breakdown acceptable to the Owner, which shall be documented on the Application for Payment (see 1.5A8 "Building Componentization Report" in this Section for additional Final Completion construction cost reporting requirements). The approved Schedule of Values will be used by the Owner as the basis for progress payments. PAYMENT FOR WORK WILL ONLY BE MADE FOR, AND IN ACCORDANCE WITH, THOSE ITEMS INCLUDED IN THE APPROVED SCHEDULE OF VALUES.
  - 1. Format: On 8-1/2" x 11" paper
  - 2. Make sum of total scheduled costs equal to the Total Contract Cost. Do not include State of Washington sales tax.
    - a. Indicate individual Items of Work including, but not limited to:

- (1) Percent Fee
- (2) Specified General Conditions
  - (a) Section 01 77 00 "Closeout Procedures" shall not be less than 10% of the Specified General Conditions.
  - (b) Preparation and submittal to Owner of Construction Baseline Schedule and Submittal Schedule shall not be less than 3% of the Specified General Conditions.
  - (c) Preparation and submittal to Owner of monthly Progress Schedule updates shall not be less than 3% of the Specified General Conditions, with the value of each update apportioned equally.
- (3) Maximum Allowable Construction Cost (MACC)
  - (a) Subcontract costs. As subcontracts are executed the Contractor shall revise the Schedule of Values to reflect the subcontract work.
  - (b) Risk Contingency Account. As Team Change Memoranda are approved, revise the Risk Contingency Account to reflect the change.
  - (d) Negotiated Support Services.
- b. For items on which progress payments will be requested for materials or equipment purchased/fabricated/delivered but not yet installed, show "initial value" for payment request and "value added" for subsequent stage(s) of completion on that unit of work.
- c. For each line item of installed value exceeding 10% of the MACC, show breakdown by major products or operations under each item.
- d. Breakdown major work efforts by floor or phases or systems as appropriate for ease of review and confirmation of Work completed.
- e. Breakdown mechanical and electrical systems or phases with material and labor as separate items.
- f. Show each allowance as a discrete line item.
3. Round figures to nearest dollar amount;
4. Coordinate items of the Schedule of Values so that there is a corresponding item in the Progress Schedule.

5. Change orders and Team Change Memoranda are to be added as separate items to the Schedule of Values as they are approved by the Owner.
6. Revise as requested by Owner.
- C. Subcontractors List: Submit a list of all contracted Subcontractors and major material suppliers consistent with Part 5.20B of the General Conditions.
  1. Update list monthly with additional information from current awards.
- D. Retainage: Submit instructions for the disposition of retainage funds.
  1. In accordance with Part 6.04B of the General Conditions and Chapter 60.28 RCW, the Owner shall reserve a Contract retainage in an amount not-to-exceed 5% percent of the moneys earned by the Contractor as trust fund for the protection and payment of:
    - a. The claims of any person arising under the Contract Documents;
    - b. The State of Washington with respect to taxes imposed pursuant to Titles 50, 51, and 82 RCW which may be due from the Contractor, and;
    - c. Owner for claims it may have against the Contractor.
  2. Contractor's written instructions should be addressed to the University of Washington, Capital Projects Office, Capital Projects Accounting, Box 352205, Seattle, Washington 98195 - 2205.
  3. At the option of the Contractor, the moneys reserved by the Owner shall be:
    - a. Retained in a fund by the Owner; or
    - b. Bonded by the Contractor (if approved by Owner) for all of the Contract retainage in a form acceptable to the Owner; or
    - c. Deposited by the Owner in an Owner's interest bearing account in a bank, mutual savings bank, or savings and loan association; or
    - d. Placed in escrow with a bank or trust company by the Owner.
      - (1) Escrow Agent: If the retained funds are to be placed in escrow, Contractor will select the escrow agent, subject to approval by the Owner. The selected agent must be a bank or trust company in the State of Washington.
      - (2) Escrow Agreement: Pursuant to electing the escrow option, an escrow agreement shall be executed by Contractor, Owner, and bank. A completed and signed escrow agreement in a form acceptable to the Owner must be on file with the Owner for payment before the Contractor's first Application for Payment is processed.

- (3) Escrow Payments: As each progress estimate is presented for payment, Contractor shall make a voucher request for the retained funds that are to be placed in escrow. Such requests should be prepared on the Owner's Retainage Invoice Voucher form and submitted in four (4) copies with the related Application for Payment. Upon receiving a retainage invoice, the Owner will issue a check payable to the Contractor and the bank jointly. Such checks will be mailed to the bank and the Contractor will receive copies of check transmittal letters.
- (4) Escrow Investments: The bank shall invest the retained funds in bonds and other securities selected by the Contractor from the following list approved by the Owner:
  - (a) Bills, certificates, notes or bonds of the United States;
  - (b) Other obligations of the United States or its agencies;
  - (c) Obligations of any corporation wholly owned by the government of the United States;
  - (d) Indebtedness of the Federal National Mortgage Association;
  - (e) Time deposits in commercial banks, mutual savings banks, and savings and loan associations in the state of Washington;
  - (f) Deposits in savings accounts in commercial banks, mutual savings banks, and savings and loan associations in the State of Washington.
- (5) The investments selected must mature on or prior to the date set for Substantial Completion, including extensions thereof or no later than forty five (45) days following the Final Acceptance of the Work. Interest on such investments shall be paid to the Contractor by the escrow agent as it accrues.
- (6) Escrow Costs and Fees: All escrow costs and fees shall be paid by the Contractor, in accordance with the escrow agreement.

### 1.3 HIGH-TECH SALES AND USE TAX DEFERRAL

- A. This Project is approved for the high-tech sales and use tax deferral under Chapter 82.63 RCW. The Owner will provide the Contractor the high-tech sales and use tax deferral certificate issued to the Owner for use on this Project by the State of Washington Department of Revenue.

1. Tax Exempt Machinery and Equipment (M&E exemption): The Contractor shall provide, with the Application for Payment, copies of the invoices for each of the following listed items, indicating the installed location(s).
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#### 1.4 DRAFT APPLICATION FOR PAYMENT

- A. Submit a draft Application for Payment for Owner's review and comment. The cutoff date shall be five (5) days prior to actual application or as otherwise agreed. Include projected costs to the end of the month in the pay request. Provide the following documents (draft documents may be marked by hand):
  1. Application and Certificate for Payment on Contract form: Fill in required information.
    - a. Mechanical and electrical Subcontractor's draft monthly payment requests shall be submitted, for review and comment, prior to the A/E's and Owner's review of the Contractor's draft monthly Application for Payment.
    - b. List Change Orders approved prior to the submission date individually (last on the form). Use Owner's Change Order designation and description (similar to an original component item of work). **DO NOT BILL FOR CHANGE ORDER PROPOSALS UNTIL AN APPROVED CHANGE ORDER HAS BEEN RECEIVED FROM THE OWNER INCORPORATING THE PROPOSAL.**
  2. Monthly Subcontractors List and Certifications form.
  3. Stored Materials: The Contractor is solely responsible for stored materials. Requests for payment on materials stored shall be for materials properly stored on the Project site. In addition to the requirements of the General Conditions payment for materials stored off-site shall be at the sole option of the Owner and comply with conditions stipulated by the Owner. These conditions may include, but are not limited to:
    - a. Provide supplier invoice
    - b. Provide insurance or a bond to cover the total loss of material and time impact to Project
  4. Monthly Progress Schedule updates with Contemporaneous Period Analysis.
  5. Negotiated Support Services: Copies of invoices and timesheets related to each negotiated support service expense identified in the GC/CM Contract, Attachment 1 to the GC/CM Contract – Summary Matrix of Cost Allocation.
  6. Apprentice and Journey Level Worker Utilization Report.
- B. The A/E and/or Owner and the Contractor shall review the Project Record for completeness and accuracy.

## 1.5 APPLICATION FOR PAYMENT

- A. The Contractor shall submit two (2) hardcopies of the Application for Payment to the Owner after responding to the Owner's comments to the draft application.
- B. Contractor is cautioned to carefully check all extensions, totals, and required information for accuracy before submittal.
- C. Applications are to be signed by a responsible officer of the Contractor. Do not sign in black ink. (NO PHOTOCOPIES OF SIGNATURE ARE PERMITTED)
- D. The Application for Payment shall include the following forms and documents:
  - 1. Application and Certificate for Payment on Contract
  - 2. Construction Invoice Voucher (for the total amount due)
  - 3. Retainage Invoice Voucher (for the retainage amount)
  - 4. Monthly Subcontractors List and Certifications
  - 5. Invoices for materials stored off-site
  - 6. Apprentice and Journey Level Worker Utilization Report
- E. Do not include certified payrolls unless requested by the Owner's Representative or required elsewhere.
- F. When the Owner's Representative and A/E finds the Application for Payment properly completed and correct, they will sign and transmit all copies of the Application for Payment to the Capital Projects accounting office for processing.
- G. If the A/E or Owner's Representative find the Application for Payment improperly or incorrectly executed, an annotated copy will be returned for a new submittal.
- H. Only minor corrections are allowed on the original, with approval of Owner.

## 1.6 PRIOR TO FINAL APPLICATION FOR PAYMENT

- A. The final Application for Payment request will be accepted for processing only after providing satisfactory completion of the following:
  - 1. Application and Certificate for Payment on Contract
  - 2. Construction Invoice Voucher (for the total amount due)
  - 3. Retainage Invoice Voucher (for the retainage amount)

4. Monthly Subcontractors List and Certifications
5. Invoices for materials stored off-site
6. Final Completion procedures are complete per Section 01 77 00 "Closeout Procedures"
7. Final Schedule of Values "Total Contract Cost"
8. Apprentice and Journey Level Worker Utilization Report
9. "Building Componentization Report" allocating the final Total Contract Cost to each of the following categories:
  - a. Site Preparation
  - b. Exterior construction
  - c. Foundations and building structure
  - d. Exterior walls
  - e. Roofing
  - f. Interior construction
  - g. Floor covering
  - h. Fixed equipment
  - i. Elevators
  - j. HVAC
  - k. Plumbing and piping
  - l. Fire protection
  - m. Lighting and electrical

#### 1.7 RELEASE OF RETAINAGE

- A. Pursuant to the completion of Work performed in accordance with the GC/CM Contract and Final Acceptance by the Owner, the following requirements must be satisfied prior to the release of retained Contract funds.
  1. "Notice of Completion of Public Works Contract (REV 31 0020)": This Department of Revenue form will be completed by the Owner, establishing the date of Final Acceptance thereon. Three copies of the notice will be mailed to the Department of Revenue and a copy will be transmitted to Contractor.
  2. "Certificate of Payment of State Excise Taxes by Public Works Contractor (REV 31 0028)": Following receipt of the Owner's Notice of Completion of Public Works Contract form and after determining that all taxes, interest and penalties due from Contractor have been paid, the Department of Revenue will issue this certificate to Owner, thereby notifying the Owner that it has no objection to the release of retainage to the Contractor.
  3. "Certificate of Payment of Contributions, Penalties and Interest on Public Work Contract (EMS 8449 760)": Upon receiving a copy of the Owner's Notice of Completion of Public Works Contract form from the Department of Revenue and

determining that the Contractor is in compliance with the provisions of the Employment Security Act, the Employment Security Department will issue this certificate to Owner, thereby notifying the Owner that it has no objection to the release of retainage to the Contractor.

4. Upon receiving a copy of the Owner's Notice of Completion of Public Works Contract form and determining that the Contractor is in compliance with the provisions of Chapter 51 RCW for payment of industrial insurance premiums, the Department of Labor and Industries will issue a certificate for the Owner, thereby notifying the Owner that it has no objection to the release of retainage to the Contractor.
  5. "Affidavit of Wages Paid on Public Works Contract" (F700-007-000): An Affidavit of Wages Paid, for the Contractor, each Subcontractor, and each sub-tier Subcontractor approved by the Industrial Statistician of the Department of Labor and Industries, must be submitted by the Contractor to the Owner. Contractors and Subcontractors may file the Affidavit of Wages Paid either on-line at the website link provided in Appendix A or by completing the forms manually.
  6. "Certificate of Payment of Labor and Materials": This Owner's form shall be completed by the Contractor and returned to Owner. If the only exception to full payment to all Subcontractors is retainage owed to Subcontractors, the appropriate box on the form should be checked.
  7. Invoice Voucher: If the retained funds are on deposit in Owner accounts, the Contractor shall prepare a Retainage Invoice Voucher for the total amount retained and submit to the Owner for payment. If these funds have been placed in escrow at the direction of Contractor, no further invoice is required.
- B. Retainage will be paid by the Owner to the Contractor sixty (60) days following the published date of Final Acceptance, contingent upon Contractor's compliance with provisions of public works statutes and as stated above. If there are either unpaid taxes or unsatisfied claims of lien against the retained percentage, disbursement of retainage funds will be made in accordance with State of Washington law.
- C. Address all transmittal of retainage documents to the Owner's Contracts Office at:  
University of Washington, Capital Projects Office, Box 352205, Seattle, Washington, 98195 - 2205.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION



## PART 1 – GENERAL

### 1.1 SUMMARY

- A. This Section specifies administrative and procedural requirements for meetings during construction in addition to requirements specified elsewhere in the Contract Documents.
- B. Contractor and Subcontractor representatives attending meetings must be qualified and authorized to act on behalf of their firms.
- C. The Owner will utilize an internet-based construction management system (CMS) for communications and documents controls with the Contractor and A/E on this Project (see Section 01 35 00 “Electronic Communications”).
  - 1. Meeting minutes, Contractor construction activity data and work plans, A/E field reports and other such communications shall be distributed electronically by e-mail.
- D. Related Sections:
  - 1. Section 01 32 16 “Construction Progress Schedule”

### 1.2 PRECONSTRUCTION MEETING

- A. The Owner will schedule a preconstruction meeting to be held prior to the Contractor mobilizing and beginning any Work. This meeting will review Contract administration requirements and mobilization procedures.
- B. Meeting location: To be determined
- C. Participants shall include:
  - 1. Contractor's Project Manager, Superintendent, CQC Representative, Safety and Health Officer, and for projects with LEED requirements, LEED Coordinator;
  - 2. Owner's Representative, Project Manager, Safety Director, and for projects with LEED requirements, the Owner's Sustainability Manager;
  - 3. A/E and the A/E's sub-consultants, as appropriate;
  - 4. Owner's consultants, as appropriate; and
  - 5. Others, including the Contractor's major Subcontractors as appropriate.
- D. Owner's Representative will: Administer the meeting
- E. A/E will: Record and distribute copies of the minutes within seven (7) days of the meeting to all meeting participants.
- F. Agenda:
  - 1. The Work including, but not limited to:

- a. Schedule and phasing requirements
  - b. Contractor's use of premises
  - c. Special conditions and coordination
2. Communications including, but not limited to:
  - a. Chain and persons authorized to direct changes
  - b. Requests for Information (RFI), field decisions, and clarifications
  - c. Non-Conformance Reports
  - d. Hazard communication
  - e. Project meetings
3. Contractor's "Site Specific Safety Plan"
4. Administrative and procedural requirements including, but not limited to:
  - a. Contract modification
  - b. Progress payment
  - c. Submittals - including Contractor's Progress Schedule
  - d. Electronic communications
5. Project LEED requirements and documentation, if any
6. Testing and inspection
7. Contractor quality control
8. Temporary facilities and controls including, but not limited to:
  - a. Deliveries and storage
  - b. Temporary utilities and enclosures
  - c. Security procedures
  - d. Noise and vibration control
  - e. Cutting, patching, and field engineering
  - f. Utility shutdowns
  - g. Contractor parking
  - h. Housekeeping and waste management
  - i. Infection control - for medical facilities projects
9. Closeout procedures – including Project Record requirements
10. Other information as appropriate

G. Contractor shall conduct a like meeting, covering the same body of information, with each Subcontractor's project manager and foreman supervising the Work prior to the performance of any work on-site by that Subcontractor.

1. Provide Owner copies of meeting minutes prepared by the Contractor with each Subcontractor, when requested by Owner.

### 1.3 CONSTRUCTION PROGRESS MEETINGS

- A. Progress meetings shall occur weekly until Substantial Completion has been achieved.
- B. Meeting location: Owner's field office, or as mutually agreed
- C. Participants shall include:
  - 1. Contractor's Project Manager, Superintendent, CQC Representative, and Safety and Health Officer as appropriate;
  - 2. Owner's Representative and Project Manager;
  - 3. A/E and the A/E's sub-consultants, as appropriate; and
  - 4. Others, including the Owner's consultants, as appropriate.
- D. Contractor shall:
  - 1. Administer the meeting;
  - 2. Provide schedules, logs and other construction activity data in support of the issues discussed at and recorded in the meeting minutes; and
  - 3. Record and distribute copies of the minutes prior to the next progress meeting to all meeting participants and provide copies at each meeting.
- E. Agenda:
  - 1. Review and approve the minutes of the previous meeting noting exceptions, if any
  - 2. Review the progress of the Work since the previous meeting
  - 3. Review the Short Interval Schedule and work plans for progress during the period
    - a. Identify pending meetings
    - b. Discuss safety activities and job hazards analysis
  - 4. Discuss field observations, problems, and conflicts
    - a. Identify problems impeding the construction Progress Schedule
  - 5. Review Quality Control
    - a. Non-Conformance Reports - discuss corrective Work actions
    - b. Infection control - for medical center projects
  - 6. Review the Submittal Schedule and RFIs - present methods to expedite as required
  - 7. Review off-site fabrication and delivery schedules
  - 8. Review proposed changes in the Work and substitution requests for:
    - a. Timely processing
    - b. Effect on the Progress Schedule and Substantial Completion
    - c. Effect on any other contracts of the Project

9. Review the Schedule of Alternates status log, if any
10. Review any other business.

#### 1.4 PRE-INSTALLATION MEETINGS

- A. Pre-installation meetings shall be held prior to the Contractor or Subcontractors beginning work on each definable feature of the Work identified in the Contract Documents to require a pre-installation meeting and/or as required by the Owner's Representative. Notify Owner's Representative at least ten (10) working days in advance of each pre-installation meeting. Meeting examples include, but not by way of limitation:
1. Site clearing and excavation
  2. Demolition and regulated materials remediation
  3. Site utilities
  4. Landscaping and site restoration
  5. Concrete
  6. Masonry
  7. Structural steel
  8. Exterior cladding systems
  9. Water and damp proofing and roofing
  10. Doors, including frames and hardware
  11. Millwork
  12. Finishes
  13. Equipment, including elevators
  14. Mechanical and Electrical systems, such as high voltage, fire alarm, and communications
  15. Specialty items
- B. Meeting location: Contractor's field office, or as mutually agreed
- C. Participants shall include:
1. Contractor's Superintendent, CQC Representative, and Safety and Health Officer as appropriate;
  2. Subcontractor's project manager or foreman supervising the Work, as appropriate;
  3. Owner's Representative;
  4. A/E and the A/E's sub-consultants, as appropriate;
  5. Owner's consultants as appropriate; and
  6. Others as appropriate.
- D. Agenda:
1. Review of the pre-installation CQC Work Plan and Contract requirements
  2. Materials - available and ready for use
  3. Submittals
  4. Persons responsible for performing the work

5. Tests - required tests, criteria for performance, who samples and how often
  6. Safety procedures and requirements
  7. Substrate - criteria for substrate
  9. Other items as appropriate
- E. Contractor shall: Administer the meeting, and record and distribute copies of the minutes within seven (7) days of each meeting to all meeting participants.

#### 1.5 CHANGE ORDER MEETINGS

- A. Change order meetings shall be held to review and resolve any change order proposals, change order requests, or other change order issues pertaining to Contract Modification. Meetings shall be held monthly until all Change Order Proposals are resolved.
- B. Meeting location: Owner's field office, or as mutually agreed
- C. Participants shall include:
1. Contractor's Project Manager, or cost engineer as appropriate;
  2. Owner's Representative;
  3. A/E and the A/E's sub-consultants, as appropriate; and
  4. Others, including the Owner's consultants as appropriate.
- D. Owner's Representative will: Administer the meeting
- E. Agenda: Review Change Order Proposals for scope and estimated costs, and negotiate Change Order Proposal prices.

#### 1.6 DRAFT APPLICATION FOR PAYMENT REVIEW MEETINGS

- A. Draft Application for Payment review meetings shall occur monthly.
- B. Meeting location: Owner's field office, or as mutually agreed
- C. Participants shall include:
1. Contractor's Project Manager;
  2. Owner's Representative;
  3. A/E and A/E's sub-consultants, as appropriate; and
  4. Owner's consultants as appropriate.
- D. Owner's Representative will: Administer the meeting.
- E. Contractor shall: Present the draft monthly Application for Payment together with required back up information for review and comment by the Owner and A/E.
- G. Agenda - Discussion will pertain to items such as:

1. Percent of work complete
2. Off-site storage
3. Bill of quantities
4. Percentage of subcontract payment allocations
5. Apprentice Utilization and Journey Level Report

#### 1.7 A/E FIELD REPORT MEETINGS

- A. A/E Field report meetings shall occur monthly until Substantial Completion.
- B. Meeting location: Owner's field office, or as mutually agreed
- C. Participants shall include:
  1. Contractor's Project Manager and Superintendent;
  2. Subcontractor representative(s) as appropriate;
  3. Owner's Representative;
  4. A/E and the A/E's sub-consultants, as appropriate; and
  5. Owner's consultants as appropriate.
- D. Contractor shall: Administer the meeting and establish, maintain and provide a log of field report items, in a format acceptable to the Owner, documenting the action/resolution of all A/E field observations.
- D. A/E will: Call attention to the Contractor and Owner discrepancies in the Work, documented in the Contract Documents and field reports.
- E. Agenda: Discussion will pertain to unresolved field report issues including, but not limited to, the quality of the Work, missing or incomplete work elements, and corrective actions.

#### 1.8 COMMISSIONING MEETINGS DURING CONSTRUCTION

- A. Commissioning meetings shall occur weekly during the start-up and commissioning phase of the Work.
- B. Meeting location: To be determined
- C. Participants shall include:
  1. Contractor's Test Engineer, and Superintendant as appropriate;
  2. Subcontractor representative(s) as appropriate;
  3. Owner's Representative;
  4. Owner's Commissioning Authority; and
  5. A/E and the A/E's sub-consultants, as appropriate.
- D. Commissioning Authority will: Administer the meeting

- E. Contractor shall: Record and distribute copies of the minutes prior to the next meeting to all participants and provide copies at each meeting.
- F. Agenda - Discussion will pertain to items such as:
  - 1. Coordination of Work of applicable trades, such as balancing, electrical, controls, communications wiring connectivity;
  - 2. Scheduling of systems shutdown and switch over;
  - 3. Start-up and functional performance tests acceptance criteria; and
  - 4. Code and ordinance inspections/approvals.

#### 1.9 SPECIAL MEETINGS

- F. Special meetings may be called at the discretion of the Owner or Contractor for the purpose of coordinating specific information or resolving special issues related to the Project.
- B. Contractor shall record and distribute copies of the minutes within three (3) days of the meeting to all meeting participants.

#### 1.10 LEED MEETINGS

- A. LEED meetings shall occur monthly until Final Completion is achieved or until LEED documentation is complete, submitted on-line to the Green Building Certificate Institute (GBCI), and is acceptable to the Owner, whichever is sooner.
- B. Meeting location: To be determined.
- C. Participants shall include:
  - 1. Contractor's LEED Coordinator, and Project Manager as appropriate;
  - 2. Owner's Sustainability Manager, and Owner's Representative as appropriate;
  - 3. A/E and A/E's sub-consultants, as appropriate;
- D. Contractor shall: Administer the meeting and record and distribute copies of the minutes prior to the next meeting to all participants and provide copies at each meeting.
- E. Agenda - Contractor shall review:
  - 1. The Contractor and Owner shall review the LEED Site and Field Binder documentation for completeness and accuracy.
  - 2. LEED construction procedures and management plans, and the preparation of GBCI on-line forms.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION



## PART 1 - GENERAL

### 1.1 SUMMARY

- A. This Section specifies administrative and procedural requirements, in addition to those defined in the General Conditions for GC/CM Projects at the University of Washington, for schedule software, Baseline Progress Schedule preparation, monthly Progress Schedule updates, contemporaneous period schedule analysis, submittal schedules, and short interval schedules.
- B. Related Sections:
  - 1. 01 26 00, "Contract Modification Procedures"
  - 2. 01 29 76, "Progress Payment Procedures"
  - 3. 01 50 00, "Temporary Facilities and Controls"
  - 4. 01 77 00, "Closeout Procedures"
- C. Owner's forms included by reference for this Section include (see Appendix A):
  - 1. Short Interval Schedule
  - 2. Contemporaneous Period Schedule Analysis
- D. As used in this Section, "Progress Schedule" refers collectively to "Baseline Progress Schedule" and "monthly Progress Schedule updates".

### 1.2 SCHEDULE SOFTWARE

- A. The Contractor shall provide Owner an authorized copy, including all original manuals, of the latest version of Primavera Project Management® for Windows or an alternate Owner approved computer scheduling software with equivalent functionality. The selected software must be capable of performing baseline-to-current schedule comparisons, cost and resource loading functions, and have the option of executing scheduling calculations in either "retained logic" or "progress override" mode. Activities must be able to process lead and lag time relationships, start-to-start or finish-to-finish relationships, and be capable of being "hammocked" as required. The software must be registered to the Owner and be provided in Windows format and on CD format compatible with the Owner's computer.
- B. If Primavera Project Management® is not used by the Contractor, the Contractor shall provide training and continuing service at the Contractor's cost to Owner's personnel in the use of the selected software.
- C. Total Float is defined as the amount of time between the earliest start date and the latest start date, or between the earliest finish date and the latest finish date of an activity on the Progress Schedule. Float is not for the exclusive use of either the Contractor or the Owner unless otherwise identified in the Contract Documents.

1. Extensions of time for Contract performance will be granted only to the extent that equitable time adjustments to the affected activity or activities exceed the total float time along the affected paths of the current Progress Schedule at the time a Field Order, or Change Order, was issued for the change.
- D. All Progress Schedule submittals, including monthly Progress Schedule updates, will be reviewed jointly by the Owner's Representative and the Contractor. Such review of the Contractor's schedules shall not constitute an approval or acceptance of the Contractor's construction means, methods, or sequencing or its ability to complete the Work in a timely manner.

### 1.3 PROGRESS SCHEDULE

- A. Within sixty (60) calendar days after GC/CM Contract execution, the Contractor shall prepare and submit to the Owner, for review and comment, a preliminary Progress Schedule utilizing a Critical Path Method (CPM) logic, based on the Contract Documents. The Owner will review the preliminary schedule for conformance with the Contract Documents and provide comments within fourteen (14) calendar days of receipt from the Contractor. The Contractor shall respond to all comments and provide the Owner a Baseline Progress Schedule within fourteen (14) calendar days of receipt of the Owner's comments.
- B. Once the Baseline Progress Schedule is submitted to the Owner, the Progress Schedule shall be formally established as the baseline file within the Contractor's scheduling software. This baseline file shall not be modified without the Owner's written approval.
  1. The amount specified in Section 01 29 76 shall be withheld from the Contractor's monthly Application for Payment if the Baseline Progress Schedule is past due.
- C. The Baseline Progress Schedule shall be the basis that the Contractor shall use: plan, organize, and execute the Work; record and report actual performance and progress through updates, and; show how the Contractor plans to complete all remaining Work. The Baseline Progress Schedule and monthly Progress Schedule updates shall be the basis for consideration and analysis of requests for time extensions as specified below. The schedule shall be in the form of an activity oriented precedence network diagram.
- D. The Baseline Progress Schedule and monthly Progress Schedule updates shall be constructed to show the order in which the Contractor proposes to carry out the Work and to indicate the restrictions of access to and availability of work area, and availability and use of manpower, materials, equipment, and include all activities of trade contractors, equipment vendors, suppliers, and Negotiated Support Services expenses. The Progress Schedule shall incorporate contractually specified limitations and restrictions, and contractually specified milestones. Construction activities shall match or be correlated with the pay items in the approved Schedule of Values. The Progress Schedule shall be prepared in sufficient detail with the assignment and coding of all activities by the Contractor and Subcontractors in consideration of, but not limited to, the following Work activities:

1. Access and availability to the Project Site, including road closures;
  2. Interfaces and dependencies with preceding, concurrent, and succeeding contractors, if applicable;
  3. The type of work to be performed and labor trades involved;
  4. All procurement, manufacturing, fabrication (both on-site and off-site), and delivery activities for all major materials and equipment;
  5. Shutdowns of existing Owner's equipment and utility services;
  6. Required delivery dates of OFCI equipment and materials;
  7. Testing, air balancing, and commissioning activities, including submission and approval of test results;
  8. Approvals required by regulatory agencies or other third parties, including obtaining an Occupancy Permit;
  9. Coordination for Owner's occupancy including Owner's cleaning, OFOI equipment and furnishings installations;
  10. Planning for phased occupancy by the Owner, with intermediate completion dates;
  11. Contractor's preliminary cleaning and final cleaning operations;
  12. Contractor's Final Punch List Report, Owner's Final Inspection (Punch List), Contractor's corrections, and Owner's re-inspection;
  13. Substantial Completion and Final Completion activities and milestones, and Final Acceptance.
- E. The activities defined in the Progress Schedule shall represent the planned durations in anticipation of normal man-power and equipment utilization in durations of whole working days. No activity durations shall exceed twenty two (22) working days. If approved by the Owner, longer durations may be allowed for non-construction activities such as procurement, delivery, or submittal activities. All durations shall be determined based upon resource planning under contractually defined on-site work conditions. In calculating activity durations, normal inclement weather shall be considered. The Contractor shall schedule the Work to minimize the effect of adverse weather. The Contractor shall also protect the work site from the effects of adverse weather or take other necessary measures such that the Work can be completed within the time established in the Contract Documents and include these provisions in the schedule as appropriate.
- F. Schedule activity identification codes shall not be alphanumeric unless approved by Owner.
1. Activity Description: Provide adequate information to readily identify each activity up to 48 characters in the general descriptive format: action, item, location (such as Install Steel Studs 3<sup>rd</sup> Floor).
  2. Activity Codes: The Contractor shall develop and provide a complete, efficient and understandable Work Breakdown Structure (WBS) code to submit to the Owner for review and approval. In addition to the WBS, activity codes may be created and assigned a conventional WBS scheme, activity codes shall be used in lieu of the WBS. Suggested character fields for the code structure are:

<u>Name</u>	<u>Length</u>	<u>Description</u>
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PHAS	1	Phase or stage
TYPE	4	Type of activity
FLOR	1	Floor
AREA	4	Area and/or room
RESP	7	Responsible party
SPEC	5	CSI section number
OF/CI	4	Owner Furnished/Contractor Installed Equipment

3. The Critical Path shall be clearly indicated on all diagrams submitted. An activity is critical when it is part of the longest duration pathway(s) through the CPM network or when its total float is less than or equal to zero.
  4. At the Owner's request, furnish a written narrative of the Contractor's determination of durations for particular activities. Such explanation may include the number of crews, crew composition, number of shifts per day, number of hours in a shift, and number of work days per week, construction equipment, material quantities, productivity qualifiers (such as weather), etc.
  5. At the Owner's request, a written explanation shall be provided for leads and/or lags on relationships and for constrained dates. These scheduling constraints shall be disallowed unless a compelling reason exists for their use.
  6. Clearly identify activities which are planned to use of overtime, double shifts, work on weekends or holidays.
  7. Schedule Statistics Report: Each submittal involving graphical and/or tabular reports using CPM shall be accompanied by a Schedule Statistics Report. Include a listing of activities with open ends and out-of-sequence progress, constraints, the schedule calculation modes (retained; contiguous or interruptible) and other statistics that are normally a part of this report.
- G. Activities shall be cost-loaded. The estimated costs to perform each Work activity shall be assigned to each activity included in the network as specified by the scheduling software. The sum of the costs assigned to all activities shall equal the Total Contract Cost in the approved Schedule of Values. No activity costs shall be assigned to manufacturing or delivery activities unless approved by the Owner. Using the cost assigned to each activity, develop a cash flow projection demonstrating the estimated cash draw down by month over the period of the Project. The cash flow projection shall be illustrated by a graphic display as generated by the computer scheduling software.
1. Contractor shall provide Owner with a formula to convert cost loaded activities to manpower requirements. This formula shall be based upon a percentage allocation of the cost loading for labor costs and an average hourly labor cost for the Project.
  2. The total cost of each Subcontractor's construction activities in the Final Schedule of Values "Total Contract Cost" shall be equal to the total Subcontractor's Contract Sum

amount, (see Section 01 29 76 "Progress Payment Procedures").

3. Contractor may request and Owner may approve, at its sole discretion, an alternative resource-loading plan if it is evaluated equally beneficial.
- H. Tabular reports required by this Section shall be prepared by the scheduling software. Reports shall contain a listing of the activities as required for the type of report being prepared. Each activity shall include the following information:
1. Activity ID;
  2. Activity Description;
  3. Original and remaining durations in work days;
  4. Early start and finish dates;
  5. Actual start and finish dates (as applicable for monthly update reports);
  6. Late start and finish dates;
  7. Total float in work days;
  8. Percentage of activity completed;
  9. The budgeted cost, if cost-loaded;
  10. Assigned activity codes;
  11. Predecessor and successor activity numbers;
  12. Leads/Lags on activity relationships;
  13. Activities with constraints, and;
  14. Reportable milestone activities, as agreed with Owner.
- I. The Contractor shall prepare computer generated tabular reports as part of the initial schedule submission and for each monthly update thereafter as follows:
1. A list of the "nearly critical" (Total Float is equal to or less than 5 days) activities, sorted by activity number with predecessor and successor relationships;
  2. The Short Interval Schedule.
  3. Other reports that the Owner and Contractor may negotiate as the Project evolves.
- J. The Contractor shall submit the Progress Schedule consisting of the reports and diagrams as specified by this Section monthly, in the following quantities.
1. One copy of a Primavera Project Management® (or approved equal) generated detailed network diagram displaying all activities in a time scaled format with their logical relationships. The network need not be confined to a single sheet but shall be printed on either C or D drawing size.
  2. One copy of the Primavera Project Management® (or approved equal) updated project file in its native format on a CD compatible with the Owner's computer.

- K. Qualifications: The Contractor shall submit the resume(s) of the designated person(s) responsible for schedules and reports (the "Contractor's Scheduler"), who is not the Project Manager or Superintendent. The "Contractor's Scheduler" shall have demonstrable capability to plan, coordinate, execute, and monitor a CPM schedule as required for this Project. Submit the qualifications of the "Contractor's Scheduler" no later than five (5) days after the GC/CM Contract execution. The Owner's Representative will approve or reasonably disapprove the proposed "Contractor's Scheduler". In the event of disapproval; a new scheduler shall be proposed within one (1) week and be subject to the same consideration criteria as noted above.
- L. Certification: When requested by the Owner, submit certification that each Subcontractor and major equipment supplier has participated in, reviewed, and concurs with the Progress Schedule and the associated cost data as it relates to their Work.

#### 1.4 MONTHLY PROGRESS SCHEDULE UPDATES

- A. The Contractor is required to prepare and submit monthly Progress Schedule updates and to participate in monthly schedule update meetings with the Owner as described below.
  - 1. Timely submission of updates is of significant and crucial importance to the management of the Project. Lack of, or late receipt of, updates diminishes their value to the Owner. If a monthly Progress Schedule update is not submitted to and reviewed with the Owner prior to the Contractor submitting its monthly Application for Payment; the monthly Schedule of Values amount for Progress Schedule updates may, at the Owner's sole judgment and discretion, be reduced from the Specified General Conditions by a unilateral Change Order (see Section 01 29 76, "Progress Payment Procedures").
- B. The Contractor shall prepare monthly Progress Schedule updates to reflect work progress achieved since the previous update. Historical performance data and/or records shall not be changed without approval of the Owner.
- C. The Contractor shall, in a second and subsequent report, incorporate any logic and duration changes that represent its revised planning, provided all such changes are identified and submitted to the Owner for comment in the narrative report required herein this Section.
- D. The Contractor shall use and maintain a fixed end date when generating the required reports and diagrams for the Owner as specified by this Section. The fixed end date shall be the Substantial Completion date. The fixed end date will be adjusted in subsequent updates only to reflect approved time extensions incorporated by Change Order.
- E. The Project shall be rescheduled each reporting period with:
  - 1. An updated data date.
  - 2. Actual start/finish dates.

3. Percent complete.
  4. Remaining durations (for each activity in the “status” or “current file”).
- F. Show changes occurring since the previous schedule submission, such as:
1. Any major changes in scope.
  2. Activities modified since previous submission including, but not limited to, logic changes.
  3. Revised projections for progress and completion, as applicable.
  4. Any other identifiable changes.
- G. The Contractor shall account for all rain days, for major events, and similar excusable non-compensable delays, during which little or no work is progressed and that are acknowledged by the Owner, in the period within which the events occur. The Contractor may account for such delays within the Contemporaneous Period Schedule Analysis and the Progress Schedule update by treating the events as it would a typical holiday at the calendar function of the software. By whatever method the Contractor chooses to account for such delays and events, a narrative description of the accounting shall be included with the narrative report required herein this Section.
- H. The Construction Progress Meeting shall be held prior to the Owner’s review and comment of the Contractor’s monthly draft Application for Payment, unless otherwise approved by Owner.
1. The Contractor shall provide copies of two tabular reports:
    - a. A total float report clearly indicating the current critical path through Substantial Completion.
    - b. A report of activities sorted by early start dates commencing with the previous monthly progress update and including all updated activities during the previous month. Actual progress of the previous month will be recorded and incorporated into the update.
  2. The Contractor shall provide copies of a narrative report to include:
    - a. A description of the Work that has progressed.
    - b. An explanation of the Work that had been scheduled to be performed in the previous period but as not performed, and why it was not performed.

- c. Anticipated delay and impact on schedule.
  - d. Corrective action recommended and its effect.
  - e. A discussion of the Work scheduled for the upcoming period noting any issues or events that could impact this work.
  - f. If the Contractor intends to make logic or original activity duration change(s), the report will include such changes. To facilitate Owner's review the Contractor will provide a "Claimdigger" report which indicates all proposed changes to the schedule.
3. The Contractor and Owner shall review these reports and discuss any differences or issues raised.

#### 1.5 CONTEMPORANEOUS PERIOD SCHEDULE ANALYSIS

- A. It is the Owner's desire and intent to resolve all issues affecting the Substantial Completion date in a timely, efficient, and effective manner. To achieve this goal, the Owner and Contractor shall participate in contemporaneous analyses of all delays and advances of the schedule by application of the Contemporaneous Period Schedule Analysis method. The Contemporaneous Period Schedule Analysis shall coincide with the monthly schedule update meetings.
1. Format for the Contemporaneous Period Schedule Analysis should be similar to the Owner's form.
- B. Assessment of impacts due to changes or other events, in accordance with the Contemporaneous Period Schedule Analysis method described herein, must be performed on the most recent update of the Progress Schedule. Further, impacts due to changes or other events shall be assessed utilizing the Progress Schedule update that represents the data date closest to, and just prior to, the date of the impacting event. An alternative method can be to progress the schedule to a data date that represents the date of the impacting event. Subsequent to the assessment of schedule sequences representing the impacting events, the schedule may be updated to the next data date with appropriate logic or duration changes resulting from the impacting events. All data shall be provided to the Owner.
- C. The logic and planning elements of the Progress Schedule are the Contractor's responsibility.
1. No Contract Time shall be modified unless directed by an approved Change Order.
- D. Submission of a valid monthly Progress Schedule update and the completion of the Contemporaneous Period Schedule Analysis are conditions precedent to the review and approval of any request for an extension in the Contract Time. Failure to complete monthly Progress Schedule updates and to participate in Contemporaneous Period Schedule Analysis will defer consideration of any time extensions by the Owner until the Work is completed



and all as-built progress can be analyzed by the Owner. Further, the Owner will assess liquidated damages, if any, regardless of the status of any requests for time extensions pending, until any such requests are resolved.

- E. The Contractor shall obtain training by a qualified consultant in the application of the Contemporaneous Period Schedule Analysis method. The training shall be provided to appropriate Contractor field personnel, appropriate major Subcontractor personnel, and appropriate Owner personnel. The training should not exceed one day. The requirement for training may be waived by the Owner provided the Contractor can demonstrate sufficient working knowledge of the Contemporaneous Period Schedule Analysis method. The Contractor shall bear all costs for training specified herein.

## 1.6 SUBMITTAL SCHEDULE

- A. General: Within ten (10) calendar days following the Owner's receipt of the Baseline Progress Schedule, the Contractor shall prepare and submit to the Owner a complete schedule of work related submittals based on the Progress Schedule, as required by the Contract Documents ("Submittal Schedule"). Correlate Submittal Schedule with the listing of principal Subcontractors.
  - 1. The amount specified in Section 01 29 76 shall be withheld from the Contractor's monthly Application for Payment if the Submittal Schedule, referenced in 1.6 of this Section, is past due.
- B. Form: Prepare Submittal Schedule in chronological sequence of submittals. Show category of submittal, name of Subcontractor, generic description of work covered, related Specification Section numbers, activity or event code on the Progress Schedule baseline file, scheduled date for first submission, and blank columns for actual date of submittal, re-submittal, and final release or acceptance by the A/E. The Submittal Schedule shall be prepared in sufficient detail and in consideration of, but not limited to, the following:
  - 1. Preparation and submission of shop drawings, layout drawings, product data, material samples, and mock-ups.
- C. Update the Submittal Schedule monthly and submit to Owner.

## 1.7 SHORT INTERVAL SCHEDULE

- A. Short Interval Schedule: Prepare and update weekly a four (4) week Short Interval Schedule. Show previous week of actual progress (planned vs. actual performance). Forecast three (3) weeks of start and completion dates for each activity, task or event in comparison to the Progress Schedule.

1. Activities in the Short Interval Schedule shall relate directly to activities in the Progress Schedule.
- B. Format for the Short Interval Schedule should be similar to the Owner's form. This format is reproducible from the available Primavera Project Management® report formats; however, the Contractor may submit an alternative format that must first be approved by the Owner. The format shall include comment annotation as necessary.
- C. Copies of the Short Interval Schedule shall be provided at the Construction Progress Meetings and will be used as a basis for discussion of progress and planned work at the meetings.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION

## PART 1 - GENERAL

### 1.1 SUMMARY

- A. This Section specifies general administrative and procedural requirements for submittals required by the Contract Documents.

### 1.2 SUBMITTAL PROCEDURES

- A. The Owner intends to utilize an internet-based construction management system (CMS) for submittals (see Section 01 35 00 "Electronic Communications").
  - 1. The electronic submittal process is not intended to be used for color samples, color charts, or material samples.
- B. Coordination: Contractor shall review submittals for completeness, accuracy, and compliance with the Contract Documents, and shall coordinate the transmittal of submittals to ensure there is no delay in the construction Progress Schedule. Submittal sequencing should coincide with the Contractor's Submittal Schedule.
  - 1. Allow fourteen (14) calendar days turnaround for each submittal, from time of receipt by the Owner. For complex submittals or submittals requiring coordination with subsequent submittals, plan additional turnaround time.
    - a. Provide a "Priority List" when submitting several submittals within a short time.
  - 2. A/E reserves the right to withhold action on a submittal requiring coordination with other submittals until related submittals are received.
  - 3. Submittals received from sources other than Contractor will be returned without action.
- C. Submittal Preparation: Contractor shall place a label on each submittal for processing. Include the following information on the label:
  - 1. Date
  - 2. Owner's Project name
  - 3. Name of Contractor and submittal number
  - 4. Name of the entity that prepared the submittal
  - 5. Specification reference number
  - 6. For Shop Drawing submittals, Contractor's certification that the submittal has been coordinated and reviewed for compliance with the requirements of the Contract Documents, and is approved for A/E's action
- D. Submittal Transmittal: Contractor shall include a transmittal with each submittal package.

1. Address no more than one topic, or related topics, on a single transmittal (i.e., mechanical items shall not be submitted with electrical items; miscellaneous specialties shall not be grouped; shoring shall be submitted separate from foundations).
  2. Record relevant information including, but not limited to: the requested review return date (in order to maintain the construction Progress Schedule) and, for Shop Drawings, variations from the requirements of the Contract Documents.
  3. Provide the minimum number of each required submittal as noted in the Contract Documents and/or as follows:
    - a. Shop Drawings: one (1) PDF
    - b. Product data: one (1) PDF
    - c. Samples: five (5) samples
    - d. Mock-ups: As required by the Contract Documents
    - e. Reference the Contract Documents for additional submittal requirements
  4. Material and Color Samples: Submit samples of actual materials and colors.
    - a. Where variation in color, pattern, texture or other characteristics are inherent in the material, submit no less than four (4) variations of each sample to show approximate limits of the variations.
- E. Portable Document Format (PDF) Requirements:
1. All documents are to be created as PDF files from the original source files, unless approved otherwise in writing by the Owner.
  2. The CAD printer shall be Autodesk DWG to PDF.pc3 print configuration.
    - a. Layer information shall not be included.
  3. All documents are to be created with a resolution of not less than 300 dpi.
  4. All fonts are to be embedded in the PDF.
  5. When compression is used, the algorithm must be LZW, CITT Group 4, or PackBits.
  6. The PDF document size must be the same as the original document size if the document were printed (e.g., a 24"x36" print should have a PDF sheet size of 24x36).
  7. Each document must be submitted as a single file.
    - a. A single O&M product reference is one file.
    - b. A single drawing is one file.
    - c. A document larger than 11"x17" is defined as single document and is one file.

- F. A/E's Action: Except for submittals provided for the Owner's information, the A/E will: review each submittal, mark each submittal with a uniform self-explanatory action stamp indicating action taken, and return promptly. Typically action stamps indicate:
1. Accepted without exception;
  2. Subject to noted corrections;
  3. Returned for re-submittal after correction; and
  4. Rejected as non-compliant with the Contract Documents.
- G. Compliance with Contract Documents requirements is the Contractor's responsibility.
1. A/E's approval of submittals does not relieve the Contractor from responsibility for a proper installation, compliance with applicable codes, or coordination of the Work.
  2. All submittals required by the Contract Documents will be reviewed by the Owner for CAD drafting compliance, PDF compliance, and to determine completeness of the documents provided.

### 1.3 SHOP DRAWINGS

- A. General: Shop Drawing submittals are defined in the General Conditions and include, but are not limited to, product data, samples and mock-ups, and layout drawings.
1. Do not reproduce Contract Documents as Shop Drawings.
  2. For CAD Shop Drawing submittals, see Section 01 77 00 "Closeout Procedures."
  3. The actual cost of each shop drawing submittal required by Divisions 02 through 49 shall be included in the subcontract bid packages.
- B. Product Data: Product data includes manufacturer's printed installation instructions, catalog cuts, standard color charts, rough-in diagrams and templates, standard wiring diagrams, and performance curves.
1. Submittal of standard product data is acceptable only when specific reference to the requirements of the Contract Documents is included. Submit specially prepared manufacturer's product data when standard product data is insufficient.
  2. Mark each product data submittal and show the following information:
    - a. Compliance with specified product requirements, including LEED requirements
    - b. Compliance with any specified industry standards and testing agency standards, with testing agency labels and seals
    - c. Manufacturer's printed recommendations
    - d. Applicable choices and options
    - e. Notation of coordination requirements
    - f. Notation of dimensions established by field measurement, as appropriate

- C. Samples and Mock-ups: Samples include, but are not limited to, actual colors, materials and products to be provided. Mock-ups include field installations and partial assemblies of components.
  - 1. Prepare samples to facilitate review. Provide the following information:
    - a. Generic description of the sample
    - b. Source of the sample
    - c. Confirmation of availability and delivery time
  - 2. Where samples are for selection of appearance characteristics from a range of standard choices, submit a full set of choices for the material or products.
  - 3. Maintain sets of approved samples and mock-ups at the Project site for quality comparisons throughout the course of construction.
- D. Layout Drawings: Drawings include, but are not limited to, fabrication and installation drawings, layouts, schematics, diagrams, schedules, patterns, and templates.
  - 1. Submit drawings drawn to accurate scale. Indicate, at a minimum, the following information:
    - a. Dimensions
    - b. Identification of products and materials included
    - c. Compliance with product installation requirements and/or industry standards
    - d. Notation of coordination requirements
    - e. Notation of dimensions established by field measurement
- E. BIM Coordinated Shop Drawings:
  - 1. General: BIM (Building Information Modeling) shall be implemented in the coordination of this Project, per the documentation requirements of "Closeout Procedures" Section 01 77 00, 1.2 Project Record. The building information model will originate from the A/E and will be a shared resource during the design and construction of the Project. The Contractor and its Subcontractors shall collaborate with the A/E and the A/E's BIM protocols to coordinate the details of the project, to prepare Shop Drawings, and to submit a final BIM model at closeout.
  - 2. Contractor shall coordinate the Work and require the Subcontractors to prepare and submit BIM coordinated Shop Drawings in CAD (Computer Aided Drafting) format. The BIM coordinated Shop Drawings shall clearly show: the building components and how the Work is to be installed in relation to the work of the other Subcontractors; systems routings, sizes and components; space for disassembly and/or removal of major equipment requiring maintenance; access to products and equipment that require periodic maintenance including, but not limited to, cable trays, pull boxes, valves,

dampers, switches, motors, filters, control components; and that maintenance access is adequate and in accordance with the requirements of Authorities Having Jurisdiction.

- a. Contractor working through the Contractor's mechanical Subcontractor shall: coordinate the mechanical systems and equipment. The mechanical Subcontractor shall at a minimum indicate the following:
  - 1) Planned piping layout showing valve locations and valve-stem movement
  - 2) Clearances for installing and maintaining insulation
  - 3) Access doors
  - 4) Equipment and accessory service connections and support details
  - 5) Fire-rated wall and floor penetrations
  - 6) Accessories such as sizes and location of concrete pads and bases
  - 7) Penetrations in floors, walls, and ceilings and their relationship to other penetrations and installations
  - 8) All equipment requiring maintenance access from ladders six feet or more in height, or from scaffolding
- b. Contractor, working through the Contractor's HVAC Subcontractor, shall indicate the location, size, and elevation of supply and exhaust systems ductwork and diffusers; fire and smoke dampers; ventilation equipment including terminal boxes, fans, and motors with VFD's; seismic bracing; and access doors in ceilings. Equipment and dampers shall be coordinated to avoid maintenance access conflicts with built-in work below.
- c. Contractor, working through the Contractor's plumbing and piping Subcontractor, shall indicate the location, size, and elevation of piping, valves, controllers and headers, cleanouts, guides and rollers, expansion joints, seismic bracing, access doors in ceilings, and fixtures and equipment. Avoid routing plumbing through electrical and data/communications rooms.
- d. Contractor, working through the Contractor's sprinkler Subcontractor, shall indicate the location, size, and elevation of the complete sprinkler system including supply and cross mains routing, valves, seismic bracing, and standpipes. Coordinate location of sprinkler heads on the ceiling layout plans.
- e. Contractor, working through the Contractor's electrical Subcontractor and fire alarm Subcontractors, shall indicate the location, size, and elevation of primary distribution conduit runs, sleeves, pull boxes, junction boxes, CATV boxes, cable tray, seismic bracing, electrical equipment and panels (with working clearances), and fixtures including sound system speakers and terminal cabinets.
  - 1) Unless otherwise indicated, electrical panels have priority for indicated locations. Mechanical and plumbing installations shall provide all required offsets to ensure that electrical panels are installed in the indicated locations.

3. Contractor shall arrange meetings with its Subcontractors to resolve any apparent conflicts on the BIM coordinated Shop Drawings.
- F. Ceiling Layout Drawings: Contractor shall submit for Owner's review detailed reflected ceiling layout drawings at a scale not less than  $1/8" = 1' - 0"$  showing gypsum wallboard soffits and headers with heights, and locations of access doors, roof openings, HVAC diffusers, sprinkler heads, fire alarm devices, lights, and other ceiling mounted appurtenances.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION



## PART 1 - GENERAL

### 1.1 SUMMARY

- A. This Section specifies minimum administrative and procedural requirements for mechanical and electrical systems functional performance testing required by the Contract Documents.
- B. Related Sections:
  - 1. 01 91 00 "General Commissioning Requirements"

### 1.2 SERVICES

- A. Test Engineer - provided by Contractor.
- B. Commissioning Authority - provided by Owner.
- C. Electrical Testing Contractor (ETC) - provided by Electrical Subcontractor (working through the Contractor's Test Engineer).

### 1.3 REQUIREMENTS FOR TEST ENGINEER

- A. The Contractor shall provide the services of a "Test Engineer" experienced in commissioning including the troubleshooting of equipment and systems. The Test Engineer shall be qualified to develop and write, coordinate and schedule, and manage and document mechanical systems functional performance tests (FPT). The Test Engineer shall also coordinate the work of the ETC and assemble the required electrical commissioning documentation.
  - 1. Qualified personnel experienced in the technical aspects of each system to be commissioned shall be provided, if necessary, to augment the expertise of the Test Engineer.
- B. The services of a full-time, on-site test engineer are to begin with the subcontract bid award of the prime mechanical and electrical (M&E) Subcontractors and continue until Substantial Completion is achieved.
  - 1. After Substantial Completion, Test Engineer services shall continue as required until the commissioning and testing, adjusting and balancing (TAB) requirements for Final Completion are achieved.

### 1.4 TEST ENGINEER DUTIES

- A. The Test Engineer shall prepare and submit all FPT and commissioning documentation required by the Contract Documents for the actual equipment and systems installed, including but not limited to, start-up plans, installation verification audit reports, start-up and FPT deficiency report forms, test equipment identification lists, FPT procedures, FPT data

forms and one-line system and riser diagrams.

1. Maintain separate M&E systems "Commissioning Binders," indexed and tabbed according to the equipment or systems requiring commissioning, to compile the start-up and FPT documentation. Blank start-up forms, approved by the Commissioning Authority, shall populate the initial binders and be replaced with completed forms that shall be submitted in final M&E systems Commissioning Binders, as a requirement of Final Completion. The binders shall be on-site during the work. (see Section 01 91 00 for the Commissioning Binders documentation requirements)
  2. Prior to testing, the Test Engineer shall have applicable Subcontractor's and manufacturer's representatives review the test and commissioning documentation to identify personnel safety issues, equipment protection issues, and to validate relevance to the actual equipment provided.
- B. Prepare and submit a "Commissioning Plan" for Owner's review and comment three (3) months prior to any equipment or systems testing and/or start-up required by the Contract Documents.
- C. Develop a commissioning schedule for all FPT and commissioning activities required by the Contract Documents and integrate into the construction Progress Schedule. Identify:
1. Commissioning Plan preparation, submittal, and review;
  2. Each required functional performance test;
  3. Sequence of testing, including commissioning activity start-up prerequisites, point-to-point testing, and balancing activities; and
  4. Submission and approval of test results.
- D. Develop and write FPT procedures for all equipment tests, and systems and cross-systems tests required by the Contract Documents. Test procedures shall be in accordance with equipment manufacturer's recommendations, where applicable. Test procedures shall fully describe the equipment or system configuration and steps required for each test. The procedures shall be appropriately documented so that another party can repeat the identical test.
1. Maintain a set of drawings for recording the sign-off of each component of the plumbing and piping system pressure testing, heating, ventilation, and air conditioning (HVAC) system duct work pressure testing, and the completed flushing/cleaning and treatment activities.
- E. Coordinate the participation of each Subcontractor, including the ETC, specific to their start-up and testing responsibilities. Inform each Subcontractor as to what their test and expected results will be prior to commissioning.

- F. Observe the progress of the work to assure that all installations requiring commissioning are being made in accordance with the Contract Documents. Prepare and submit installation verification audit reports prior to the start-up of equipment or systems for which a formal start-up is specified in the Contract Documents.
- G. Coordinate all cross-systems testing such as HVAC, environmental controls, fire alarm, emergency power, life safety, elevators, and chillers controls.
- H. Manage and observe the start-up testing and all final tests of equipment and systems required by the commissioning plan and document test results.
- I. Report any deficiency in equipment or systems and either enforce compliance with the Contract Documents or provide Owner with technical expertise to recommend modifications to the equipment or systems to correct the deficiency. Oversee and direct the correction of deficiencies found during commissioning.
- J. Coordinate the required Commissioning Authority, A/E, or other Owner-witness participant for all test/approval procedures, after verifying that pretests have been satisfactorily conducted and final tests are ready to be performed.
  - 1. Notify the Owner's Representative in writing of the date, time, location and anticipated duration of start-up and test activities, with a minimum of five (5) working days advance notice.
  - 2. Obtain the signature of the designated witness on all data forms. If the witness is unavailable at the scheduled time and location of the activity, so note, and proceed per schedule without witness.
- K. Compare operation and maintenance information provided by the various Subcontractors and vendors with the Project Record documents and report any discrepancies to the Owner's Representative.
- L. Oversee and provide Owner with operating instruction and training for the mechanical and electrical equipment and systems specified in the Contract Documents, with coordination by the M&E Subcontractors.
- M. Provide as-built information to update the commissioning basis-of-design criteria.

## 1.5 TEST FAILURES

- A. In the event that a functional test fails, the Contractor shall determine the cause of failure, rectify the failure as soon as possible, and then retest. If more than two (2) functional tests of the same system are required, all costs for additional testing shall be borne by the Contractor, at the Owner's sole discretion.

## 1.6 CANCELLATIONS

- A. The Test Engineer shall give at least 48 hours advance notice to the Owner's Representative of cancellation of any scheduled test.
  - 1. Any costs incurred by Owner due to insufficient advance notice of cancellations shall be borne by the Contractor, at the Owner's sole discretion.

#### 1.7 WARRANTY TESTS

- A. In the event a product fails during the warranty period, the Contractor shall determine the cause of the failure, rectify the failure as soon as possible, and then retest. All warranty testing shall be borne by the Contractor.

#### 1.8 TEST ENGINEER QUALIFICATIONS

- A. The Contractor shall propose a Test Engineer, who is competent in the Project's M&E systems design and intent, for the Owner to evaluate and approve or reject in writing, based upon the following criteria which shall be documented in the Test Engineer resume.
  - 1. The Test Engineer shall have extensive experience in start-up and troubleshooting of HVAC, hot water heating, chilled water, steam, plumbing, electrical, emergency power, fire alarm, lighting controls, life safety systems, and other systems of similar complexity to those contained in the Contract Documents that are required to be commissioned.
  - 2. The Test Engineer shall:
    - a. Be familiar with the Project's control operating system(s);
    - b. Be capable of troubleshooting control code and recommending necessary modifications;
    - c. Be knowledgeable in the testing and balancing of both air and hydronic systems;
    - d. Have an excellent working knowledge of complex fire alarm, environmental and electric power control systems;
    - e. Have excellent communication and writing skills, be highly organized, and be able to work well with the Project's Subcontractors; and
    - f. Have a Bachelor's degree in mechanical engineering, PE certifications, and related field experience.
  - (1) However, in lieu of a Bachelor's degree and PE certifications, other

technical training with extensive practical field experience may be considered.

- B. Test Engineer Resume - The Contractor shall submit the Test Engineer's resume, including the following documentation:
1. Present or most recent employment:
    - a. Company name and address
    - b. Present title and job description
    - c. Dates of employment
  2. Other relevant work experience:
    - a. Company name and address
    - b. Title and description
    - c. Dates of employment
  3. For a minimum of three (3) similar projects, description of commissioning experience and roles performed in commissioning activities that demonstrate working knowledge of complex systems.
  4. Samples of a commissioning plan, a start-up plan, and a FPT with data forms written by the Test Engineer.
  5. References from a minimum of three (3) project owners and/or commissioning authorities.
  6. Description of education, certifications, and other technical training or field experience.

#### 1.9 COMMISSIONING AUTHORITY

- A. The Owner will provide a "Commissioning Authority," or appoint an Owner-designated witness, to act as the commissioning authority.
1. The Commissioning Authority will provide no labor or equipment in the commissioning process.
- B. The duties of the Commissioning Authority are to:
1. Provide commissioning basis-of-design criteria, for Contractor's information;
  2. Ascertain that the Project commissioning processes and information provided is in accordance with the requirements of the Contract Documents;
  3. Review the Contractor's Commissioning Plan, start-up plans, installation verification

audit reports, start-up and FPT deficiency report forms, and FPT data forms;

4. Review the Contractor's equipment, systems and cross-systems FPT procedures;
  5. Witness, verify, and approve satisfactory completion of equipment, systems and cross-systems FPT, based upon the Contract Documents requirements;
  6. Review for accuracy, comment on, and approve specified close-out documentation.
  7. Recommend Substantial Completion when commissioning and training has been successfully completed; and
  8. Provide final commissioning reports to the Owner.
- C. The Commissioning Authority will communicate as follows:
1. The Commissioning Authority will formally communicate with the Contractor via approved project channels. It is expected, however, that informal communication and coordination will be conducted directly with the Test Engineer. As the Owner's commissioning representative, it is expected that the Commissioning Authority will communicate directly with A/E, as may be appropriate.
  2. The Commissioning Authority will keep the Owner's Representative advised regarding commissioning activities and progress, equipment and systems performance, and any problems and solutions thereto.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION

## PART 1 – GENERAL

### 1.1 SUMMARY

- A. This Section specifies administrative and procedural requirements for Contract closeout including, but not limited to:
  - 1. Project Record
  - 2. Operation and Maintenance Manuals
  - 3. Warranties and Bonds Manual
  - 4. Operating instructions and training
  - 5. Cleaning
  - 6. Owner's Final Inspection
  - 7. Substantial Completion
  - 8. Final Completion, and
  - 9. Final Acceptance
- B. For additional specific construction Work, closeout requirements are described in Divisions 02 thru 49 of the Specifications.

### 1.2 PROJECT RECORD

- A. General: Project Record documents include the Contractor's as-built Drawings, as-built Specifications, and as-built Shop Drawings required by the Contract Documents. Project Record documents must be protected from deterioration and stored in a secure fire-resistant location.
- B. As-built Drawings: Maintain black line prints of the bid set Contract Drawings and approved Shop Drawings. Mark the drawings to show new information that was not shown on the bid set Drawings, and on the approved Shop Drawings, including the actual installation where the installation varies substantively from the work as originally shown. Mark drawings to show conditions fully and accurately. Where Shop Drawings are used, record a cross-reference at the corresponding location on the Drawings. Give particular attention to concealed elements that would be difficult to measure and record at a later date.
  - 1. Organize as-built Drawings in manageable sets, bind with durable paper cover sheets, and print suitable titles, dates, and other identification on the cover of each set.
  - 2. Mark with reproducible pencil and distinguish between variations in separate categories of the Work. Text size is to be 1/8" minimum. Good basic drafting practice must be applied.
  - 3. Show bid addenda items, Change Orders, and Request for Information (RFI) responses by their number and date the revisions with a "cloud" around the revision.
  - 4. Keep accurate measurements of below-grade site work, including permanent shoring, in accordance with Section 01 71 23 "Field Engineering."

5. Show mechanical dampers, valves, reheat boxes, cleanouts, and other equipment and items that require maintenance.
  6. Show location of construction-concealed mechanical, electrical and plumbing (MEP) riser installations including, but not limited to, piping, ductwork, and conduits referenced to visible and accessible features.
  7. Show field changes of dimensions and details.
  8. X-out conditions not constructed and appropriately annotate "not constructed" to convey the actual as constructed condition.
- C. As-built Specifications: Maintain one (1) copy of the bid set Contract Specifications showing all addenda, substitutions, Change Orders, and RFIs. Give particular attention to the selection of options, changes in product data, and information on elements engineered by the Contractor and note related as-built Drawing information, as appropriate. Clear, legible documentation must be applied.
- D. As-built Shop Drawings: The Contractor shall comply with the following CAD (Computer-Aided Drafting) standards and requirements when preparing BIM and as-built record Shop Drawings required by the Contract Documents.
1. Cover sheets shall contain a complete index of all sheets.
  2. Symbols shown must be symbols used in the Contract Documents.
  3. Standard drafting practice shall be:
    - a. Title block
      - (1) All sheets shall have a title block.
      - (2) Title block information is to be on the right side of the sheet.
      - (3) Title blocks shall include the following information:
        - a. Date
        - b. University Project Name
        - c. University Project Number
        - d. University Facility Number (FACNUM)
        - e. Sheet name
        - f. Sheet number
        - g. Contractor or Subcontractor company name
        - h. A/E's Seal (whoever prepared the drawing)
        - i. A Key Plan
    - b. Layering format: Use Army Corps of Engineers A/E/C CAC standard found at: <https://cadbim.usace.army.mil/CAD>
    - c. Scale and Units:



- (1) All objects are to be drawn at full scale for the assigned unit of measure.
  - (2) All drawings are to have a unit of measure assigned and not set to “unitless.”
- d. External references usage in CAD Documents: External references are not allowed for submittals. All external references are to be bound using the “bind” option, instead of the “insert” option.
- e. Area of Work: CAD drawings shall include a boundary that defines the area of work, showing only the area where work is performed.
- 4. CAD Compliance Submittal Review Requirements: CAD Shop Drawings shall be electronically submitted for Owner’s CAD compliance review and approval prior to submitting the final as-built Shop Drawings. The Contractor may request a compliance review at any time during the work prior to Substantial Completion.
- 5. Project Record submittal: Provide all record as-built Shop Drawings required by the Contract Documents in CAD and PDF format and, when specified, in BIM and PDF format (per the requirements of Section 01 33 00 “Submittal Procedures”).
  - a. CAD files shall be submitted in the latest release of AutoCAD.dwg format.
    - (1) Custom menus or arx applications are not allowed if they create a requirement for the drawing to be used. No menus, custom user interface files or arx applications are to be submitted.
    - (2) Each CAD drawing shall represent a single printed sheet where the file name conspicuously identifies the sheet number (e.g. sheet A2.1 CAD file name might be A2-1.dwg).
    - (3) For all disciplines in a submittal, the CAD drawings shall be in a single folder. All supporting files (font file, line types, plot configurations, plot style tables, etc.) are to be in a sub folder.
  - b. When preparing BIM Shop Drawings, the Contractor shall prepare BIM files in the mutually agreed release of Autodesk Revit.rvt format between Owner, A/E, and Contractor and shall perform coordination and interference checks using NavisWorks.
    - (1) All CAD drawings shall be exported from Autodesk Revit.

### 1.3 OPERATIONS AND MAINTENANCE (O&M) MANUALS

- A. Separate manuals shall be provided by the Mechanical and Electrical (M&E) Subcontractors titled MECHANICAL or ELECTRICAL and an additional manual provided by the General

- Contractor titled ARCHITECTURAL for all other information. The preliminary manuals shall be labeled "Preliminary" and comply with all requirements.
- B. The O&M Manuals shall contain all the information needed to operate, maintain and repair all systems, equipment, and product finishes provided in the Project. They shall be presented and arranged logically for efficient use by Owner's operation personnel. As a minimum, the information provided shall include, but not be limited to, the following: (see Architectural, Mechanical and Electrical Divisions for additional requirements)
1. Product description including, but not limited to, manufacturer, product name or equipment make and model number (and other nameplate data), size and dimensions, color, Material Safety Data Sheets (and related product information), and other pertinent information
  2. Supplier's name, address, e-mail address, phone, and reference order numbers
  3. Product finishes maintenance and cleaning instructions
  4. Performance and calibration data for specific product provided (extraneous catalog data must be eliminated)
  5. Descriptions and diagrams of system assembly and configuration (including components and interrelations)
  6. Manufacturer's recommended equipment operating and maintenance instructions, including routine lubrication and servicing data, start-up and shutdown procedures, and any seasonal or emergency procedures
  7. Manufacturer's checklists and methods for troubleshooting
  8. Complete parts list with parts numbers indicating common replacement parts and anticipated useful life
  9. Copies of: digitally signed warranties; any certificates from respective manufacturers, suppliers, and Subcontractors; permits and/or licenses, and equipment service and maintenance contracts.
- C. The O&M Manuals shall contain the following information for specified items, when the item is specified elsewhere in the Contract Documents:
1. As-built door hardware schedule and submittal documentation
  2. Elevator systems documentation
    - a. Wiring/equipment locations diagrams
  3. Refrigeration controls schematics / sequence of operation documentation
  4. Motors data and variable frequency drives (VFDs) documentation

- a. Final settings programmed into the VFDs
- 5. Fan and pump curves documentation
- 6. HVAC filters schedule
- 7. Environmental controls systems (ECS) documentation including hardware and software manuals
- 8. Electrical - Short Circuit Coordination and Arc Flash Study Report
- 9. Pull calculations documentation for MV wire, cable, and terminations
- 10. Electrical transformer factory test reports documentation
- D. Drawings included in the manual shall not exceed 11" x 17."
- E. Hard copy manuals shall be bound in a slant-D, 3-ring, view binder with a clear vinyl overlay insert on the front cover and spine.
  - 1. Provide a cover slip sheet and a spine sheet typed with ARCHITECTURAL, MECHANICAL, and/or ELECTRICAL - OPERATIONS AND MAINTENANCE MANUAL, University Project name, University Project number, University Facility number, A/E name, and Contractor name. Label manuals consecutively (ex., Mechanical 1 of 3).
  - 2. Each manual shall have a typed index and tabbed dividers between specification divisions and sections or, when presented in a logical format by Contractor and approved by Owner, between systems/equipment categories.
  - 3. Contents of the manual shall be printed on white 8-1/2" x 11" acid free, recycled copy paper.
- F. ARCHITECTURAL, MECHANICAL, and ELECTRICAL manuals may be combined into one manual, with approval of Owner.

#### 1.4 WARRANTIES AND BONDS MANUAL

- A. Assemble executed warranties and bonds, and any certificates from the respective manufacturers, suppliers, and Subcontractors. Provide preliminary review copies of all warranties and bonds and a final manual will the original documents, titles "Warranties and Bonds Manual." Manuals shall be assembled in the same format as the O&M Manuals and include a table of contents in complete and orderly sequence.

#### 1.5 OPERATING INSTRUCTIONS AND TRAINING

- A. The Contractor shall provide on-site instruction and training for Owner's personnel in all aspects of the philosophy, operation and maintenance of equipment and systems. Instruction and training shall be provided by a qualified trainer from the Contractor or Subcontractor who supplied and installed the equipment and/or systems or a manufacturer's training representative who is familiar with all aspects of the design, operation, maintenance, and troubleshooting of the specified equipment and systems. Training shall be conducted in a classroom setting with appropriate schematics, handouts, and audio/visual aids. All training shall be digitally recorded in video, cataloged, and provided to Owner in a DVD/container labeled with session identification and date. Attendance shall be recorded. For work requiring commissioning, see Section 01 91 00 "General Commission Requirements" for further training session agenda requirements.
  - 1. Prepare and submit a training plan for Owner's information and coordination. For each training session, the training plan shall include the following:
    - a. Dates, start and finish times, and locations
    - b. Outline of the information to be presented
    - c. Names and qualifications of the presenters
    - d. List of texts and other materials required to support training

## 1.6 CLEANING

- A. Contractor clean up during construction is specified in the Contract Documents.
  - 1. If Contractor fails to clean as specified in the Contract Documents, and after reasonable notice from Owner, Owner may do so and the cost thereof shall be charged to Contractor.
  - 2. For work in medical centers, reference housekeeping in Section 01 35 33 "Infection Control."
  - 3. Contractor shall employ continuous housekeeping cleaning during construction to minimize interior construction dust and particulates during the Work.
- B. Preliminary Cleaning: Perform the following preliminary cleaning operations as a prerequisite for Owner's Final Inspection. Although the Contractor is responsible for this Work, the actual costs shall be included in the Division 02 through 49 subcontract bid packages. The following are examples, without limitation, of minimum cleaning requirements:
  - 1. Remove labels that are not permanent.
  - 2. Remove temporary protective coatings and wrappings from all products.
  - 3. Remove glazing compounds and other vision-obscuring substances from transparent and reflective materials provided by the Contractor including, but not limited to, mirrors, glass in doors and interior construction, glass canopies and skylights, and windows inside and out.

4. Clean all exposed building interior surfaces, including cabinet interiors, and new exterior surfaces to be free of foreign substances including, but not limited to, stains and films.
  5. Leave floors broom-clean. Vacuum carpeted surfaces and clean consistent with manufacturer's recommendations for installation.
  6. Remove and clean all construction debris and refuse from:
    - a. Roofs, mechanical and electrical rooms, tunnels and equipment vaults
    - b. Limited access spaces including above ceiling areas and shafts
    - c. Physically inaccessible components of the Work including wall and chase cavities, gutters and downspouts, floor drains and other drainage systems
  7. Wipe surfaces of M&E equipment, including elevator equipment and similar Architectural equipment. Remove excess lubrication and other substances.
  8. Clean the Project site of construction waste, rubbish and litter. Sweep paved areas broom clean and remove stains, spills, and other foreign deposits.
- C. Final Cleaning: Prior to Substantial Completion, employ experienced workers or professional cleaners for final cleaning of the Work. Clean to a condition expected of a normal commercial building cleaning and maintenance program. Comply with manufacturer's instructions. Final cleaning is a negotiated support service.
1. Leave entire Project clean and ready for occupancy. All new interior, including cabinet interiors, and exterior building surfaces, fixtures and equipment shall be turned over to the Owner in a new condition, free of all damage, dust, dirt, spots, stains, encrustations, and other blemishes.
  2. Clean transparent materials including mirrors, glass in doors and interior construction, glass canopies and skylights, and windows inside and out.
  3. Clean plumbing fixtures to a sanitary condition.
  4. Clean light fixtures and lamps.
  5. Owner will wax and apply sealers to vinyl composition tile and sheet vinyl floors.
- D. Compliance: The Contractor shall:
1. Use non-toxic Green Seal Certified cleaning products, or products with low-volatile organic compounds (VOC), and cleaning paper with a post-consumer recycled content
  2. Employ equipment with high efficiency particulate filtration and sweep compound to keep dust down

3. Comply with current regulations and standards of authorities having jurisdiction and the safety standards for cleaning specified in manufacturer's instructions.

#### 1.7 OWNER'S FINAL INSPECTION

- A. Prior to Final Inspection: The Contractor shall satisfactorily complete the following actions prior to the Owner's final inspection of the Project.
  1. Submit written notice that the Project is ready for final inspection. Include a copy of the Contractor's final punch list report (see Section 01 45 00 "Contractor Quality Control") and list all incomplete work items that have been reviewed with the Owner, and which the Owner has agreed are not necessary prior to Substantial Completion.
    - a. Include a written plan/schedule outlining all actions necessary to achieve Substantial Completion, without requiring extra ordinary participation by Owner and A/E.
  2. Complete preliminary cleaning operations.
  3. Submit a list of all equipment and systems requiring instruction and training with a proposed schedule of times and locations for the instruction, for Owner's review and comment.
  4. Replace all ventilation systems air filters specified for construction with final filters.
  5. Complete start-up and functional performance testing of all systems required by the Contract Documents and AHJ including, but not limited to: electrical testing; environmental control systems point-to-point testing; emergency eyewash and safety shower testing; fume hood face velocity testing; and HVAC air balancing.
  6. Submit one (1) hard copy each of the current air balancing report and the M&E Commissioning Binders labeled "Preliminary," listing all deficiencies, for Owner's review and comment.
  7. Submit the final copper and fiber optic communications cabling test results in PDF format, on Owner's CMS.
  8. Submit the final audio/visual equipment documentation including, but not limited to, manufacturer/model information and an itemized summary list with equipment serial numbers in PDF format, on Owner's CMS.
- B. Owner's Final Inspection: Upon satisfactory completion of the actions in 1.7A, Owner will determine if the Project is complete and ready for final inspection and, at Owner's sole discretion, commence final inspection, or provide a written deficiency list of items to the Contractor of work that must be completed to the satisfaction of the Owner prior to Owner's final inspection. Final inspection is performed by the A/E and Owner's representatives.

1. After the Owner has issued the final inspection list of corrective work items, the Contractor shall make the required corrections and/or identify items that the Contractor feels are not required by the Contract Documents, and resolve these items with the Owner.
- C. Re-inspection: Contractor shall request, in writing, re-inspection after completing the Owner's final inspection list of corrective work items and providing the Owner the final inspection report notated with a signed-off approval for each of the corrected items. Those items whose completion is delayed due to circumstances acceptable to the Owner will be exceptions. The Owner's Representative will back check the items or have the A/E perform a re-inspection.
  1. If the A/E is required to perform more than one re-inspection, the costs for additional inspections may be borne by the Contractor, at the Owner's sole discretion.

## 1.8 SUBSTANTIAL COMPLETION

- A. Substantial Completion: Substantial Completion (for either the entire Work or portions thereof) shall be achieved when all Work, other than incidental corrective and incidental punch list work, is complete including, but not limited to, the following actions:
  1. Complete final cleaning operations.
  2. Submit the "Preliminary" Operations and Maintenance Manual for Owner's review and comment in one (1) hard copy and in PDF format, on Owner's CMS.
  3. Submit all sign-offs, releases, jurisdictional settlements, judgments, and other records from AHJ allowing the Owner's full and unrestricted use and benefit of the facilities including, but not limited to, a temporary or permanent certificate of occupancy permit, operating permits and/or licenses for the use of building equipment such as elevators, boilers, paint booths, etc. and similar necessary certificates and releases.
    - a. Provide a list of any outstanding work required by AHJ.
  4. Submit the current Project Record as-built Drawings and Specifications identified "Preliminary" Project Record (marked with the date of submission) in PDF format, on Owner's CMS.
  5. Submit the Project Record as-built Shop Drawings required by the Contract Documents and, when specified, the BIM in accordance with this Section 1.2D.5, on Owner's CMS.
  6. Remove all construction tools and temporary facilities not required for Final Completion work from the Project site including, but not limited to, storage sheds, samples and mock-ups, Project identification signage, site fences, crane and hoist base foundation construction, temporary enclosures, and construction electrical power and service.

7. Complete Owner's personnel operating instructions and training and submit training DVD's.
8. Deliver specified maintenance equipment and tools to Owner, with itemized summary list.
9. Complete final change-over of locks, transmit new keys to Owner, and return Owner's loaned construction keys.
10. Complete all air balancing, testing and commissioning work required by the Contract Documents, allowing the Owner to fully occupy the Work for the use for which it is intended. Incidental Work, that is not life safety or occupational safety commissioning work, whose completion is delayed due to circumstances excused by the Owner, will be the exception.
  - a. Submit one (1) hard copy each of the current air balancing report and M&E Commissioning Binders (marked with the date of submission) noting the corrections for deficiencies listed in the "Preliminary" report and binders and indicating any incomplete Work.
11. Submit all controls systems software files required by the Contract Documents including, but not limited to, lighting and environmental controls.
12. Submit one (1) hard copy of the current Build It LEED Toolkit ® with all LEED documentation labeled "Preliminary," for Owner's review and comment.
- B. Substantial Completion: Upon a satisfactory completion of the actions in 1.8A above and the General Conditions requirements for Substantial Completion, the Owner will prepare a letter of Substantial Completion and forward to Contractor. The letter will identify the date of Substantial Completion and include the final punch list report and the commissioning deficiencies list, listing all remaining incomplete work. Contract warranties will begin as of the date of Substantial Completion, as specified in Section 01 78 36 "Warranties," or as otherwise indicated in the Contract Documents.
  1. Substantial Completion and the start of warranties for incomplete items will be established in writing by the Owner when the item is determined complete.

## 1.9 FINAL COMPLETION

Prior to Final Completion: Final Completion shall be achieved when the Work is fully and finally complete, to the Owner's satisfaction in accordance with the Contract Documents including, but not limited to, the following:

1. All Work, including incidental corrective or punch list work, and air balancing and commissioning work (if included in the scope of the Work) is complete and correct to the satisfaction of the Owner.



2. All remaining temporary facilities are removed from the Project site and the site (including landscape) is restored to original conditions or Contract Documents requirements.
3. All final permits, originally issued as temporary permits, have been submitted.
4. The final marked-up Project Record as-built Drawings and Specifications identified Final Project Record (marked with the date of submission) have been submitted in hard copy; and in PDF format, on Owner's CMS.
5. The complete Operations and Maintenance Manual and Warranties and Bonds Manual have been submitted in PDF format, on Owner's CMS, and a hard copy of the Warranties and Bonds Manual with original documents has been submitted.
6. The Contractor's final 3-ring binder of all MSDS used for construction, marked with the date of submission, has been submitted in PDF format, on Owner's CMS.
7. The Contractor's final cumulative Construction Waste Management Report (marked with the date of submission) has been submitted in PDF format, on Owner's CMS.
8. All Change Orders are approved and signed by both parties.
9. A draft of the Final Application for Payment has been submitted to Owner for review and approval.
10. The final Schedule of Values and the Building Componentization Report in hard and electronic copies (see Section 01 29 76 "Progress Payment Procedures") have been submitted.
11. The final air balancing report and the final M&E Commissioning Binders (marked with the date of submission) have been submitted in PDF format, on Owner's CMS.
  - b. For Projects with a Test Engineer, the as-built information updating the A/E commissioning basis-of-design has been submitted with the Commissioning Binders.
12. The software file used to calculate the power systems studies (Power Tools – SKM ®) has been submitted.
13. Specified spare parts, extra stock of materials, and extra materials of value to the Owner, with itemized summary list, have been submitted.
14. The "Regulated Materials – Waste Manifests" (marked with date of submission) have been submitted in PDF format, on Owner's CMS.
15. All required USGBC LEED certification on-line forms are submitted and the final Build It LEED Toolkit ® with all final LEED documentation including the LEED estimated construction costs have been submitted in PDF format, on Owner's CMS.

- B. Final Completion: Upon satisfactory completion of the requirements in 1.9A above to achieve Final Completion, the Owner will approve and process the final Application for Payment and establish the date of Final Completion thereon.

#### 1.10 FINAL ACCEPTANCE

- A. Final Application for Payment has been approved by Owner and payment made to the Contractor.
- B. The Owner will establish the date of Final Acceptance and issue the letter of Final Acceptance after the Contractor has completed the requirements of the Contract Documents.
  - 1. The Contractor shall follow the requirements outlined in the General Conditions and Section 01 29 76 "Progress Payment Procedures" for release of retainage.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION

## PART 1 - GENERAL

### 1.1 SUMMARY

- A. Comply with the commissioning provisions specified in this Section and elsewhere in the Contract Documents.
- B. General:
  - 1. Unless noted otherwise, functional performance tests (FPT) apply to all equipment and systems identified to be tested in the Contract Documents.
  - 2. Submittals shall be in accordance with Section 01 33 00 "Submittal Procedures" and for CAD (Computer Aided Drafting) Record Drawings, in accordance with Section 01 77 00 "Closeout Procedures."
  - 3. The duties of the Contractor's "Test Engineer" and Owner's "Commissioning Authority" are described in Section 01 75 00 "Test Engineer Services."
  - 4. The Contractor shall ensure that the Commissioning Authority, or other Owner-designated witness, is provided safe access to witness the performance of the equipment or systems being commissioned and is reasonably furnished ladders, scaffolding, and staging, if required, for witnessing.

### 1.2 COMMISSIONING DOCUMENTATION

- A. Commissioning Plan: The Contractor shall prepare and submit a "Commissioning Plan" that identifies how commissioning activities will be integrated into the construction Progress Schedule and how commissioning responsibilities are distributed. Include, as a minimum, the following:
  - 1. An organizational chart showing lines of communication and authority of the Test Engineer relative to key Contractor positions and to key Subcontractors
  - 2. Who will be responsible for producing the various procedures, reports, Owner notifications, and forms required by the Contract Documents
  - 3. A list of all control systems software required by the Contract Documents
  - 4. The commissioning schedule
  - 5. Commissioning forms and other documentation
  - 6. Description of start-up and test procedures
  - 7. A list of Subcontractors who will participate in each of the tests

8. The instrumentation required for each test and who will provide the instrumentation
  9. Operational description for each test. (This shall include, for example, the commissioning basis-of-design criteria provided by the commissioning authority, code requirements, the specifics of the equipment to be provided, sequences of operation, operating priorities, and other necessary information.)
  10. One-line system and riser diagrams
- B. Mechanical and Electrical Commissioning Binders (M&E): The M&E “Commissioning Binders” shall include the submittals, test equipment, commissioning procedures, installation verification audits, and FPT procedures documentation described in this Section.

### 1.3 SUBMITTALS

- A. Start-up plans: Submit start-up plans, with start-up test procedures and documentation forms, for the equipment and systems for which a start-up is specified in the Contract Documents. Start-up plans shall include the following:
1. Start-up schedule
  2. Names of firms/individuals required to participate
  3. Detailed start-up procedures
  4. Start-up forms
  5. Operations and maintenance product data
- B. Start-up installation verification audit report: Submit installation verification audit reports prior to start-up of equipment and systems for which a start-up is specified in the Contract Documents. Identify:
1. Equipment and/or systems, to be started-up;
  2. Prestart-up tests performed, including manufacturer’s factory tests;
  3. Deficiencies noted;
  4. Corrective action taken; and
  5. Dates and initials of persons making the entries.
- C. Start-up deficiency report form: Submit start-up deficiency report forms within five (5) days following the start-up of each equipment or system to report any deficiencies discovered in conjunction with start-up. Identify:
1. Equipment and/or systems started-up;
  2. Location and identification of the deficient equipment and/or materials;
  3. Date of observation and initials of observer;
  4. Deficiencies noted;
  5. Corrective action taken; and
  6. Date of correction and initials of the person making the correction.

- D. Test equipment identification list: Submit a list of all test equipment used in commissioning, sorted according to intended use. Provide an updated list, if any equipment is added to the commissioning, while testing is in progress. The list shall include the following information:
1. Manufacturer
  2. Model number
  3. Serial number
  4. Date of most recent calibration
  5. Range
  6. Accuracy
  7. Resolution
  8. Intended use
- E. Testing, Adjusting and Balancing (TAB) progress reports: Submit weekly TAB progress reports after TAB activities have begun. Identify the following:
1. Systems or subsystems for which preliminary balancing is complete
  2. Systems or subsystems for which final balancing is complete
  3. Status of deficiencies and balancing problems encountered, including corrective actions taken
  4. Updated schedule of remaining TAB activities
- F. FPT procedure documentation: Submit FPT procedure documentation for FPT specified in the Contract Documents. The documentation shall include the following:
1. FPT procedure description
  2. Procedures that are based upon the actual equipment and/or systems configuration
  3. The value for all set points and inputs, positions of adjustable devices, valves, dampers and switches
  4. The acceptable test range for each FPT
  5. Updated one-line system and riser diagrams
  6. An alphanumeric designator for each procedure
  7. Reference to the applicable Specifications section upon which the procedure is based
- G. FPT data forms: Submit FPT data forms to document the equipment or systems FPT specified in the Contract Documents.
1. Identify each FPT data form by a unique designator, consisting of an applicable FPT procedure designator followed by a dash and digit suffix to distinguish multiple repetitions of the same procedure.
  2. The FPT data form shall identify:

- a. Who needs to be in attendance for the tests, including but not limited to, Subcontractors, Commissioning Authority or other Owner-designated witness, regulatory agencies, and others as appropriate; and
  - b. The sequence of the tests to be performed.
3. Include space to record the following:
  - a. Description of the procedure
  - b. Whether the form is for a retest of a failed procedure
  - c. Identification and location of the equipment being tested
  - d. Identification of instrumentation used, by type and serial number
  - e. Observed conditions at each step of the procedure
  - f. Acceptable results, as specified
  - g. Date of the test
  - h. Names of technicians performing the procedure
  - i. Name and signature of the Contractor's Test Engineer
  - j. Name and signature of the Commissioning Authority or Owner-designated witness
    - (1) Signature of witness shall only indicate concurrence with reported results and observations. Acceptance of the results will be reported separately by the Commissioning Authority after review of the FPT data forms.
- H. FPT deficiency report forms: Submit FPT deficiency report forms at the end of each day for all tests in which acceptable results were not achieved during the day. When corrections have been completed, update the FPT deficiency report form. FPT deficiency report forms shall record the following:
  1. Associated FPT data form number and description
  2. Equipment identification and location
  3. Date of test
  4. Name of person reporting the deficiency
  5. Description of the observations associated with the failure of the test
  6. Cause of the failure, if apparent at the time of the test
  7. Date and description of corrective action taken
  8. Name and signature of person taking corrective action
  9. Schedule for retest
- I. One-line system and riser diagrams: Submit one-line system and riser diagrams with the Commissioning Plan, updated one-line system and riser diagrams with the FPT procedure documentation, and as-built one-line system and riser diagrams with the final M&E Commissioning Binders. One-line system and riser diagrams shall be submitted for the following, when included in the work of the Contract Documents:
  1. Owner-provided one-line system and riser diagrams in CAD format for Contractor's use:

- a. Hot water heating
  - b. Domestic water
  - c. Steam and condensate
  - d. Chilled water
  - e. Condenser water
  - f. Supply air
  - g. Return air
  - h. Exhaust air
  - i. Electrical normal and emergency power
2. Subcontractor-provided one-line system and riser diagrams CAD Shop Drawings for Contractor's use:
  - a. Environmental control systems (ECS)
  - b. Fire alarm/smoke evacuation/life safety graphics and riser diagrams
  - c. Lighting control system diagrams
  - d. Electrical distribution equipment and spot or network substations schematic diagrams
3. The actual cost of each required one-line diagram required by Divisions 02 through 49 shall be included in the subcontract bid packages.

## PART 2 - PRODUCTS

### 2.1 TEST EQUIPMENT

- A. Provide industry standard test equipment required for performing the tests specified in the Contract Documents.
- B. Instrumentation shall meet the following standards:
  1. Be of sufficient quality and accuracy to test and measure system performance within the tolerances required to determine adequate performance
  2. Be calibrated on the manufacturer's recommended intervals with calibration tags permanently affixed to the instrument being used
  3. Be maintained in good repair and operational condition throughout the duration of use on this Project
  4. Be recalibrated/repared if dropped or damaged in any way since last calibrated
- C. For all temperature measurements, including air, liquids, and surfaces of pipes and components, use appropriate probes that meet the following requirements:

1. Range: Minimum +14°F to 248°F
  2. Type: Thermometer, digital electronic
  3. Minimum accuracy: +/- 0.5°F
  4. Calibration Interval: Per manufacturer instruction, not to exceed every twelve (12) months.
- D. For hydronic systems pressure and differential pressure measurement instruments, the test equipment shall meet the following requirements:
1. Range: 0 to 30 psi (1 pound per square inch), 0 to 60 psi, and 0 to 200 psi
  2. Type: Calibrated test gauges, 3 inch, or electronic digital device (TSI Performance Measurement Tools or similar) meeting accuracy and calibration interval requirements.
  3. Minimum accuracy: 2% with a gauged scale; 3% with an electronic reading
  4. Calibration interval: Per manufacturer's recommendation, not to exceed every twelve (12) months.
  5. Note: Use lowest range instrument or scale.
- E. For air pressure measurement instruments, the test equipment shall meet the following requirements:
1. Range: 0 to 1 inch WC (water column), 0 to 4 inch WC, 0 to 10 inch WC
  2. Type: Use properly leveled and zeroed manometer, magnehelic or electronic instrument meeting accuracy requirements
  3. Minimum accuracy for electronic devices: 2% with a magnehelic reading; 3% with a electronic reading
  4. Calibration interval for electronic devices: Per manufacturer's recommendation, not to exceed every twelve (12) months
  5. Note: Use lowest range instrument or scale
- F. Refer to electrical inspection, calibration, and testing requirements for instrumentation related to electrical systems and equipment.

## PART 3 - EXECUTION

### 3.1 COMMISSIONING PROCEDURE

- A. Sequence of testing: Commissioning shall proceed from lower to higher levels of complexity. For each system, testing at the lower level shall be completed prior to starting the next higher level of tests. In general, the order of testing, from lowest to highest is as follows:
1. Static tests (e.g., duct leakage tests)
  2. Motors, actuators, sensors, and other system components requiring start-up and FPT
  3. Point-to-point (PTP) testing
  4. Balancing
  5. System functional performance tests



6. Cross-systems functional performance tests
  - B. Retesting: Repeat, at no additional cost to the Owner, the complete functional test procedure for each test in which acceptable results are not achieved. Repeat tests until acceptable results are achieved. Fill out a new FPT data form for each retest.
  - C. Correction of deficiencies:
    1. Correct FPT deficiencies promptly and schedule retest.
      - a. Corrections during FPT are generally prohibited to avoid consuming the time of personnel waiting for the test, but not involved in making the correction. Exceptions will be allowed if the cause of the failure is obvious and corrective action can be completed in less than five (5) minutes. If corrections are made under this exception, the failure shall be noted on the FPT data form. A new FPT data form, marked "retest," shall be submitted after the correction has been made. The entire FPT procedure shall be repeated.

### 3.2 INSTALLATION VERIFICATION AUDIT

- A. Conduct an installation verification audit before equipment or system start-up begins. The audit shall include, but not be limited to, a check of the following equipment or systems:
  1. Piping specialties, including balance, control, and isolation valves
  2. Ductwork specialty items, including turning devices; balance, fire, smoke and control dampers; and access doors
  3. Control sensors by type and locations
  4. Piping, valves, starters, gauges, thermometers, and other components of the Work specified for formal start-up in the Contract Documents
  5. Accessibility to equipment in 1 - 4 above
  6. Verification of final programmed variable frequency drives (VFD) settings
- B. If any part of the Work is found to be incomplete, inaccessible, incorrect, or non-functional, the Contractor shall make note of deficiencies, and correct deficiencies before system start-up work proceeds.
- C. Coordinate with the electrical testing contractor (ETC) for the audit of electrical systems required by the Contract Documents.

### 3.3 TESTING, ADJUSTING, AND BALANCING (TAB)

- A. Complete all PTP testing prior to start of TAB.
- B. Coordinate and perform air and hydronic balancing. Advise the TAB firm when systems are complete and ready for balancing. Start TAB as early as possible following system start-ups

and component FPT, in order to be essentially complete prior to system FPT. Coordinate TAB activities with other construction schedule activities.

- C. Verify completion of PTP testing and the accuracy of the TAB work prior to commencing any FPT activities which may be adversely affected by incomplete PTP testing and improper balancing.

### 3.4 FUNCTIONAL PERFORMANCE TEST PROCEDURES

- A. FPT procedures must confirm the performance of systems to the extent required by the Contract Documents.
  - 1. Emphasis shall be placed on testing procedures which will conclusively determine actual system performance and compliance with the design.
- B. FPT procedures shall demonstrate the actual performance of specified safety shut-offs in a real or closely simulated condition of failure. Failure conditions shall include adequate oil pressure, proof-of-flow, non-freezing conditions, maximum head pressure, and other conditions common to the equipment.
- C. Systems may include safety devices and components that control a variety of equipment operating as a system. Interlocks may be hard-wired or installed via software. FPT procedures shall demonstrate these interlocks.

### 3.5 ECS SOFTWARE REVIEW

- A. Review ECS software and required ECS cross-systems software routines prior to the installation of control devices. The review shall include:
  - 1. Obtaining ECS program documentation
  - 2. Review of the programming approach
  - 3. Interface with other systems, including but not limited to:
    - a. Lighting
    - b. Fire alarm
    - c. Security
    - d. Clock
    - e. Emergency generator monitoring
    - f. Sump pumps
    - g. Distributed and mechanical utility metering
- B. Discrepancies in programming approaches shall be resolved with the Owner to provide the most appropriate, simple, and straightforward approach to software routines.
- C. The actual cost of the ECS software review required by Divisions 02 through 49 shall be included in the subcontract bid packages.

### 3.6 COMMISSIONING MEETINGS

- A. The Contractor shall participate in the following meetings with the Commissioning Authority. Other Subcontractors may, at Owner's sole discretion, be required to attend as necessary.
1. Pre-commissioning kick-off meeting
  2. Commissioning meetings described in Section 01 31 19 "Project Meetings"
  3. ECS software review, and design intent clarification meeting
  4. Preliminary O&M Manual review meeting

### 3.7 EQUIPMENT OPERATING INSTRUCTIONS AND TRAINING AGENDA

- A. Each training session shall include an agenda addressing the following:
1. Introduction of presenters
  2. Using the O&M information:
    - a. What is the equipment
    - b. Basic operating procedures (including start-up/shut-down)
    - c. Preventative maintenance procedures
    - d. Troubleshooting procedures
  3. What does it do, or serve
  4. Any special features
  5. Safety precautions
  6. Maintaining warranties, guarantees, and warranty periods
  7. Instruction on how to use proprietary instrumentation or operating equipment
  8. Recommended spares
  9. Review of start-up reports and FPT results
  10. Jobsite walk-through

END OF SECTION

## PART 1- GENERAL

### 1.1 SECTION INCLUDES

- A. Reinforcing steel for cast-in-place concrete.
- B. Supports and accessories for steel reinforcement.

### 1.2 RELATED REQUIREMENTS

- A. Section 03 10 00 - Concrete Forming and Accessories.
- B. Section 03 30 00 - Cast-in-Place Concrete.
- C. Section 03 30 03 - Underslab Vapor Retarder
- D. Section 03 45 00 - Precast Concrete Stairs: Reinforcement for precast concrete stairs.
- E. Section 04 20 00 - Unit Masonry: Reinforcement for masonry.
- F. Structural General Notes included with the Drawings.

### 1.3 REFERENCE STANDARDS

- A. ACI 301 - Specifications for Structural Concrete for Buildings; American Concrete Institute International.
- B. ACI 318 - Building Code Requirements for Structural Concrete and Commentary.
- C. ACI SP-66 - ACI Detailing Manual; American Concrete Institute International.
- D. ASTM A615/A615M - Standard Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement.
- E. ASTM A706/A706M - Standard Specification for Low-Alloy Steel Deformed and Plain Bars for Concrete Reinforcement.
- F. AWS D1.4/D1.4M - Structural Welding Code - Reinforcing Steel.
- G. CRSI (DA4) - Manual of Standard Practice; Concrete Reinforcing Steel Institute.

### 1.4 SUBMITTALS

- A. See Structural General Notes.
- B. Shop Placement Drawings: Comply with requirements of ACI SP-66. Include bar schedules, shapes of bent bars, spacing of bars, placement of bars and location of splices.
- C. Manufacturer's Certificate: Certify that reinforcing steel and accessories supplied for this project meet or exceed specified requirements.
  - 1. Submit material properties reports for type and grade of material.
- D. Reports: Submit certified copies of mill test report of reinforcement materials analysis.

### 1.5 QUALITY ASSURANCE

- A. Perform work of this section in accordance with ACI 301.
  - 1. Maintain one copy of document on Site.
- B. Welders' Certificates: Submit certifications for welders employed on the project, verifying AWS and WABO qualification within the previous 12 months.

## PART 2 - PRODUCTS

### 2.1 REINFORCEMENT

- A. Reinforcing Steel: ASTM A 615/A 615M including supplement S1; Grade 60 (420) and Grade 100. See Sheet S.0.01 for additional information.
  - 1. Unfinished.
- B. Reinforcing Steel to be Welded: ASTM A706/A706M, deformed low-alloy steel bars.
- C. Spirals for Drilled Shafts: Deformed bars confirming to ASTM A615 Grade 100.
- D. Special Ductile Quality Requirements: For vertical reinforcement in shear walls and longitudinal collector beam reinforcement refers to structural general notes.
- E. Reinforcement Accessories:
  - 1. Tie Wire: Annealed, minimum 16 gage.
  - 2. Chairs, Bolsters, Bar Supports, Spacers: Sized and shaped for adequate support of reinforcement during concrete placement.
    - a. Bar supports shall conform to CRSI MSP-1, Chapter 3 "Bar Supports".
    - b. Use galvanized steel except over fill or membrane.
    - c. Plastic coated steel where bearing surface is exposed.
  - 3. Provide stainless steel components for placement within 1-1/2 inches of weathering surfaces.

### 2.2 FABRICATION

- A. Fabricate concrete reinforcing including hooks and bends in accordance with CRSI (DA4) - Manual of Standard Practice, ACI SP-66 - ACI Detailing Manual, ACI 318, and ACI 301.
- B. Welding of reinforcement is permitted only if authorized. Perform welding in accordance with AWS D1.4. See structural notes.
- C. Splices: See structural notes on Drawings.
- D. Provide corner bars at wall and footing intersections.
- E. Lap adjacent mats of Welded Wire Fabric a minimum of 8-inches at sides and ends.
- F. Locate reinforcing splices not specified or indicated on drawings at point of minimum stress.
  - 1. Review locations of splices in question with Architect.
- G. No bars partially embedded in hardened concrete shall be field bent unless specifically so detailed or approved by the structural engineer.
- H. Set wire ties so ends are directed into concrete, not toward surfaces.

## PART 3 - EXECUTION

### 3.1 PLACEMENT

- A. Place, support and secure reinforcement against displacement. Do not deviate from required position.
- B. Do not displace or damage vapor retarder.
- C. Accommodate placement of formed openings.
- D. Maintain concrete cover around reinforcing as follows: except as shown on drawings
  - 1. Column and Beam Ties: 1.5 inch.
  - 2. Walls (exposed to weather or backfill): 1-1/2 inches at #5 or smaller bars. Provide

2-inches. at #6 bars or larger.

3. Footings and Concrete Formed against Earth: 3-inches, earth face.
4. Slabs and Walls (interior face): 3/4-inch.

E. Conform to applicable code for concrete cover over reinforcement.

### 3.2 FIELD QUALITY CONTROL

- A. An independent testing agency, as specified in Section 01 45 23 - Testing and Inspecting Services, and the structural drawings will inspect installed reinforcement for conformance to contract documents before concrete placement.

END OF SECTION

## PART 1 - GENERAL

### 1.1 SECTION INCLUDES

- A. Concrete building frame members.
- B. Elevated concrete slabs.
- C. Floors and slabs on grade.
- D. Concrete shear walls, elevator shaft walls, and foundation walls.
- E. Joint devices associated with concrete work.
- F. Miscellaneous concrete elements, including equipment pads and thrust blocks.
- G. Concrete curing and sealing

### 1.2 RELATED REQUIREMENTS

- A. Section 03 10 00 - Concrete Forming and Accessories.
- B. Section 03 20 00 - Concrete Reinforcing.
- C. Section 03 30 03 - Underslab Vapor Retarder.
- D. Section 03 35 13 - Concrete Floor and Architectural CIP Finishing.
- E. Section 05 12 00 - Structural Steel Framing: Connections to structural steel.
- F. Section 07 14 10 – Horizontal Fluid Applied Waterproofing: Preparing concrete surfaces to receive waterproofing.
- G. Section 07 92 00 - Joint Sealers.
- H. Section 32 13 13 - Concrete Paving: Sidewalks, curbs and gutters.
- I. Structural Notes included with Drawings.
  - 1. In case of conflicting requirements the more stringent requirement shall apply.

### 1.3 REFERENCE STANDARDS

- A. ACI 211.1 - Standard Practice for Selecting Proportions for Normal, Heavyweight, and Mass Concrete.
- B. ACI 301 - Specifications for Structural Concrete for Buildings.
- C. ACI 302.1R - Guide for Concrete Floor and Slab Construction.
- D. ACI 304R - Guide for Measuring, Mixing, Transporting, and Placing Concrete.
- E. ACI 305R - Hot Weather Concreting.
- F. ACI 306R - Cold Weather Concreting.
- G. ACI 308R - Guide to Curing Concrete; American Concrete Institute International; 2001.
- H. ACI - SP6694 - ACI Detailing Manual: formerly ACI 315 Manual of Standard Practice for Detailing Concrete Structures.
- I. ACI 318 - Building Code Requirements for Structural Concrete and Commentary; American Concrete Institute International; 2008.

- J. ASTM C33 - Standard Specification for Concrete Aggregates.
- K. ASTM C39/C39M - Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens.
- L. ASTM C94/C94M - Standard Specification for Ready-Mixed Concrete.
- M. ASTM C143/C143M - Standard Test Method for Slump of Hydraulic-Cement Concrete.
- N. ASTM C150 - Standard Specification for Portland Cement.
- O. ASTM C171 - Standard Specification for Sheet Materials for Curing Concrete.
- P. ASTM C494/C494M - Standard Specification for Chemical Admixtures for Concrete.
- Q. ASTM C618 - Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete.
- R. ASTM C685/C685M - Standard Specification for Concrete Made by Volumetric Batching and Continuous Mixing.
- S. ASTM C881/C881M - Standard Specification for Epoxy-Resin-Base Bonding Systems for Concrete.
- T. ASTM C1107/C1107M - Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink).
- U. ASTM C1240 - Standard Specification for Silica Fume Used in Cementitious Mixtures.

#### 1.4 SUBMITTALS

- A. Design Mixes: Submit per this Section and 01 45 23 - Testing and Inspection Services for testing.
- B. Test Reports: Submit two copies of laboratory and field test reports. Reports must show compliance with 2012 Seattle Building Code section 1903.
- C. Certificates: Submit letter from concrete supplier that concrete delivered meets the requirements of this Section.
- D. Product Data: Submit manufacturers' data on manufactured products showing compliance with specified requirements.
- E. All admixtures, cure/sealers etc. must be certified in writing to work with final floor finish, adhesive and other specified paints and coatings.
- F. Samples: Submit two, 10-inch long samples of construction joint devices.
- G. Manufacturer's Installation Instructions: Indicate installation procedures and interface required with adjacent construction for concrete accessories.
- H. LEED Submittals: If any wood or wood-based form materials, including supports, are permanently installed in the project, submit documentation required for sustainably harvested wood as specified in Section 01 60 00 - Product Requirements.
- I. Project Record Documents: Accurately record actual locations of embedded utilities and components that will be concealed from view upon completion of concrete work.

#### 1.5 QUALITY ASSURANCE

- A. Perform work of this Section in accordance with ACI 301, ACI 308 and ACI 318.
  - 1. Maintain one copy of each document on Site.



- B. Acquire cement from one source and each aggregate from one source for entire project.
- C. Follow recommendations of ACI 305R when concreting during hot weather.
- D. Follow recommendations of ACI 306R when concreting during cold weather.
- E. Special Inspection is called for in the Structural Notes on the Drawings. See those notes for additional requirements.
- F. Additional requirements are set forth in the Structural Notes on the Drawings.

#### 1.6 MOCK-UP

- A. Construct and erect mock-up of architectural finish panels and precast elements only.
  - 1. Coordinate with mock-ups required in other Sections as necessary to build a complete mock-up. Coordinating this work should save effort as one multiple product mockup is created instead of several.
  - 2. Coordinate with requirements of 03 10 00 - Concrete Forming and Accessories for formwork and tolerances.
  - 3. Panel Size: Sufficient to illustrate full range of treatment.
  - 4. Number of floor/wall panels: 2.
  - 5. Locate where directed.
- B. If requested by Architect, cast concrete against mock-up panel. Obtain acceptance of resulting surface finish prior to erecting formwork.
- C. Accepted mock-up floor panel is considered basis of quality for the finished work. Keep mock-up exposed to view for duration of concrete work.
- D. Mock-up may not remain as part of the Work.

### PART 2 - PRODUCTS

#### 2.1 FORMWORK

- A. Comply with requirements of Section 03 10 00 - Concrete Forming and Accessories.

#### 2.2 REINFORCEMENT

- A. Comply with requirements of Section 03 20 00 - Concrete Reinforcing..

#### 2.3 CONCRETE MATERIALS

- A. Cement: ASTM C150, Type I - Normal portland type.
  - 1. Provide expansive hydraulic cement type K conforming to ASTM C845 at area noted on drawings.
- B. Fine and Coarse Aggregates: ASTM C33.
  - 1. Source shall have proven history of successful use. Provide documentation per submittals above.
  - 2. Source shall be consistent unless 10 days prior notice is given for approval after recheck of mix design.
- C. Fly Ash: ASTM C618, Class C or F.
- D. Calcined Pozzolan: ASTM C618, Class N.
- E. Silica Fume: ASTM C1240, proportioned in accordance with ACI 211.1. Amorphous Silica.
- F. Water: Clean and not detrimental to concrete per ASTM C94 and potable

G. Fiber Reinforcement: per structural general notes.

## 2.4 CHEMICAL ADMIXTURES

- A. Do not use chemicals that will result in soluble chloride ions in excess of 0.1 percent by weight of cement.
- B. Air Entrainment Admixture: ASTM C260.
- C. Chemical Admixtures: ASTM C494, Type A - Water Reducing, Type B - Retarding, and Type G - Water Reducing, High Range and Retarding.
  - 1. Do not use chemicals that will result in soluble chloride ions in excess of 0.1 percent by weight of cement.

## 2.5 SEALING AND CURING COMPOUNDS

- A. Sealing compounds at interior floors, are to be placed as a floor finish where no other finish is specified.
  - 1. Sealing compounds are not intended to be used as a curing compounds.
- B. Curing compounds are to be used on exterior work only, only when water curing cannot be used and only upon approval of the architect..
- C. Liquid Curing Compound: ASTM C309, Type 1, Class B clear or translucent, Euclid Aqua-clear VOX, or accepted equal. Use: Exterior slabs on grade.
- D. Liquid Sealing Compounds:
  - 1. ASTM C1315 High Solids Acrylic Curing and Sealing Membrane. Euclid Rez-Seal VOX or accepted equal. Use: Interior walls and floors receiving no other finish.

## 2.6 ACCESSORY MATERIALS

- A. Epoxy Bonding System: ASTM C881. Provide HS - 200 Solid Bond Epoxy manufactured by Anchor-it Fastening Systems, Adhesives Technology Corp., or accepted equal.
- B. Underslab Vapor Retarder: See Section 03 30 03 - Underslab Vapor Retarder.
- C. Non-Shrink Grout: ASTM C1107; premixed compound consisting of non-metallic aggregate, cement, water reducing and plasticizing agents, flowable rate meeting ASTM C939.
  - 1. Minimum Compressive Strength at 72 Hours: 5000 psi per ASTM C109.
  - 2. Minimum Compressive Strength at 28 Days: 8000 psi per ASTM C109.
  - 3. Product: Euclid Chemical Co. NS Grout, or accepted equal.
- D. Dry Pack Grout: ASTM C1107 premixed compound consisting of non-metallic aggregate, cement designed specifically for mixing and placing at at damp pack consistency.
  - 1. Minimum Compressive Strength at 72 hours 3000 psi (21MPa.) per ASTM C109.
  - 2. Minimum Compressive Strength at 28 Days: 8000 psi (55MPa) per ASTM C109.
  - 3. Product: Euclid Chemical Co. Dry Pack Grout, or accepted equal.
- E. Moisture-Retaining Cover: ASTM C171; regular curing paper, white curing paper, clear polyethylene, white polyethylene, or white burlap-polyethylene sheet.

## 2.7 BONDING AND JOINTING PRODUCTS

- A. Epoxy Bonding System: Complying with ASTM C881/C881M and of Type required for specific application.
- B. Joint Filler: Nonextruding, resilient asphalt impregnated fiberboard or felt, 1/2-inch thick and 4-inches deep; tongue and groove profile.
- C. Control Joints: See Drawings and notes.

- D. Sealant and Primer: As specified in Section 07 92 00 - Joint Sealers.

## 2.8 CONCRETE MIX DESIGN

- A. See also Structural General Notes.
- B. Proportioning Normal Weight Concrete: Comply with ACI 211.1 recommendations.
- C. Concrete Strength: Establish required average strength for each type of concrete on the basis of trial mixtures, as specified in ACI 301.
  - 1. See Structural Notes for additional requirements.
  - 2. For trial mixtures method, employ independent testing agency acceptable to Architect for preparing and reporting proposed mix designs.
- D. Admixtures: Add acceptable admixtures as recommended in ACI 211.1 and at rates recommended by manufacturer.
- E. Fiber Reinforcement: Add to mix per structural general notes.
- F. Normal Weight Concrete:
  - 1. See Structural Notes for additional requirements.
  - 2. Compressive Strength at all Structural Concrete including Walls, per ASTM C39 at 28 Days: As shown in structural general notes.
  - 3. Fly Ash Content: Maximum 20 percent of cementitious materials by weight.

## 2.9 MIXING

- A. On Project Site: Mix in drum type batch mixer, complying with ASTM C685. Mix each batch not less than 1-1/2 minutes and not more than 5 minutes.
- B. Transit Mixers: Comply with ASTM C94/C94M.

## PART 3 EXECUTION

### 3.1 EXAMINATION

- A. Verify lines, levels, and dimensions before proceeding with work of this Section.

### 3.2 PREPARATION

- A. Verify that forms are clean and free of rust before applying release agent.
- B. Coordinate placement of embedded items with erection of concrete formwork and placement of form accessories.
- C. Prepare previously placed concrete by sand blasting and applying bonding agent in accordance with manufacturer's instructions.
  - 1. Use epoxy bonding system for bonding to damp surfaces, for structural load-bearing applications, and where curing under humid conditions is required.
- D. In locations where new concrete is doweled to existing work see structural drawings for jointing dowel requirements.
- E. In locations where new concrete is doweled to existing work, drill holes in existing concrete, insert steel dowels and pack solid with non-shrink grout.

### 3.3 PLACING CONCRETE

- A. Place concrete in accordance with ACI 305 and 306 for hot and cold weather conditions.
- B. Place concrete in accordance with ACI 304R.

- C. Place concrete for floor slabs in accordance with ACI 302.1R.
- D. Notify Architect not less than 48 hours prior to commencement of placement operations.
- E. Ensure reinforcement, inserts, and embedded parts will not be disturbed during concrete placement.
- F. Repair underslab vapor retarder damaged during placement of concrete reinforcing. Repair with vapor retarder material; lap over damaged areas minimum 6-inches and seal watertight. See Section 03 30 03 - Underslab Vapor Retarder.
- G. Separate slabs on grade from vertical surfaces with joint filler, unless noted otherwise
- H. Place joint filler in floor slab pattern placement sequence. Set top to required elevations. Secure to resist movement by wet concrete.
- I. Extend joint filler from bottom of slab to within 1/2-inch of finished slab surface. Conform to Section 07 92 00 - Joint Sealers for finish joint sealer requirements.
- J. Install joint devices in accordance with manufacturer's instructions.
- K. Apply sealants in joint devices in accordance with Section 07 92 00 - Joint Sealers.
- L. Maintain records of concrete placement. Record date, location, quantity, air temperature, and test samples taken.
- M. Place concrete continuously between predetermined expansion, control, and construction joints.
- N. Do not use aluminum pipe for pumping concrete.
- O. Do not interrupt successive placement; do not permit cold joints to occur.
- P. Saw cut joints within 24 hours after placing. Use 3/16-inch thick blade, cut into 1/4 depth of slab thickness.
- Q. Water cure concrete a minimum of 7 days for concrete with expansive hydraulic cement.

### 3.4 CONCRETE FINISHING

- A. Repair surface defects, including tie holes, immediately after removing formwork.
- B. Form Finish: Rub down or chip off fins or other raised areas 1/4-inch or more in height.
- C. Exposed Form Finish: Rub down or chip off and smooth fins or other raised areas 1/4-inch or more in height. Provide finish as follows:
  - 1. As is finish: No additional finishing
  - 2. Smooth Rubbed Finish: Wet concrete and rub with carborundum brick or other abrasive, not more than 24 hours after form removal.
  - 3. Grout Cleaned Finish: Wet areas to be cleaned and apply grout mixture by brush or spray; scrub immediately to remove excess grout. After drying, rub vigorously with clean burlap, and keep moist for 36 hours. Use this finish for "Architectural Concrete" noted on the drawings.
  - 4. Cork Floated Finish: Immediately after form removal, apply grout with trowel or firm rubber float; compress grout with low-speed grinder, and apply final texture with cork float.
  - 5. Light Sand Blast: only small aggregate exposed for use on site walls exposed to view.
  - 6. At Shotcrete: steel trowel flat and smooth.
    - a. Walls to be hidden from view use wood float finish.
- D. Concrete Slabs: Finish to requirements of Section 03 35 13 - Concrete Floor and Architectural CIP Finishing and as follows

1. Seal all concrete not scheduled to receive any other finish.
- E. Slope surfaces as indicated.
- F. In areas with floor drains, maintain floor elevation at walls; pitch surfaces uniformly to drains as indicated on drawings. If no slope is shown contact Architect with an RFI immediately.
- G. At exposed concrete columns, provide additional non-shrink cementitious, nonmetallic grout complying with ASTM C1107/C 107M and capable of developing a minimum compressive strength of 8,000 psi at 28 days prior to the concrete pour for the column corner and surface finish.

### 3.5 CURING AND PROTECTION

- A. Comply with requirements of color additive/curing sealer manufacturer to avoid mottling and uneven color in finish floor.
- B. Comply with requirements of ACI 305 for hot weather conditions, ACI 306 for cold weather conditions and ACI 308 for curing in general. Immediately after placement, protect concrete from premature drying, excessively hot or cold temperatures, and mechanical injury.
- C. Maintain concrete with minimal moisture loss at relatively constant temperature for period necessary for hydration of cement and hardening of concrete.
  1. Normal concrete: Not less than 7 days.
- D. Remove forms in accordance with ACI 318.
- E. Formed Surfaces: Cure by moist curing with forms in place for full curing period unless noted below:
  1. Footings: 24 hours.
  2. Walls: 72 hours.
- F. Surfaces Not in Contact with Forms:
  1. Slabs and Floors To Receive Adhesive-Applied Flooring: Curing compounds and other surface coatings are usually considered unacceptable by flooring and adhesive manufacturers. If such materials must be used, obtain the approval of the flooring and adhesive manufacturers and architect prior to use or remove the surface coating after curing to flooring manufacturer's satisfaction.
  2. Initial Curing: Start as soon as free water has disappeared and before surface is dry. Keep continuously moist for not less than three days by water ponding, water-saturated sand, water-fog spray, saturated burlap, or by curing compounds.
  3. Final Curing: Begin after initial curing but before surface is dry.
    - a. Moisture-Retaining Cover: Seal in place with waterproof tape or adhesive.
  4. Curing Compound: If permission is granted, follow manufacturer's recommendations, using application rate recommended by manufacturer.

### 3.6 SHORING & RESORHING

- A. See structural general notes.

### 3.7 FIELD QUALITY CONTROL

- A. An independent testing agency will perform field quality control tests, as specified in Section 01 45 23 - Testing and Inspecting Services.
- B. Provide free access to concrete operations at project site and cooperate with appointed firm.
- C. Submit proposed mix design of each class of concrete to inspection and testing firm and Architect for review prior to commencement of concrete operations.

- D. Tests of concrete and concrete materials may be performed at any time to ensure conformance with specified requirements.
- E. Compressive Strength Tests: ASTM C39/C39M. For each test, mold and cure three concrete test cylinders. Obtain test samples for every 100 cu yd or less of each class of concrete placed.
- F. Take one additional test cylinder during cold weather concreting, cured on job site under same conditions as concrete it represents.
- G. Perform one slump test for each set of test cylinders taken, following procedures of ASTM C143/C143M.

### 3.8 DEFECTIVE CONCRETE

- A. Test Results: The testing agency shall report test results in writing to Architect and Contractor within 24 hours of test.
- B. Defective Concrete: Concrete not conforming to required lines, details, dimensions, tolerances or specified requirements.
- C. Repair or replacement of defective concrete will be determined by the Architect. The cost of additional testing shall be borne by Contractor when defective concrete is identified.
- D. Do not patch, fill, touch-up, repair, or replace exposed concrete except upon express direction of Architect for each individual area.

### 3.9 MISCELLANEOUS PENETRATIONS

- A. Pipe and ducts not formed into the concrete by their placement or by the use of void forms must have any gap between the item and the concrete filled with non-shrink grout. If the penetration passes through an exterior wall exposed to drainage and/or weather. The exposed area must be damp-proofed and sealed to ensure against leakage.

### 3.10 SCHEDULE - CONCRETE TYPES AND FINISHES

- A. See Structural Drawings for additional information.

END OF SECTION

## PART 1 - GENERAL

### 1.1 SUMMARY

- A. Section Includes:
  - 1. Post-tensioning of cast-in-place concrete with bonded and fully-encapsulated, prestressing tendons.
  - 2. Prestressing tendons, bearing plates, connections, and post-tensioning operations.
  - 3. Repair of cracks in post-tensioned concrete by epoxy injection.
- B. Related Work Specified Elsewhere:
  - 1. Sections in Division 03 - Concrete for forming, reinforcing, shoring, and reshoring.

### 1.2 SYSTEM DESCRIPTION

- A. Structural Performance: Provide post-tensioning system, with ICC approved components, to develop final force (design force) indicated on the drawings.
- B. Engineering Responsibility: Engage a manufacturer who utilizes a qualified professional engineer to prepare calculations and other structural data for post-tensioning systems in the State of Washington.
- C. Tensioning Criteria:
  - 1. Maximum Stress (Jacking Stress): To overcome stressing friction, tendons may be temporarily stressed to a tension higher than initial stress. In no case shall temporary stress exceed 80% of the strand tensile strength.
  - 2. Stressing Friction: Calculate anticipated stressing friction using results of field experience and field tests for tendons of similar length.
  - 3. Initial Stress (Anchoring Stress): Not to exceed 70% strand tensile strength, and not to exceed maximum allowable stress (jacking stress) minus anticipated stressing friction, whichever is least.
  - 4. Effective Stress (Design Stress): The stress remaining after all losses. The effective stress used in calculating the minimum working forces as indicated on the Drawings.

### 1.3 SUBMITTALS

- A. Shop Drawings: Completely detail post-tensioning process including arrangement of tendons, sequence of installing and methods for maintaining alignment, type of anchorage enclosures, anchoring devices, block-outs, sleeves, conduit inserts, anchors, all other features, intermediate stressing joints and anchorages and sequence of stressing.
  - 1. Include each detail in shop drawings pertaining to the post-tensioned concrete, specifically noting procedures that may affect working of the structure in part or as a whole.
  - 2. Shop drawings and calculations shall bear the stamp and signature of a registered professional engineer in the State of Washington where the project is being constructed.
  - 3. Include ICC Evaluation Reports for components.
  - 4. Additional information for bonded post-tensioned concrete:
    - a. Complete description of the post-tensioning system anchorage and method proposed for use; such descriptions shall include tendon size, blockout dimensions, tendon and anchorage layout and design calculations as required to fully substantiate any deviations from the method shown on the Drawings.
    - b. Certified Test Reports confirming the post-tensioning system anchorage meets or exceeds the minimum test requirements of FIP "Recommendations for Acceptance of Post-tensioning Systems".
    - c. Evidence that the proposed post-tensioning anchorage has been successfully used on projects on similar magnitude.

- B. Product Data: With the shop drawings, submit data covering stressing operations with descriptions of equipment to be used, sequence of operations, evidence that the allowable stress will not be exceeded, method of determining stressing friction, method proposed for determining continuing accuracy of the correlation between gauge reading and actual force exerted by hydraulic jack, all other related data, and complete specifications for materials to be used.
- C. Calculations: With the shop drawings, submit calculations showing effective tendon forces considering losses from anchorage seating, elastic shortening of concrete shrinkage and creep of concrete, relaxation of tendon stress, and friction, achieving the minimum effective force indicated on the structural drawings.
- D. Information: With the shop drawings, submit:
  - 1. Current gauge calibration chart for each set of stressing equipment.
  - 2. Field stressing procedure.
  - 3. Stress-strain curves for each heat, by an independent laboratory.
  - 4. Mill test reports and analyses.
  - 5. Bonding grout mix design
  - 6. Submit manufacturer's information indicating the percentage (by weight) of post-consumer and/or post-industrial recycled content in the post-tensioning tendon system.
  - 7. Submit manufacturer's information indicating the location where post-tensioning tendons and accessories are manufactured and, if known, location where the primary raw materials were extracted or recovered.
- E. Test results from testing required by Part 2 Article titled Source Quality Control".
- F. Record Documents: Record actual locations of tendons; stressing sequence and tendon loads established, and tendon elongations. Report percent deviation of measured elongations to calculated elongations.

#### 1.4 QUALITY ASSURANCE

- A. Installer Qualifications: An experienced installer who has completed post-tensioned concrete Work similar in material, design, and extent to that indicated for this Project and whose work has resulted in construction with a record of successful in-service performance, and using systems approved by the local code authority. Installer must have a minimum of five years of experience in such work.
  - 1. Supervision: Perform Work of this Section under continuous direction of a superintendent experienced in the required operations, who shall exercise strict control for full compliance with requirements indicated and specified. Maintain complete and current records of the operations.
- B. Professional Engineer Qualifications: A professional engineer who is legally qualified to practice in the jurisdiction where Project is located and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for post-tensioned concrete installations that are similar to those indicated for this Project in material, design, and extent.
- C. Testing Agency Qualifications: An independent testing agency, acceptable to authorities having jurisdiction, qualified according to ASTM C1077 and ASTM E329 to conduct the testing indicated, as documented according to ASTM E548.
- D. Preinstallation Conference: Conduct conferences at the Project Site to comply with requirements in Section 01 31 00 - Project Management and Coordination. Review methods and procedures related to post-tensioned concrete including, but not limited to, the following:
  - 1. Review tendon anchorage details, tendon drapes, tendon profile tolerances, bonded post-tensioned system requirements, sleeve locations, and cautions regarding cutting and core drilling.



2. Review and finalize construction schedule and verify availability of materials, installer's personnel, equipment, and facilities needed to make progress and avoid delays.

#### 1.5 DELIVERY, STORAGE, AND HANDLING

- A. Deliver tendons in coils of adequate diameter to prevent damage or overstressing, each coil securely tied and tagged for identification.
- B. Store under cover and protect from weather.
- C. Handle by methods that prevent scratching of strand wire and all other post-tensioning components.

### PART 2 PRODUCTS

#### 2.1 MATERIALS

- A. Design of metal bearing plates, anchorage devices, stressing grippers, void forms, and slippage sheathing shall be the standard types for the method of post-tensioning used, and shall conform to approved submittals. Dead-end anchorage shall be factory applied.
- B. Post-tensioning Strand: Conform to ASTM A416 "Specifications for Uncoated Seven-Wire Stress-Relieved Strand for Prestressed Concrete" and Post-Tensioning Institute "Specification for Single Strand Unbonded Tendons" Grade 270.
- C. Unbonded Tendon Sheathing: Use corrosion resistant plastic. Grease and cover assembled strand with polyethylene sheathing; encapsulate ends of tendons using plastic trumpets or other durable approved method. Provide similar system for protection of cut ends.
- D. Grout: Non-shrink grout, Master Builders "Embeco", W.R. Grace "Vibrofoil", or accepted equal.
- E. Distribution Plates and Anchorages: Secure strands at both ends with the approved anchoring devices.
  1. Anchoring Devices: Provide devices designed so that strand wire will not kink, neck down, or otherwise be damaged, and to hold strands without slip exceeding 1/8-inch at load equal to applied load of the tendon at tensioning.
  2. Distribution Plates: Provide welded or cast steel bearing assemblies to support and distribute load from anchoring devices. Loaded bending stresses shall not exceed 20 ksi for structural steel or 15 ksi for cast steel except as test data may indicate that higher stresses are satisfactory, and corresponding higher stresses may be permitted for higher strength steel; use structural steel conforming to ASTM A36 and cast steel conforming to ASTM A148. Bearing plates, distribution plates, anchor bolts, bearing bars, and the like shall be hot-dip galvanized after fabrication where these items are exposed and unprotected from the weather. Welding shall be inspected and approved before galvanizing.
  3. Maximum Concentrated Bearing Stresses: Not exceeding 60 percent of concrete compressive strength at time of tensioning.
  4. Design, Fabrication, and Installation: Conform to AISC standards and to AWS D1.1 Structural Welding Code.
  5. Recesses: Provide for the concrete or grout covering over strand end connections.
- F. Additional requirements for bonded post-tensioned concrete:
  1. Anchorage:
    - a. The post-tensioning system anchorage shall be specifically suited for bonded tendons. The anchorages shall consist of a cast-in-bearing plate and a separate anchor head which is placed after concealing. All post-tensioning system anchorages must be approved in writing as per Paragraph 1.4, A, 4.

- b. All post-tensioning system anchorages shall meet or exceed the minimum test requirements of FIP "Recommendations for Acceptance of Post-Tensioning Systems".
  - c. All post-tensioning system stressing anchorages shall be capable of lift-off, detensioning or retensioning a tendon at any time prior to grouting.
  - d. Additional reinforcement required in the local anchorage zone due to the post-tensioning force shall be part of the post-tensioning system anchorage for multistrand anchorages.
2. Grout:
- a. Post-tensioned prestressing steel shall be bonded to the concrete by completely filling the entire void space between the sheathing and the tendon with grout consisting of Portland cement, potable water, and admixtures (if desired). Grout compressive strength to match or exceed compressive strength of the surrounding concrete member.
  - b. Portland cement shall conform to ASTM C150, Types I or II. Cement used for grouting shall be fresh and shall not contain any lumps or other indication of hydration or "pack set."
  - c. The water used in the grout shall be potable, clean and free of injurious quantities of substances known to be harmful to Portland cement or prestressing steel.
  - d. Admixtures, if used, shall impart the properties of low-water content, good flowability, minimum bleed, and expansion if desired. They shall contain no chemicals in quantities that may have harmful effect on the prestressing steel or cement. All admixtures shall be used in accordance with the instructions of the manufacturer. The use of admixtures must have approval of the Engineer prior to use in grout.
3. Duct:
- a. All duct systems are to be made of plastic.
    - i. Plastic duct shall be made of High Density Polyethylene (HDPE) according to ASTM D3350 cell classification 324420C, or Polypropylene with a specific gravity of 0.90 to 0.91.
    - ii. Corrugation of ducts may be either spiral, concentric, or any other shape for which it can be demonstrated that the duct can be completely filled with grout.
    - iii. Duct shall be grout-tight and capable of transferring satisfactory bond and be designed specifically for post-tensioned tendons.
    - iv. The inside duct area shall be large enough to allow installation of all strand and for grouting.
    - v. The wall thickness of the duct shall be such that wearing through the wall by the strand during stressing is avoided. This requirement shall be met at specified minimum radius of curvature of the particular tendon size with a total strand movement of 3 feet and the full tendon stressed to 80% GUTS. The minimum remaining wall thickness of the duct after testing shall be at least 0.04 inches.
    - vi. Ducts shall be coupled with specially designed couplers in a manner which is watertight without the use of tape.
    - vii. Ducts with couplers shall be able to transfer longitudinal forces as follows without effecting watertightness: for duct diameter up to 2-1/2 inches, 200 pounds, and for duct diameter exceeding 2-1/2 inches, 400 pounds.
    - viii. Ducts with couplers shall be capable of bending to specified minimum radius of curvature without causing damage in the duct nor sharp kinks. This requirement is met if at least three full cycles of reversed bending have been applied to the duct and watertightness is not affected (See ix).

A minimum radius of curvature of 3 feet shall apply for ducts in prefabricated tendon applications.

- ix. Ducts including couplers shall be watertight. Watertightness is provided if water loss in 40 inch long duct specimens with couplers, tested according to vii and viii above, do not exceed 1.5% of the duct volume within 5 minutes. Water shall be kept at a pressure of 7 psi during the test.
  - x. Irreversible deformations of the duct cross-sectional dimensions, i.e., diameter, under a point load of 150 pounds shall not exceed ¼ inch nor 5% of the duct cross-sectional dimensions, whichever is larger, one minute after removal of the load of 70°F ambient temperature. The point load shall be applied without impact through a #4 reinforcement bar, bearing on the duct between corrugations.
  - xi. Friction and wobble coefficients for the particular duct shall be submitted by the post-tensioning system supplier. Frictional losses due to vertical and horizontal intentional or non-intentional variance from a straight line trajectory shall be based on experimentally determined curvature and wobble coefficient and experience from previous jobs. In no case shall friction and wobble coefficients be used that are less than the minimum specified by the Engineer.
  - xii. Ducts shall be capable of transferring 40% of the specified tensile strength of the tendon within a length not exceeding 45 duct diameters.
4. Couplers:
- a. Coupling of bonded tendons shall be used only at locations specifically indicated and/or accepted by the Engineer.
  - b. Coupling of tendons shall not be used at points of sharp tendon curvature.
  - c. Tendon couplers shall be an integral part of the post-tensioning system and designed as such. Tendon couplers shall be subjected to similar requirements as the post-tensioning system anchorage, see Paragraph F1 above.

## 2.2 SOURCE QUALITY CONTROL

- A. Employ and pay for an independent testing agency to evaluation quality-control and testing methods for post-tensioned concrete.
  - 1. Allow testing agency access to material storage areas, concrete production equipment, concrete placement, and curing facilities. Cooperate with Owner's testing agency and provide samples of materials and concrete mixes as may be requested for additional testing and evaluation.
- B. Testing: Test following samples which shall be furnished by Contractor:
  - 1. One test sample of tendon (uncoated and unwrapped), with complete set of stressing hardware.
  - 2. One test sample of strand for each 5,000 pounds, or fraction thereof, from each heat of strand to be used.
  - 3. Certificate: Transmittal for above test samples shall be accomplished by Contractor's certificate that the submitted test samples are taken from, and are representative of, the materials to be used in the Work.
  - 4. Retained Test Samples: Testing agency shall fasten both broken pieces of each test sample together and label with project title, heat and coil number, date tested, and ultimate load, and shall retain test samples available for inspection until disposal is authorized by Architect.

## PART 3 EXECUTION

### 3.1 GENERAL

- A. Verify location of post-tensioning tendons with X-Ray or other approved NDT method prior to drilling holes or installing low velocity fasteners deeper than 3/4-inches in post-tensioned concrete.

### 3.2 CONCRETE

- A. Conform to Section 03 30 00 - Cast-in-Place Concrete and the following requirements.
- B. Inserts in Concrete: Accurately install and secure in forms, including enclosures, spacer bars, and other inserts required for Work of this Section. Do not attach inserts to tendons.
- C. Edge or End Forms: Accurately drill for and secure the connection of all anchoring hardware and projecting strand and reinforcing steel.
- D. Concrete Placing: Place and vibrate the concrete by methods that ensure alignment of tendons and reinforcing bars, and to ensure uniform consolidation of concrete.
- E. Holes: Holes in concrete, other than those indicated on the Drawings or shown in approved submittals, are not permitted within 2-feet of bearing plates.

### 3.3 FABRICATING TENDONS

- A. Install strands in the anchorage hardware to form a parallel lay cable with no crossed wires. Apply mastic to completely cover each strand, and cover the mastic with waterproof kraft paper if not enclosed within sheathing. Sheathing or covering shall extend to boring plates.

### 3.4 PLACING TENDONS

- A. Bearing Plates: Bolt to forms or securely fasten to reinforcing steel to ensure no displacement occurs during concrete placing, align bearing plates perpendicular to tendon axis.
- B. Supports: Support tendons at exact vertical locations indicated on the drawings with steel wire chairs or bolsters of correct height. Provide adequate number of supports, not less than four per span, located to support the tendon in correct parabolic curves and meeting the tolerances shown in the drawings. In addition to indicated reinforcing bars, provide additional reinforcing bars tied to the tendons to prevent tendon movement during concrete placing. Keep tendons straight in plan and at correct curves. Offset tendons or adjust tendon spacing only when approved in advance.
- C. Equipment: In placing tendons, make adequate provision for the stressing equipment by locating the tendons and projecting the reinforcing bars as nearly as possible in a vertical alignment. Keep entire stressing equipment area free of any construction materials and equipment or obstructions until all stressing operations are completed.
- D. Additional requirements for bonded post-tensioned concrete:
  - 1. All bonded post-tensioned tendons shall have a grout vent in the anchorage area.
  - 2. Pre-placing strands in the sheathing prior to concrete placement is permitted to facilitate construction sequencing.

### 3.5 TENSIONING OPERATIONS

- A. Perform tensioning under continuous special inspection. Do not start operations until tests on field-cured concrete test cylinders specified in Section 03 30 00 - Cast-in-Place Concrete indicate concrete has attained the strength indicated on the drawings or a minimum 3,000 psi compressive strength.
- B. Jacks: Stress tendons with approved motor-operated hydraulic jacks that provide uniform pressure, each jack equipped with an accurately calibrated gauge at least six inches in diameter, having a fine pointer, and with gauge pressure markings at close increments to permit computing

of stress at any time. Maintain jacking, tensioning, and tendon elongation records as work progresses. Jack against tendon pressure plates, not against concrete.

- C. Tensioning: Perform by jacking. For tendons 100 feet long or less, jack from one end unless otherwise shown or approved in advance. For tendons greater than 100 feet long, jack from each end unless otherwise shown or approved in advance.
- D. Procedure: Based on the stressing friction determined as specified under Paragraph "Stressing Friction" above, stressing procedure shall be established, approved, and followed by the stressing personnel. In general, the procedure for each tendon shall conform to the following:
  - 1. Stressing: Stress to gauge reading equivalent to initial stress plus maximum stress required to overcome stressing friction, as determine above.
  - 2. Grippers: Insert grippers and gradually reduce jack load to transfer stressing stress to anchorages.
  - 3. Restressing: Restress tendon and record the gauge reading at which all load is completely removed from grippers. This load shall be not less than the gauge reading equal to the initial stress (anchoring stress) on the tendon. A variation of 7 percent plus or minus is acceptable for any one tendon provided that the initial stress in any three adjacent tendons is no less than the sum of required stress for these three tendons. Any cumulative negative tolerance resulting in overall reduction of initial stress will not be permitted.
  - 4. Cut off excess tendon inside face of concrete only after elongation records have been reported and approved. Apply touch-up primer to cut end or add caps for fully encapsulated tendons.
- E. Stressing Sequence: Conform to the approved submittals.

### 3.6 GROUTING

- A. Promptly when the stressing operation is completed on a tendon, coat end anchorages, grippers, and tendon ends with an approved epoxy concrete adhesive. Fill pockets of stressing terminals and anchorage recesses while the epoxy adhesive is fresh with a non-shrink grout containing no chlorides, installed as a stiff mixture, rammed solid, troweled smooth where exposed, and damp cured until fully set.
- B. Additional requirements for bonded post-tensioned concrete:
  - 1. Post-tensioned prestressing steel shall be bonded to the concrete by completely filling the entire void space between the sheathing and the tendon with grout.
  - 2. After stressing is completed and the stressing records approved by the engineer, cut off the excess strand approximately  $\frac{3}{4}$  inch from the face of the wedges.
  - 3. Preparation of ducts:
    - a. All ducts shall be clean and free of deleterious materials that would impair bonding or interfere with grouting procedures.
  - 4. Grout Mixing Equipment:
    - a. The grouting equipment shall include a holding tank, a mixer capable of continuous mechanical mixing which will produce a grout free of lumps and undispersed cement, and a grout pump. The equipment shall be able to pump the mixed grout in a manner which will comply with all requirements.
    - b. The grout pump shall be a positive displacement type and be able to produce an outlet pressure of at least 50 psi. The pump shall have seals adequate to prevent introduction of oil, air, or other foreign substance into the grout, and to prevent loss of grout or water.
    - c. A pressure gauge having a full-scale reading of no greater than 300 psi shall be placed at some point in the grout line between the pump outlet and the duct inlet.

- d. The grouting equipment shall contain a screen to screen the grout prior to its introduction into the grout pump. The screen shall be easily accessible for inspection and cleaning.
  - e. The grouting equipment shall utilize gravity feed to the pump inlet from a hopper attached to and directly over it. The hopper must be kept at least partially full of grout at all times during the pumping operation to prevent air from being drawn into the post-tensioning duct.
  - f. Suitable alternate equipment specifically developed for post-tensioning tendons may be used when suitability is satisfactorily demonstrated to the Engineer.
5. Mixing of grout:
- a. Water shall be added to the mixer first, followed by Portland cement and admixture (if used), or as required by the admixture manufacturer.
  - b. Mixing shall be of such duration as to obtain a uniform, thoroughly blended grout, without excessive temperature increase or loss of expansive properties of the admixture (if used). The grout shall be continuously agitated until it is pumped.
  - c. Water shall not be added to increase grout flowability which has been decreased by delayed use of grout.
  - d. Proportions of materials shall be based on tests made on the grout before grouting is begun, or may be selected based on prior documented experience with similar materials and equipment and under comparable field conditions (weather, temperature, etc). The water content shall be the minimum necessary for proper placement, and when Type I or II cement is used shall not exceed a water-cement ratio of 0.45 or approximately 5 gallons of water per sack (94 pound) of cement. The water content for Type III cement shall be established for a particular brand based on tests.
  - e. The pumpability of the grout may be determined by the Engineer in accordance with the U.S. Corps of Engineers Method CRD-C79. When the method is used, the efflux time of the grout sample immediately after mixing shall not be less than 11 seconds.
6. Injection of grout:
- a. All grout vent openings shall be open when grouting starts. Grout shall be allowed to flow from the first vent after the inlet pipe until any residual flushing water or entrapped air has been removed, at which time the vent should be capped or otherwise closed. Remaining vents shall be closed in sequence in the same manner.
  - b. The pumping pressure at the tendon inlet shall not exceed 90 psi.
  - c. When one-way flow of grout cannot be maintained, the grout shall be immediately flushed out of the duct with water.
  - d. Grout shall be pumped through the duct and continuously wasted at the outlet pipe until no visible slugs of water or air are ejected and the efflux time of ejected grout is not less than 11 seconds. The outlet vent shall then be closed and the pumping pressure held momentarily. The vent at the inlet shall then be closed while maintaining this pressure.
7. When the temperature is below 32°F, ducts shall be kept free of water to avoid damage due to freezing. The temperature of the concrete shall be 35°F or higher from the time of grouting until job cured 2-inch cubes of grout reach a minimum compressive strength of 800 psi. Grout shall not be above 90°F during mixing or pumping. If necessary, the mixing water shall be cooled.

### 3.7 REPAIR OF SURFACE DEFECTS AND CRACKS

- A. Repair surface defects in accordance with Section 03 30 00 - Cast-in-Place Concrete.
- B. Modify or repair concrete not conforming to required lines, details and elevations.

- C. Modify or repair concrete not properly placed, resulting in honeycombing or other defects.
- D. Provide crack repair of all cracks .02" in width. Repair smaller cracks as directed by the Architect during the first year after Substantial Completion. Crack injection shall include pressure injection of epoxy filler specifically intended for crack repair. See Structural General Notes for assumed amount of crack repair.

3.8 GROUTING ANCHORAGE RECESS

- A. Anchorage recess shall be coated with a bonding agent and then filled flush with a non-shrink grout containing no chlorides. White cement shall be added as required for the filler to match adjacent concrete when cured if concrete is to remain exposed.

3.9 FIELD QUALITY CONTROL

- A. Inspection: Continuous inspection is required during placing of tendons and other reinforcing, anchorages, concrete, and during stressing operations.
- B. Survey: Contractor's Surveyor shall instrument survey post-tensioned concrete elevations both before and after post-tensioning operations are performed, and again 30 days after completion of stressing. Survey shall include mid-span and support elevations. Submit copies of complete survey results.

END OF SECTION

## PART 1 - GENERAL

### 1.1 SECTION INCLUDES

- A. Concrete Block.
- B. Mortar and Grout.
- C. Reinforcement and Anchorage.
- D. Flexible Flashings.
- E. Accessories.

### 1.2 RELATED REQUIREMENTS

- A. Section 01 46 00 - Seismic Design Requirements For Nonstructural Systems.
- B. Section 03 20 00 - Concrete Reinforcing: Reinforcing steel for grouted masonry.
- C. Section 04 42 00 - Exterior Stone Cladding: Stone veneer walls
- D. Section 05 50 00 - Metal Fabrications: Loose steel lintels and fabricated steel items.
- E. Section 07 21 00 - Thermal Insulation: Insulation for cavity spaces.
- F. Section 07 25 00 - Weather Barriers
- G. Section 07 62 00 - Sheet Metal Flashing and Trim: Through-wall masonry flashings.
- H. Section 07 84 00 - Firestopping: Firestopping at penetrations of fire-rated masonry and at top of fire-rated walls.
- I. Section 079200 - Joint Sealers: Backing rod and sealant at control and expansion joints.
- J. Section 08 11 13 - Hollow Metal Doors and Frames: Door frames installed in masonry

### 1.3 REFERENCE STANDARDS

- A. ACI 530/ASCE 5/TMS 402 - Building Code Requirements for Masonry Structures; American Concrete Institute International.
- B. ACI 530.1/ASCE 6/TMS 602 - Specification for Masonry Structures; American Concrete Institute International.
- C. ASTM A580/A 580M - Standard Specification for Stainless Steel Wire.
- D. ASTM C90 - Standard Specification for Loadbearing Concrete Masonry Units.
- E. ASTM C91 - Standard Specification for Masonry Cement.
- F. ASTM C140 - Standard Test Methods of Sampling and Testing Concrete Masonry Units and Related Units.
- G. ASTM C144 - Standard Specification for Aggregate for Masonry Mortar.
- H. ASTM C150 - Standard Specification for Portland Cement.
- I. ASTM C207 - Standard Specification for Hydrated Lime for Masonry Purposes.
- J. ASTM C270 - Standard Specification for Mortar for Unit Masonry.
- K. ASTM C404 - Standard Specification for Aggregates for Masonry Grout.



- L. ASTM C476 - Standard Specification for Grout for Masonry.
- M. ASTM C780 - Standard Test Method for Preconstruction and Construction Evaluation of Mortars for Plain and Reinforced Unit Masonry.
- N. ASTM D1056 - Standard Specification for Flexible Cellular Materials-Sponge or Expanded Rubber.

#### 1.4 ADMINISTRATIVE REQUIREMENTS

- A. Preinstallation Meeting: Convene a preinstallation meeting one week before starting Work of this Section; require attendance by all relevant installers.
- B. Coordination: coordinate this work with other elements of the exterior wall assembly to ensure complete weather tight construction

#### 1.5 SUBMITTALS

- A. Product Data: Provide data for masonry units, fabricated wire reinforcement, mortar, and masonry accessories, grout and grout and mortar admixtures.
  - 1. Provide structural properties and load handling capabilities of all materials
- B. Shop Drawings: Provide drawings that show the pattern and number of the following: Relieving Angles/Ledgers, Lentils, and other support for the masonry.
- C. Manufacturer's Certificate: Certify that masonry units meet or exceed specified requirements.
- D. Mix Designs: For each type of mortar and grout. Include description of type and proportions of ingredients.
  - 1. Include test reports, per ASTM C780, for mortar mixes required to comply with property specification.
  - 2. Include test reports, per ASTM C1019, for grout mixes required to comply with compressive strength requirement.

#### 1.6 QUALITY ASSURANCE

- A. Comply with provisions of ACI 530/ASCE 5/TMS 402 and ACI 530.1/ASCE 6/TMS 602, except where exceeded by requirements of the contract documents.
- B. Source Limitations for Mortar Materials: Obtain mortar ingredients of a uniform quality, including color for exposed masonry, from a single manufacturer for each cementitious component and from one source or producer for each aggregate.

#### 1.7 MOCK-UP

- A. For each type of masonry construct masonry wall corner as a mock-up panel sized 8 feet long by 6 feet high, which includes mortar and accessories, Window, any adjoining concrete elements and precast concrete elements.
  - 1. Masonry may be part of another mock-up that may or may not remain.
- B. Locate where directed.
- C. Mock-up may remain as part of the Work.
- D. Coordinate with mockups in Division 03, 04 and 05, and other Sections where required.

#### 1.8 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, handle, and store masonry units by means that will prevent mechanical damage and contamination by other materials.
- B. Store cementitious materials on elevated platforms, under cover, and in a dry location. Do not

use cementitious materials that have become damp

## PART 2 - PRODUCTS

### 2.1 GENERAL

- A. See structural general notes on the drawings for additional requirements.

### 2.2 CONCRETE MASONRY UNITS

- A. Concrete Block: Comply with referenced standards and as follows:
  - 1. Size: Standard units with nominal face dimensions of 16-inches x 8-inches and nominal depth of 8-inches.
  - 2. Special Shapes: Provide non-standard blocks configured for corners, control joint edges, and other detailed conditions.
  - 3. Load-Bearing Units: ASTM C90.
    - a. Hollow block, as indicated.
    - b. Exposed faces: Manufacturer's standard color and texture.

### 2.3 MORTAR AND GROUT MATERIALS

- A. Masonry Cement: ASTM C91, Type S.
- B. Portland Cement: ASTM C150, Type I; color as required to produce approved color sample.
  - 1. Not more than 0.60 percent alkali.
  - 2. Hydrated Lime: ASTM C207, Type S.
  - 3. Mortar Aggregate: ASTM C144.
  - 4. Grout Aggregate: ASTM C404.
- C. Water: Clean and potable.
- D. Admixtures: Do not use chemicals that will result in soluble chloride ions in excess of 0.1 percent by weight of cement.

### 2.4 REINFORCEMENT AND ANCHORAGE

- B. Reinforcing Steel: Type specified in Section 03 20 00 - Concrete Reinforcing; size and grade as indicated on drawings; uncoated finish.
- C. Interior Single Wythe Joint Reinforcement: Truss type; ASTM A82/A82M steel wire, hot dip galvanized after fabrication to ASTM A153/A153M, Class B; 0.1483-inch side rods with 0.1483-inch cross rods; width as required to provide not more than 1-inch and not less than 1/2-inch of mortar coverage on each exposure.
- D. Exterior Single Wythe Joint Reinforcement: Truss type; stainless steel conforming to ASTM A580/A580M Type 304; 0.1483-inch side rods with 0.1483-inch cross rods; width as required to provide not more than 1-inch and not less than 1/2-inch of mortar coverage on each exposure.
- E. Other reinforcement and anchors to structure see structural notes and drawings.
- F. Steel Lintels and Shelf Angles: Per Section 05 50 00 - Metal Fabrications, hot dipped galvanized.
- G. Stainless-Steel Drill Screws for Steel Studs: Proprietary fastener consisting of carbon-steel drill point and 300 Series stainless-steel shank, complying with ASTM C954 except manufactured with hex washer head and neoprene washer, No. 10 diameter by length required to penetrate steel stud flange with not less than three exposed threads.
  - 1. Products:

- a. Dayton Superior Corporation, Dur-O-Wal Division; Stainless Steel SX Fastener.
- b. ITW Buildex; Scots long life Tek's.

## 2.5 FLASHINGS

- A. Metal Flashing: Provide metal flashing, where flashing is exposed or partly exposed and where indicated, complying with SMACNA's "Architectural Sheet Metal Manual" and as follows:
  1. Stainless Steel: ASTM A240/A240M, Type 304, 0.016-inch thick.
  2. Fabricate continuous flashings in sections 8 feet long minimum, but not exceeding 12 feet. Provide splice plates at joints of formed, smooth metal flashing.
  3. Fabricate corner pieces as a single, watertight, piece with 2 foot legs.
  4. Fabricate through-wall metal flashing embedded in masonry from stainless steel, with ribs at 3-inch intervals along length of flashing to provide an integral mortar bond.
    - a. Products:
      - 1) Cheney Flashing Company; Cheney Flashing (Dovetail) or Cheney 3-Way Flashing (Sawtooth).
      - 2) Keystone Flashing Company, Inc.; Keystone 3-Way Interlocking Thruwall Flashing.
  5. Fabricate through-wall flashing with drip edge, unless otherwise indicated. Fabricate by extending flashing 1/2-inch out from wall, with outer edge bent down 30 degrees and hemmed.
  6. Fabricate end dams and termination bars from stainless steel
- B. "Flexible Flashing" Rubberized Asphalt Flashing: Self-adhering polymer-modified asphalt sheet complying with ASTM D1970; minimum 0.040-inch total thickness; with cross-linked polyethylene top surface (also labeled as "self-sealing membrane flashing").
  1. Manufacturers:
    - a. Grace; Product Perm-a-Barrier.

## 2.6 CAVITY WALL DRAINAGE SYSTEM

- A. General: Provide separate items listed below and specified elsewhere in this Section, or provide single product below.
- B. Manufacturer: Mortar Net "Total Flash": [www.mortarnet.com](http://www.mortarnet.com).
- C. Pre-assembled flashing system comprised of the following:
  1. Termination bar.
  2. Drainage mat (mortar diverter).
  3. Weep tabs.
  4. Stainless steel drip edge.
  5. Pre-formed and stainless steel corner boots.
  6. Edge dams.

## 2.7 ACCESSORIES

- A. Preformed Control Joints: Neoprene material. Provide with corner and tee accessories, fused joints.
  1. Manufacturers:
    - a. Blok-Lok: Exp-Joint; for horizontal or vertical joints in brick
    - b. Blok-Lok: BL-A Control Joint for Concrete Masonry Units
    - c. Dur-O-Wal; Product D/A 2010 (horizontal) and D/A 2015 (vertical): [www.dur-o-wal.com](http://www.dur-o-wal.com).
    - d. Substitutions: See Section 01 60 00 - Product Requirements.
- B. Joint Filler: Closed cell polyvinyl chloride; oversized 50 percent to joint width; self-expanding; 1-inch wide by maximum lengths available.

- C. Cavity Mortar Control: Semi-rigid polyethylene or polyester mesh panels, sized to thickness of wall cavity, and designed to prevent mortar droppings from clogging weeps and cavity vents and allow proper cavity drainage (or see Article 2.6 above)
  - 1. Mortar Diverter: Panels designed for installation at flashing locations.
    - a. Manufacturers:
      - 1) Advanced Building Products Inc: [www.advancedflashing.com](http://www.advancedflashing.com).
      - 2) Mortar Net USA, Ltd; Product Mortar Net: [www.mortarnet.com](http://www.mortarnet.com).
      - 3) Substitutions: See Section 01 60 00 - Product Requirements.
- D. Air Barrier: See Section 07 25 00 - Weather Barriers.
- E. Weeps: Molded PVC grilles, insect resistant. (or see 2.6 above)
  - 1. Manufacturers:
    - a. CavClear/Archovations, Inc: [www.cavclear.com](http://www.cavclear.com).
    - b. Dur-O-Wal: [www.dur-o-wal.com](http://www.dur-o-wal.com).
    - c. Hohmann & Barnard, Inc: [www.h-b.com](http://www.h-b.com).
    - d. Substitutions: See Section 01 60 00 - Product Requirements.
- F. Cleaning Solution: General purpose, concentrated acidic cleaner for brick, tile and concrete surfaces; must not be harmful to masonry work.
  - 1. ProSoCo Sure Klean 600 Detergent or accepted equal.
- G. CMU Sealer: See Section 07 19 10 - Water Repellents. Note: painted CMU need not be sealed.

## 2.8 MORTAR AND GROUT MIXES

- A. Mortar for Unit Masonry: ASTM C270, using the Proportion Specification.
  - 1. Exterior, loadbearing masonry: Type S.
  - 2. Interior, loadbearing masonry: Type S.
- B. Grout: ASTM C476. Consistency required to fill completely volumes indicated for grouting; fine grout for spaces with smallest horizontal dimension of 2-inches or less; coarse grout for spaces with smallest horizontal dimension greater than 2-inches.
- C. See Structural drawings for further information

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Verify that field conditions are acceptable and are ready to receive masonry.
- B. Verify that related items provided under other Sections are properly sized and located.
- C. Verify that built-in items are in proper location, and ready for roughing into masonry Work.

### 3.2 PREPARATION

- A. Direct and coordinate placement of metal anchors self-adhering membrane, and accessories supplied for installation under other Sections.
- B. Provide temporary bracing during installation of masonry work. Maintain in place until building structure provides permanent bracing.
- C. Prime surfaces to receive rubberized asphalt or similar flashing as needed to comply with manufacturer's recommendations.

### 3.3 COLD AND HOT WEATHER REQUIREMENTS

- A. Comply with requirements of ACI 530.1/ASCE 6/TMS 602 or applicable building code, whichever is more stringent.

### 3.4 COURSING

- A. Establish lines, levels, and coursing indicated. Protect from displacement.
  - 1. Do not use or portions of units less than the length of the running bond (e.g. 1/3 or 1/2 etc)
- B. Maintain masonry courses to uniform dimension. Form vertical and horizontal joints of uniform thickness.
- C. Concrete Masonry Units:
  - 1. Bond: Running.
  - 2. Coursing: One unit and one mortar joint to equal 8-inches.
  - 3. Mortar Joints: Concave.

### 3.5 PLACING AND BONDING

- A. Lay hollow masonry units with face shell bedding on head and bed joints.
- B. Buttering corners of joints or excessive furrowing of mortar joints is not permitted.
- C. Remove excess mortar and mortar smears as work progresses.
- D. Interlock intersections and external corners, except for units laid in stack bond.
- E. Do not shift or tap masonry units after mortar has achieved initial set. Where adjustment must be made, remove mortar and replace.
- F. Perform job site cutting of masonry units with proper tools to provide straight, clean, unchipped edges. Prevent broken masonry unit corners or edges.
- G. Cut mortar joints flush where wall tile is scheduled or resilient base is scheduled, or any membrane or coating is applied.
- H. Isolate masonry partitions from vertical structural framing members with a control joint.
- I. Isolate top joint of masonry partitions from horizontal structural framing members and slabs or decks with compressible joint filler.

### 3.6 WEEPS/CAVITY VENTS

- A. Install weeps in veneer walls at 16-inches on center horizontally above through-wall flashing, above shelf angles and lintels, and at bottom of walls.

### 3.7 CAVITY MORTAR CONTROL

- A. Do not permit mortar to drop or accumulate into cavity air space or to plug weep/cavity vents. See "Mortar Net" listed under Accessories above.
- B. For cavity walls, build inner structure wythe or stud backup ahead of outer wythe to accommodate accessories.
- C. Install cavity mortar control panels continuously throughout full height of exterior masonry cavities during construction of exterior wythe, complying with manufacturer's installation instructions. Verify that airspace width is no more than 3/8-inch greater than panel thickness. Install horizontally between joint reinforcement. Stagger end joints in adjacent rows. Fit to perimeter construction and penetrations without voids.
- D. Install cavity mortar diverter at base of cavity and at other flashing locations as recommended by manufacturer to prevent mortar droppings from blocking weep/cavity vents.

### 3.8 REINFORCEMENT AND ANCHORAGE - GENERAL

- A. Unless otherwise indicated on drawings or specified under specific wall type, install horizontal joint reinforcement 16-inches on center.
- B. Place masonry joint reinforcement in first and second horizontal joints above and below openings. Extend minimum 16-inches each side of opening.
- C. Place continuous joint reinforcement in first and second joint below top of walls.
- D. Lap joint reinforcement ends minimum 6-inches.

### 3.9 REINFORCEMENT AND ANCHORAGE - SINGLE WYTHE MASONRY

- A. Install horizontal joint reinforcement 16-inches on center.
- B. Place masonry joint reinforcement in first and second horizontal joints above and below openings. Extend minimum 16-inches each side of opening.
- C. Place continuous joint reinforcement in first and second joint below top of walls.
- D. Lap joint reinforcement ends minimum 6-inches.
- E. Reinforce joint corners and intersections with strap anchors 16-inches on center.

### 3.10 MASONRY FLASHINGS

- A. Whether or not specifically indicated, install masonry flashing to divert water to exterior at all locations where downward flow of water will be interrupted.
  - 1. Extend flashings full width at such interruptions and at least 4-inches into adjacent masonry and turn up at least 4-inches to form watertight pan.
  - 2. Remove or cover protrusions or sharp edges that could puncture flashings.
  - 3. Seal lapped ends and penetrations of flashing before covering with mortar.
- B. Extend metal flashings 1/2-inch beyond of exterior face of masonry and include a 1/2-inch drip edge.
- C. Extend laminated and flexible flashings to within 1/4-inch of exterior face of masonry.

### 3.11 LINTELS

- A. Install loose steel lintels over openings.
- B. Maintain a minimum of 8-inches of bearing on each side of the opening, unless noted otherwise.
- C. Install reinforced unit masonry lintels over openings where steel or precast concrete lintels are not scheduled. See Structural drawings but as a minimum for:
  - 1. Openings to 42-inches: Place two, No. 3 reinforcing bars 1-inch from bottom web.
  - 2. Openings from 42-inches to 78-inches: Place two, No. 5 reinforcing bars 1-inch from bottom web.
  - 3. Openings over 78-inches: Reinforce openings as detailed.
  - 4. Do not splice reinforcing bars.
  - 5. Support and secure reinforcing bars from displacement. Maintain position within 1/2-inch of dimensioned position.
  - 6. Place and consolidate grout fill without displacing reinforcing.
  - 7. Allow masonry lintels to attain specified strength before removing temporary supports.

### 3.12 GROUTED COMPONENTS

- A. Use low-lift masonry practices including but not limited to:
  - 1. Grout vertically reinforced cells no more than four foot high lifts.
  - 2. Mechanically Vibrate grout pours over 12-inches in height.

- B. Reinforcement: See structural drawings.
- C. Support and secure reinforcing bars from displacement. Maintain position within 1/2-inch of dimensioned position.
- D. Place and consolidate grout fill without displacing reinforcing.
- E. At bearing locations, fill masonry cores with grout for a minimum 12-inches either side of opening.

### 3.13 CONTROL AND EXPANSION JOINTS

- A. Do not continue horizontal joint reinforcement through control and expansion joints.
- B. Form control joint with a sheet building paper bond breaker fitted to one side of the hollow contour end of the block unit. Fill the resultant core with grout fill. Rake joint at exposed unit faces for placement of backer rod and sealant.
- C. Install preformed control joint device in continuous lengths. Seal butt and corner joints in accordance with manufacturer's instructions.
- D. Size control joint in accordance with Section 07 92 00 - Joint Sealer for sealant performance.

### 3.14 BUILT-IN WORK

- A. As work progresses, install items to be built into the work and furnished under other Sections.
- B. Install built-in items plumb, level, and true to line.
- C. Bed anchors of metal door and glazed frames in adjacent mortar joints. Fill frame voids solid with grout.
  - 1. Fill adjacent masonry cores with grout minimum 12-inches from framed openings.
- D. Do not build into masonry construction organic materials that are subject to deterioration.

### 3.15 TOLERANCES

- A. Maximum Variation from Alignment of Columns and Pilasters: 1/4-inch.
- B. Maximum Variation from Unit to Adjacent Unit: 1/16-inch.
- C. Maximum Variation from Plane of Wall: 1/4-inch in 10-feet. and 1/2-inch in 20-feet. or more.
- D. Maximum Variation from Plumb: 1/4-inch per story non-cumulative; 1/2-inch in two stories or more.
- E. Maximum Variation from Level Coursing: 1/8-inch in 3-feet; 1/4-inch in 10-feet; 1/2-inch in 30-feet.
- F. Maximum Variation of Joint Thickness: 1/8-inch in 3-feet.
- G. Maximum Variation from Cross Sectional Thickness of Walls: 1/4-inch.

### 3.16 CUTTING AND FITTING

- A. Cut and fit for chases, pipes, conduit, and sleeves. Coordinate with other Sections of Work to provide correct size, shape, and location.
- B. Obtain approval prior to cutting or fitting masonry work not indicated or where appearance or strength of masonry work may be impaired.

### 3.17 FIELD QUALITY CONTROL

- A. An independent testing agency will perform field quality control tests, as specified in Section

01 45 23 - Testing and Inspecting Services.

- B. Concrete Masonry Unit Tests: Test each variety of concrete unit masonry in accordance with ASTM C140 for conformance to requirements of this specification.
- C. Mortar Tests: Test each type of mortar in accordance with ASTM C780, testing with same frequency as masonry samples.
- D. Grout Test: For each mix provided, per ASTM C1019.

### 3.18 CLEANING

- A. In-Progress Cleaning: Clean unit masonry as work progresses by dry brushing to remove mortar fins and smears before tooling joints
- B. Remove excess mortar and mortar droppings.
- C. Replace defective mortar. Match adjacent work.
- D. Clean entire surface including adjacent concrete surfaces with cleaning solution.
- E. Use non-metallic tools in cleaning operations.
- F. Surfaces soiled during construction must be re-cleaned during final cleaning

### 3.19 PROTECTION

- A. Protect finished surfaces from damage and soiling.
- B. Without damaging completed work, provide protective boards at exposed external corners that are subject to damage by construction activities.

END OF SECTION



## PART 1 - GENERAL

### 1.1 SECTION INCLUDES

- A. Cut stone veneer at exterior walls.
- B. Metal anchors and supports.

### 1.2 RELATED REQUIREMENTS

- A. Section 03 30 00 – Cast-in-Place Concrete: Backup walls for exterior stone cladding.
- B. Section 04 20 00 – Unit Masonry: Backup walls for exterior stone cladding.
- C. Section 05 50 00 - Metal Fabrications: Metal fabricated items for building into cut stone.
- D. Section 07 19 00 - Water Repellants: Treatment for exterior stone cladding.
- E. Section 07 21 00 - Thermal Insulation: Insulation behind stone cladding.
- F. Section 07 25 00 - Weather Barriers: Weather-resistant air barriers on walls behind stone cladding.
- G. Section 07 62 00 - Sheet Metal Flashing and Trim: Flashings at copings.
- H. Division 08 Sections for curtain wall, doors frames, and other adjoining products.

### 1.3 REFERENCE STANDARDS

- A. ASTM A666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar.
- B. ASTM C67 - Standard Test Methods for Sampling and Testing Brick and Structural Clay Tile.
- C. ASTM C568 - Standard Specification for Limestone Dimension Stone.
- D. ASTM C1242 - Standard Guide for Selection, Design, and Installation of Dimension Stone Attachment Systems.
- E. ILI Indiana Limestone Handbook.
- F. MIA Dimensional Stone Design Manual.

### 1.4 ADMINISTRATIVE REQUIREMENTS

- A. Preinstallation Meeting: Convene one week before starting work of this Section.
- B. Coordination: coordinate this work with other elements of the exterior wall assembly to ensure complete weather tight construction.

### 1.5 SUBMITTALS

- A. Product Data: For each variety of stone, stone accessory, mortar products, and other manufactured products indicated.
- B. Shop Drawings: Show fabrication and installation details for dimension stone cladding system, including dimensions and profiles of stone units.
  - 1. Provide Details at a minimum of 3"=1" scale.
  - 2. Show locations and details of joints both within dimension stone cladding system and between dimension stone cladding system and other construction.
  - 3. Include details of joints.
  - 4. Show locations and details of anchors and backup structure.

5. Include large-scale shaded elevations and details of decorative surfaces and inscriptions.
6. For installed products indicated to comply with design loads, include structural analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
- C. Samples: Submit for each color, grade, finish, and variety of stone required, three stone samples 1' x 3' in size, illustrating color range and texture, markings, surface finish.
- D. Samples: Submit a sample of a horizontal joint. Sample will be kept as a control for joint quality of finished countertops and similar surfaces.
- E. Submit stone fabricator's installation instructions and field erection or setting drawings; indicate panel identifying marks and locations on setting drawings.
- F. Test reports: ASTM C568 and C67 testing.
- G. Reports:
  1. Detrimental substrate conditions
  2. Surveys of wall plumbness for:
    - a. CMU backup walls.
    - b. Concrete backup walls.
    - c. Final stone facing.

#### 1.6 QUALITY ASSURANCE

- A. Engage a Professional Engineer experienced in this type of work and licensed in the State of Washington to design anchors and supports.
  1. Design anchors to resist positive and negative wind pressures and other loads as required by applicable code.
  2. Design anchor attachment to stone with a factor of safety of 5:1.
  3. Design each individual anchor with a factor of safety in the vertical dead-load-bearing direction of 4:1 and in the horizontal lateral-load-bearing direction of 2:1.
- B. Perform work in accordance with ILI Indiana Limestone Handbook and the MIA Dimensional Stone Design Manual, as applicable to the Work.
- C. Stone Fabricator: Company specializing in fabricating cut stone with minimum ten years of documented experience.
- D. Installer Qualifications: Company specializing in performing the work of this section with minimum five years of experience.

#### 1.7 MOCK-UP

- A. Construct stone exterior wall mock-up, as shown in the drawings, including one window bay and stone anchor accessories, sill and head flashings, window frame, corner condition, typical control joint. **Stone area of mock-up to be at least 200 sf.**
- B. Locate where directed.
- C. Use same sequencing as proposed for building.
- D. **If acceptable to architect**, mock-up may ~~not~~ remain as part of the Work.

#### 1.8 DELIVERY, STORAGE, AND HANDLING

- A. Store and handle stone and related materials to prevent deterioration or damage due to moisture, temperature changes, contaminants, corrosion, breaking, chipping, and other causes.
  1. Lift stone with wide-belt slings; do not use wire rope or ropes that might cause staining. Move stone, if required, using dollies with cushioned wood supports.

2. Store stone on wood skids or pallets with nonstaining, waterproof covers. Arrange to distribute weight evenly and to prevent damage to stone. Ventilate under covers to prevent condensation.
- B. Mark stone units, on surface that will be concealed after installation, with designations used on Shop Drawings to identify individual stone units. Orient markings on vertical panels so that they are right side up when units are installed.
- C. Store cementitious materials on elevated platforms, under cover, and in a dry location. Do not use cementitious materials that have become damp.
- D. Store stone panels vertically on edge, resting weight on panel edge.
- E. Protect stone from discoloration.

#### 1.9 FIELD CONDITIONS

- A. Coordinate the work with plumbing rough-in, electrical rough-in, and installation of associated and adjacent components.
- B. During temporary storage on site, at the end of working day, and during rainy weather, cover stone work exposed to weather with non-staining waterproof coverings, securely anchored.

### PART 2 - PRODUCTS

#### 2.1 STONE

- A. Limestone: Complying with ASTM C568 Classification III - High Density.
  1. Material Color and Finish: Western Tile and Marble "Crema Arena" in compliance with Indiana Limestone Institute of American (ILI) "Select Grade", matching that used on Molecular Engineering & Sciences Building (MoES) referenced in Section 01 11 00 - Summary of Work.
  2. Thickness: 2-cm.
  3. Face Sizes: As indicated on drawings
  4. Surface Texture: Flamed finish.
  5. Acceptable Producers:
    - a. Columbia Stone
    - b. Rhodes Architectural Stone
    - c. Western Tile and Marble

#### 2.2 PERFORMANCE REQUIREMENTS

- A. General: Design stone anchors and anchoring systems according to ASTM C1242.
- B. Structural Performance: Provide dimension stone cladding system capable of withstanding the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:
  1. Wind Loads: Determine loads based on the following minimum design wind pressures:
    - a. Uniform pressure as indicated on Drawings.
- C. Seismic Performance: Provide dimension stone cladding system capable of withstanding the effects of earthquake motions determined according to ASCE 7 and as indicated in General Structural Notes under "Design Criteria" on Drawing Sheet S0.01-2.
- D. Thermal Movements: Provide dimension stone cladding system that allows for thermal movements resulting from the following maximum change (range) in ambient and surface temperatures by preventing displacement of stone, opening of joints, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Base

engineering calculation on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.

1. Temperature Change (Range): 120 deg F, ambient; 180 deg F, material surfaces.
- E. Horizontal Building Movement (Interstory Drift): Allow for maximum horizontal building movement equal to quotient resulting from dividing floor-to-floor height at any floor by 400.
- F. Shrinkage and Creep: Allow for progressive vertical shortening of building frame equal to 1/8-inch in 10-feet.
- G. Safety Factors for Stone: Design dimension stone cladding system to withstand loads indicated without exceeding allowable working stress of stone determined by dividing stone's average ultimate strength, as established by testing, by the following safety factors:
  1. Safety Factor: **5**.
- H. Design stone anchors and backup structure to withstand loads indicated without exceeding allowable working stresses established by the following:
  1. For Structural Steel: AISC's "Specification for Structural Steel Buildings - Allowable Stress Design and Plastic Design."
  2. For Cold-Formed Steel: AISI's "North American Specification for the Design of Cold-Formed Steel Structural Members."
  3. For Cast-in-Place and Post-Installed Fasteners in Concrete: One-fourth of tested capacity when installed in concrete with compressive strength indicated.
- I. Limit deflection in each prefabricated assembly caused by indicated loads and thermal movements, acting singly or in combination with one another, to not more than 1/720 of assembly's clear span or the following, whichever is smaller:
  1. 1/16-inch, measured in plane of wall.
  2. 1/4-inch, measured perpendicular to wall.
- J. Provisions for Fabrication and Erection Tolerances: Allow for fabrication and erection tolerances of building's structural system. Concrete fabrication and erection tolerances are specified in Section 03 30 00 - Cast-in-Place Concrete. Structural-steel fabrication and erection tolerances are specified in Section 05 12 00 - Structural Steel Framing.
- K. Provision for Deflection of Building Structure: Allow for the following:
  1. Deflection due to Weight of Dimension Stone Cladding System: Allow for 1/4-inch vertical deflection in 20-foot span of structural members supporting dimension stone cladding system.
  2. Live Load Deflection: Allow for 1/4-inch vertical deflection, in 20-foot span of structural members supporting dimension stone cladding system, due to live loads imposed on building's structural frame after stone installation.
- L. Control of Corrosion and Staining: Prevent galvanic and other forms of corrosion as well as staining by isolating metals and other materials from direct contact with incompatible materials. Use materials that do not stain exposed surfaces of stone and joint materials.

### 2.3 ANCHORS AND ACCESSORIES

- A. Anchors and Other Components in Contact with Stone: Stainless steel, ASTM A666, Type 304.
  1. Sizes and Configurations: As required for vertical and horizontal support of stone and applicable loads.
  2. Wire ties are not permitted.
  3. **Aluminum support systems are acceptable. Maintain separation between aluminum and stainless steel to prevent galvanic corrosion.**
- B. Support Components Not in Contact With Stone: Stainless steel, ASTM A666, Type 304.

**1. Aluminum systems are acceptable. Anchors into concrete, cmu and other back-up walls to be stainless steel. Maintain separation between aluminum and stainless steel to prevent galvanic corrosion.**

- C. Setting Buttons and Shims: Plastic type.
- D. Flashings: Stainless steel as specified in Section 07 62 00 - Sheet Metal Flashing and Trim.
- E. Cleaning Solution: Type recommended by stone producer that will not harm stone, joint materials, or adjacent surfaces.

#### 2.4 STONE FABRICATION

- A. Panel Widths: As indicated on the Drawings.
- B. Fabrication Tolerances:
  - 1. Maximum Variation From Thickness: 1/8-inch.
  - 2. Maximum Variation From Face Size: 1/16-inch.
  - 3. Maximum Variation From Flat: 1/16-inch/sq ft.
- C. Fabricate units for uniform coloration between adjacent units and over the full area of the installation.
- D. Where corner detail is not indicated, form external corners to square joint profile.
- E. Cut drip slot in bottom surface of work projecting more than 1/2-inch over wall openings. Size slot not less than 3/8-inch wide and 1/4-inch deep; full width of projection.

### PART 3 - EXECUTION

#### 3.1 EXAMINATION

- A. Verify that support work and site conditions are ready to receive work of this Section.
- B. Verify that items built-in under other Sections are properly located and sized.
- C. Submit a written report, endorsed by Installer, listing conditions detrimental to performance of dimension stone cladding.

#### 3.2 PREPARATION

- A. Clean stone prior to erection. Do not use wire brushes or implements that will mark or damage exposed surfaces.

#### 3.3 INSTALLATION

- A. Install flashings of longest practical length and seal watertight to back-up. Lap end joint minimum 6-inches and seal watertight.
- B. Erect stone in accordance with stone supplier's instructions and erection drawings.
- C. Attach anchors securely to stone and to backup surfaces. Comply with recommendations in ASTM C1242.
- D. Set stone with a consistent vertical joint width of 1/4-inch and a consistent horizontal width of 1/2-inch.
- E. Install anchors and place removable setting buttons to support stone and to establish joint dimensions.

#### 3.4 TOLERANCES

- A. Positioning of Elements: Maximum 1/16-inch from true position.
- B. Maximum Variation from Plane of Wall: 1/4-inch in 10-feet; 1/2-inch in 50-feet.
- C. Maximum Variation between Face Plane of Adjacent Panels: 1/16-inch.
- D. Maximum Variation from Plumb: 1/4-inch per story non-cumulative; 1/2-inch in any two stories.
- E. Maximum Variation from Level Coursing: 1/8-inch in 3-feet; 1/4-inch in 10-feet; 1/2-inch maximum.
- F. Maximum Variation of Joint (gap) Width: 1/8-inch in 3-feet.

### 3.5 CUTTING AND FITTING

- A. Obtain approval prior to cutting or fitting any item not so indicated on Drawings.
- B. Do not impair appearance or strength of stone work by cutting.

### 3.6 CLEANING

- A. Clean soiled surfaces with cleaning solution.
- B. Use non-metallic tools in cleaning operations.
- C. Protect finished work from other construction activities. Leave covered until date of Substantial Completion.

### 3.7 SEALING

- A. Seal stonework after fabrication and again after installation with water repellent specified in Section 07 19 00 - Water Repellents.

END OF SECTION

## PART 1 - GENERAL

### 1.1 SECTION INCLUDES

- A. Structural steel framing members, support members.
- B. Base plates, shear stud connectors.
- C. Grouting under base plates.

### 1.2 REFERENCE STANDARDS

- A. AISC (MAN) - Steel Construction Manual; American Institute of Steel Construction, Inc.
- B. AISC S303 - Code of Standard Practice for Steel Buildings and Bridges.
- C. AISC S348 - Specification for Structural Joints Using ASTM A325 or A490 Bolts.
- D. ASTM A36/A36M - Standard Specification for Carbon Structural Steel.
- E. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
- F. ASTM A108 - Standard Specification for Steel Bar, Carbon and Alloy, Cold Finished.
- G. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
- H. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
- I. ASTM A242/A242M - Standard Specification for High-Strength Low-Alloy Structural Steel.
- J. ASTM A307 - Standard Specification for Carbon Steel Bolts and Studs, 60 000 PSI Tensile Strength.
- K. ASTM A325 - Standard Specification for Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength.
- L. ASTM A500 - Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes.
- M. ASTM A992/A992M - Standard Specification for Structural Steel Shapes.
- N. ASTM C1107/C1107M - Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink).
- O. ASTM F959 - Standard Specification for Compressible-Washer-Type Direct Tension Indicators for Use with Structural Fasteners.
- P. AWS A2.4 - Standard Symbols for Welding, Brazing, and Nondestructive Examination.
- Q. AWS D1.1/D1.1M - Structural Welding Code - Steel.
- R. SSPC-Paint 20 - Zinc-Rich Primers (Type I, "Inorganic," and Type II, "Organic").

### 1.3 SUBMITTALS

- A. See Structural Drawings and General Notes for additional submittal requirements.
- B. Shop Drawings:
  - 1. Indicate profiles, sizes, spacing, locations of structural members, openings, attachments,

- and fasteners.
- 2. Connections.
- 3. Indicate cambers.
- 4. Indicate welded connections with AWS A2.4 welding symbols. Indicate net weld lengths.
- C. Manufacturer's Mill Certificate: Certify that products meet or exceed specified requirements.
- D. Written reports noted in Quality Assurance below.
- E. Welders Certificates: Certify welders employed on the Work, verifying AWS and WABO qualification within the previous 12 months.

#### 1.4 QUALITY ASSURANCE

- A. Fabricate structural steel members in accordance with AISC "Steel Construction Manual."
- B. Fabricator: Company specializing in performing the Work of this Section with not less than 3 years of documented experience.
  - 1. AISC certified plant category Cbd.
  - OR
  - 2. Provide full time inspection during the fabrication of the steel.
    - a. Inspection will be conducted at the plant by Owner's inspection agency
    - b. Plant must be acceptable to and approved in writing by the Engineer and Building official.
- C. Erector: Company specializing in performing the Work of this Section with not less than 3 years of documented experience.
- D. Prepare a written report of results of visual inspection of HSS tube and pipe seam weld.
- E. Prepare a written welding procedures report in accordance with AWS D1.1.
- F. Prepare a written report of Charpy V-notch testing data per structural drawing general notes
- G. Special Inspection Requirements: See Structural Drawings and General Notes.

### PART 2 - PRODUCTS

#### 2.1 MATERIALS

- A. Structural Steel Members not mentioned below: ASTM A36.
- B. Rolled Steel Structural Shapes: ASTM A992/A992M.
- C. Steel Shapes, Plates, and Bars: ASTM A242/A242M high-strength, corrosion-resistant structural steel.
- D. Cold-Formed Structural Tubing: ASTM A500, Grade B.
- E. Steel Bars and Plates: ASTM A36/A36M GR-50
- F. Pipe: ASTM A53, Grade B, Finish black.
- G. Shear Stud Connectors: Made from ASTM A108 Grade 1015 bars.
- H. Structural Bolts and Nuts: Carbon steel, ASTM A307, Grade A galvanized to ASTM A153/A153M, Class C.
- I. High-Strength Bolts, Nuts, and Washers: ASTM A325 SC, Type 1, medium carbon, galvanized with matching nuts and washers.
- J. Anchor Bolts J type: ASTM A36.



1. "Wet Sticking" of anchor bolts is not allowed.
- K. Anchor Bolts, Headed: ASTM A307, Grade A galvanized to ASTM A153/A153M, Class C for galvanized structural members.
- L. High-Strength Anchor Bolts: ASTM A325, Type 1 medium carbon, galvanized.
- M. Load Indicator Washers: Provide washers complying with ASTM F959 at all connections requiring high-strength bolts.
- N. Threaded Rod: ASTM A36.
- O. Welding Materials: AWS D1.1; type required for materials being welded.
- P. Grout: Non-shrink, non-metallic aggregate type, complying with ASTM C1107/C 1107M and capable of developing a minimum compressive strength of 9,000 psi at 28 days. Provide NS Grout manufactured by Euclid Chemical Co., or accepted equal.
- Q. Shop and Touch-Up Primer: Tnemec 394, or accepted equal.
- R. Touch-Up Primer for Galvanized Surfaces: SSPC-Paint 20, Type II - Organic, complying with VOC limitations of authorities having jurisdiction.
- S. Epoxy for embedments and Expansion anchors
  1. Provide product with current ICC report for application at cracked concrete.

## 2.2 FABRICATION

- A. Shop fabricate to greatest extent possible.
- B. For All welding:
  1. Use E70 XX Electrodes.
  2. Prequalified welds per AWS and WABO only.
  3. Additional requirements for welding and welds are set forth in the Structural Notes located on the Drawings.
- C. Continuously seal joined members by continuous welds. Grind exposed welds smooth.
- D. Fabricate connections for bolt, nut, and washer connectors.
- E. Develop required camber for members.

## 2.3 FINISH

- A. Prepare structural component surfaces in accordance with SSPC SP 6 for any exterior members and SSPC SP 3 for any interior members.
- B. Shop prime structural steel members. Do not prime surfaces that will be field welded or in contact with concrete. See Section 09 90 00 - Painting and Coating.

## 2.4 SOURCE QUALITY CONTROL

- A. High-Strength Bolts: Provide testing and verification of shop-bolted connections in accordance with AISC "Specification for Structural Joints Using ASTM A325 or A490 Bolts".
- B. Welded Connections: Visually inspect all field-welded connections and test in accordance with AWS D1.1

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Verify that conditions are appropriate for erection of structural steel and that the work may properly proceed.
- B. Visually inspect HSS tubes and pipes at the exterior face and interior face at each end of each piece.
  - 1. Note any defect found and do not use that piece without written approval of the Engineer.

### 3.2 ERECTION

- A. Erect structural steel in compliance with AISC "Code of Standard Practice for Steel Buildings and Bridges".
- B. Allow for erection loads, and provide sufficient temporary bracing to maintain structure in safe condition, plumb, and in true alignment until completion of erection and installation of permanent bracing.
- C. Field weld components indicated on accepted Shop Drawings.
- D. Use specified carbon steel bolts and high-strength bolts where indicated on the Drawings. Install high-strength bolts in accordance with AISC "Specification for Structural Joints Using ASTM A325 or A490 Bolts".
- E. Do not field cut or alter structural members without prior written approval of Structural Engineer
- F. After erection, spot prime welds, abrasions, and surfaces not shop primed.
- G. Grout solidly between column plates and bearing surfaces, complying with manufacturer's instructions for nonshrink grout. Trowel grouted surfaces smooth, splaying neatly to 45 degrees.

### 3.3 TOLERANCES

- A. Maximum Variation from Plumb: 1/4-inch per story, non-cumulative.
- B. Maximum Offset from True Alignment: 1/4-inch.

### 3.4 FIELD QUALITY CONTROL

- A. An independent testing agency will perform field quality control tests, as specified in Section 01 45 23 - Testing and Inspecting Services and as listed in the Structural Notes.
- B. High-Strength Bolts: Provide testing and verification of field-bolted connections in accordance with AISC "Specification for Structural Joints Using ASTM A325 or A490 Bolts".
- C. Welded Connections: Visually inspect all field-welded connections
- D. Testing Welded connections. See Section 01 45 23 -Testing and Inspecting Services.

END OF SECTION

## PART 1 - GENERAL

### 1.1 SECTION INCLUDES

- A. Preservative treated wood nailers and curbs for roofing and items installed on roof.

### 1.2 REFERENCE STANDARDS

- A. AWPAC - Lumber, Timber, Bridge Ties and Mine Ties -- Preservative Treatment by Pressure Processes.
- B. AWPAC U1 - Use Category System: User Specification for Treated Wood.
- C. PS 20 - American Softwood Lumber Standard; National Institute of Standards and Technology (Department of Commerce); 2005.

### 1.3 SUBMITTALS

- A. Product Data: Provide technical data on wood preservative materials and application instructions.
- B. LEED Submittals: Submit applicable LEED Submittal Form for each different product made of sustainably harvested wood, salvaged and reused wood, wood fabricated from recovered timber, as well as locally-sourced wood, as specified in Section 01 35 15 - LEED Requirements.

### 1.4 QUALITY ASSURANCE

- A. Lumber: Comply with PS 20 and approved grading rules and inspection agency.
  - 1. Acceptable Lumber Inspection Agency: Western Wood Products Association (WWPA).
- B. Preservative-Treated Wood: Provide lumber marked or stamped by an ALSC-accredited testing agency, certifying level and type of treatment in accordance with AWPAC standards.

### 1.6 DELIVERY, STORAGE, AND HANDLING

- A. General: Cover wood products to protect against moisture. Support stacked products to prevent deformation and to allow air circulation.

## PART 2 - PRODUCTS

### 2.1 GENERAL REQUIREMENTS

- A. Dimension Lumber: Comply with PS 20 and requirements of specified grading agency.
  - 1. Hem-Fir.

### 2.2 DIMENSION LUMBER FOR CONCEALED APPLICATIONS

- A. Sizes: Nominal sizes as indicated on Drawings, S4S.
- B. Moisture Content: S-dry or MC19.
- C. Miscellaneous Blocking, Nailers, Grounds, and Furring:
  - 1. Lumber: S4S, No. 2 or Standard Grade.

### 2.3 ACCESSORIES

- A. Fasteners and Anchors:
  - 1. Fasteners: Stainless steel for exterior, high humidity and treated wood locations, unfinished steel elsewhere.

## 2.4 FACTORY WOOD TREATMENT

- A. Treated Lumber: Comply with requirements of AWP A U1 - Use Category System for wood treatments determined by use categories, expected service conditions, and specific applications.
  - 1. Preservative-Treated Wood: Provide lumber and plywood marked or stamped by an ALSC-accredited testing agency, certifying level and type of treatment in accordance with AWP A standards.
- C. Pressure Treatment of Lumber Above Grade: Preservative P5 per AWP A Treatment C2 for lumber using copper boron azole (CBA) type.
  - 1. Kiln dry after treatment to maximum moisture content of 19 percent for lumber.
  - 2. Treat lumber in contact with roofing, roof expansion joint cover assemblies, and roof flashings.
- E. Manufacturers Preservative Treatment:
  - 1. Conrad Forest Products - 800-356-7146

## PART 3 - EXECUTION

### 3.1 INSTALLATION - GENERAL

- A. Select material sizes to minimize waste.
- B. Reuse scrap to the greatest extent possible; clearly separate scrap for use on site as accessory components, including: shims, bracing, and blocking.

### 3.2 BLOCKING, NAILERS, AND SUPPORTS

- A. Provide blocking, nailers, and support members as indicated or as required to support roof expansion joint cover assemblies, roof flashings, and other items indicated.

### 3.3 INSTALLATION OF ACCESSORIES AND MISCELLANEOUS WOOD

- A. Use pressure treated wood for specified exterior use.
- B. Curb roof openings except where prefabricated curbs are provided. Form corners by alternating lapping side members.
- C. Coordinate curb installation with installation of parapet construction and roof openings.
- D. Coordinate installation of wood accessories and miscellaneous wood with devices or other items attaching to them.

### 3.4 SITE APPLIED WOOD TREATMENT

- A. Apply preservative treatment compatible with factory applied treatment at site-sawn cuts, complying with manufacturer's instructions.
- B. Allow treatment to dry prior to erecting members.

END OF SECTION

## PART 1 - GENERAL

### 1.1 SECTION INCLUDES

- A. Elastomeric roofing membrane, adhered conventional application.
- B. Insulation, flat and tapered.
- C. Insulation protection board.
- D. Accessories.

### 1.2 RELATED REQUIREMENTS

- A. Section 07 62 00 - Sheet Metal Flashing and Trim; stainless steel flashings and counter flashings.
- B. Section 09 21 16 - Gypsum Board Assemblies: Gypsum roof board.
- C. Section 22 13 14 - Sanitary Waste and Storm Drainage Systems: Roof drains.

### 1.3 REFERENCE STANDARDS

- A. ASTM C209 - Standard Test Methods for Cellulosic Fiber Insulating Board.
- B. ASTM C518 - Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus.
- C. ASTM C1177/C 1177M - Standard Specification for Glass Mat Gypsum Substrate for Use as Sheathing.
- D. ASTM C1278/C 1278M Standard Specification for Fiber-Reinforced Gypsum Panel.
- E. ASTM C1289 - Standard Specification for Faced Rigid Cellular Polyisocyanurate Thermal Insulation Board.
- F. ASTM D412 - Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers- Tension.
- G. ASTM D570 - Standard Test Method for Water Absorption of Plastics.
- H. ASTM D746 - Standard Test Method for Brittleness Temperature of Plastics and Elastomers by Impact.
- I. ASTM D1621 - Standard Test Method for Compressive Properties of Rigid Cellular Plastics.
- J. ASTM D3273 - Standard Test Method for Resistance to Growth of Mold on the Surface of Interior Coatings in an Environmental Chamber.
- K. ASTM D4637 - Standard Specification for EPDM Sheet Used in Single-Ply Roof Membrane.
- L. ASTM E96/E 96M - Standard Test Methods for Water Vapor Transmission of Materials.
- M. FM DS 1-28 - Wind Design.

### 1.4 ADMINISTRATIVE REQUIREMENTS

- A. Coordinate with installation of associated counter flashings installed under other Sections.
- B. Preinstallation Meeting: Convene a preinstallation meeting one week before starting Work of this Section; require attendance by all affected installers; review preparation and installation procedures and coordination and scheduling necessary for related Work.

#### 1.5 SUBMITTALS

- A. Product Data: Include data for membrane materials, flashing materials, insulation protection board, insulation, vapor retarder, and fasteners.
- B. Shop Drawings: Indicate joint or termination detail conditions, conditions of interface with other materials, setting plan for tapered insulation, mechanical fastener layout, and paver layout at mechanical penthouse. Include heights of insulation at drains, roof edges, valleys and ridges.
- C. Manufacturer's Installation Instructions: Indicate membrane seaming precautions and perimeter conditions requiring special attention.
- D. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
- E. Manufacturer's Field Reports: Indicate procedures followed, ambient temperatures, humidity, wind velocity during application, and supplementary instructions given.
- F. Warranty: Submit manufacturer warranty and ensure forms have been completed in Owner's name and registered with manufacturer.

#### 1.6 QUALITY ASSURANCE

- A. Perform Work in accordance with NRCA Roofing Manual and the manufacturer's written instructions.
  - 1. Maintain one copy on site.
- B. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this Section with minimum 20 years of experience.
- C. Applicator Qualifications: Company specializing in performing the Work of this Section with a minimum 5 years of experience and approved by the manufacturer. Applicator shall have installed at least three (3) roofing applications of this type or similar (single-ply membrane fully adhered) system of equal or greater size within the past three (3) years. Written documentation of these applications shall be submitted at the time of bid with the bid form.
- D. Design system to meet IBC wind requirements. See Structural notes for exposure zone and wind speed.

#### 1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver products in manufacturer's original containers, dry, undamaged, with seals and labels intact.
- B. Store products in weather protected environment, clear of ground and moisture.
- C. Protect foam insulation from direct exposure to sunlight.

- D. Handle all materials to prevent damage. Place all materials on pallets and fully protect from moisture.
- E. Membrane rolls shall be stored lying down on pallets and fully protected from the weather with clean canvas tarpaulins. Unvented polyethylene tarpaulins are not accepted due to the accumulation of moisture beneath the tarpaulin in certain weather conditions, which may affect the membrane.
- F. All adhesives shall be stored at temperatures between 40° F (5° C) and 80° F (27° C).
- G. All flammable materials shall be stored in a cool, dry area away from sparks and open flames. Follow precautions outlined on containers or supplied by material manufacturer/supplier.
- H. All materials or existing construction that is damaged by the Contractor as determined by the Owner's Representative or Roofing Manufacturers Representative is to be removed from the job site and replaced at no cost to the Owner.

#### 1.8 PROJECT CONDITIONS

- A. Coordinate the Work with installation of associated counter flashings installed by other Sections as the Work of this Section proceeds.
- B. Roofing materials may be applied under certain adverse weather conditions but only after consultation with the manufacturer's technical representative, as installation time and system integrity may be affected.
- C. Only as much of the new roofing as can be made weathertight each day, including all flashing and detail work, shall be applied. All seams shall be cleaned and sealed before leaving the job site that day.
- D. Schedule and execute the Work without exposing the interior building areas to the effects of inclement weather.
- E. The Applicator is cautioned that selected roofing membranes are incompatible with asphalt, coal tar, heavy oils, roofing cements, creosote and some preservative materials. Such materials shall not remain in contact with membranes. The Applicator shall consult Roofing Manufacturer's Representative regarding compatibility, precautions and recommendations.
- F. Arrange work sequence to avoid use of newly constructed roofing as a walking surface or for equipment movement and storage. Where such access is absolutely required, provide all necessary protection and barriers to segregate the work area and to prevent damage to adjacent areas. Provide substantial protection layer consisting of plywood over manufacturer's approved protection sheet or plywood over insulation board for all new and existing roof areas which receive rooftop traffic during construction.
- G. Prior to and during application, all dirt, debris and dust shall be removed from surfaces either by vacuuming, sweeping, blowing with compressed air and/or similar methods.
- H. The Applicator shall take precautions that storage and/or application of materials and/or equipment does not overload the roof deck or building structure.
- I. All rooftop contamination that is anticipated or that occurs shall be reported to Roofing

Manufacturer's Representative to determine the corrective steps to be taken.

- J. Applicator shall immediately stop work if any unusual or concealed condition is discovered and shall immediately notify Contractor of such condition in writing for correction at the Owner's expense (letter copy to Roofing Manufacturer's Representative).
- K. The fully adhered elastomeric membrane shall not be applied under the following conditions without consulting manufacturer's technical representative for precautionary steps:
  - 1. The roof assembly permits interior air to pressurize the membrane underside.
  - 2. Any exterior wall has 10% or more of the surface area comprised of opening doors or windows.
  - 3. The wall/deck intersection permits air entry into the wall flashing area.
- L. Precautions shall be taken when using 4oofing-system adhesives at or near rooftop vents or air intakes. Adhesive odors could enter the building. Coordinate the operation of vents and air intakes in such a manner as to avoid the intake of adhesive odor while ventilating the building. Keep lids on unused cans at all times.

## 1.9 FIELD CONDITIONS

- A. Do not apply roofing membrane during unsuitable weather.
- B. Do not apply roofing membrane when ambient temperature is below 40 degrees F or above 90 degrees F.
- C. Do not apply roofing membrane to damp or frozen deck surface or when precipitation is expected or occurring.
- D. Do not expose materials vulnerable to water or sun damage in quantities greater than can be weatherproofed the same day.

## 1.10 WARRANTY

- A. See Section 01 78 36 - Warranties for additional warranty requirements.
- B. Correct defective Work within a two year period after Date of Substantial Completion.
- C. Provide 15 year manufacturer's Total Roofing System Warranty covering all materials incorporated into the roof and labor. Warranty shall cover failure to prevent penetration of water and roof failure due to wind with peak wind gusts of 72 mph measured at 10-m above ground level.

## PART 2 - PRODUCTS

### 2.1 ACCEPTABLE MANUFACTURERS

- A. EPDM Membrane Materials:
  - 1. Subject to compliance with requirements furnish products of one of the following:
    - a. Carlisle SynTec: [www.carlisle-syntec.com](http://www.carlisle-syntec.com).
    - b. Firestone Building Products Co: [www.firestonebpco.com](http://www.firestonebpco.com).
  - 2. Substitutions: See Section 01 60 00 - Product Requirements.
- B. Temporary roofing Materials: Of same manufacturer as EPDM roofing.



- C. Gypsum Roof Board: Specified in Section 09 21 16 - Gypsum Board Assemblies.
- D. Insulation: Of same manufacturer as membrane, to provide a complete UL rated assembly.
- E. Insulation Cover Board: Of same manufacturer as membrane, to provide a complete UL rated assembly.

## 2.2 ROOFING

- A. Elastomeric Membrane Roofing: One ply membrane, fully adhered over insulation protection board and insulation.
- B. Roofing Assembly Requirements:
  - 1. Roof Covering External Fire-Resistance Classification: UL Class A.
  - 2. Factory Mutual Classification: Class I and windstorm resistance of I-90 in accordance with FM DS 1-28.
  - 3. Insulation Thermal Resistance (R-Value) Minimum Average: R-38.
- C. Acceptable Insulation Types:
  - 1. Tapered and Uniform thickness polyisocyanurate board insulation to provide a complete UL rated and manufacturer warrantable assembly and system.

## 2.3 ROOFING MEMBRANE AND ASSOCIATED MATERIALS

- A. Membrane: Ethylene-propylene-diene-terpolymer (EPDM); externally reinforced with fabric; complying with minimum properties of ASTM D4637.
  - 1. Thickness: 0.060-inch.
  - 2. Sheet Width: 120-inches, minimum; factory-fabricate into largest sheets possible.
  - 3. Color: Black.
  - 4. Tensile Strength: 1685 psi, measured in accordance with ASTM D412.
  - 5. Elongation at Break of Fabric: 480 percent before and after aging, measured in accordance with ASTM D412.
  - 6. Water Absorption: +3.6 percent increase in weight, maximum, measured in accordance with ASTM D471, 7 day immersion at 158 deg F.
  - 7. Water Vapor Permeability: 0.05 perm inch, measured in accordance with ASTM E96/E 96M.
  - 8. Brittleness Temperature: Minus 67 min deg F, measured in accordance with ASTM D746.
- B. Seaming Materials: As recommended by membrane manufacturer.
- C. Adhesive: Manufacturer's recommended adhesive for the deck and project conditions.
- D. Membrane Fasteners:
  - 1. Disc Washers and Screws: Manufacturer's standard.
- E. Flexible Flashing Material: Same material as membrane; conforming to the following:
  - 1. Thickness: 0.060-inch.
  - 2. Color: Match roofing.

## 2.4 INSULATION

- A. Polyisocyanurate Board Insulation: Rigid cellular foam, complying with ASTM C1289, Type I, Class 1, non-reinforced foam core and with the following

characteristics:

1. Board Thickness: As required to achieve specified thermal resistance (including the tapered board and insulation cover board) specified in Part 2 Article titled "Roofing".
2. Tapered Board: As required to achieve slope of not less than 1/4-inch/foot; not less than 1/2-inch thick; fabricate of fewest layers possible.
3. Thermal Resistance: R-value of 5.6/inch (aged value).
4. Board Edges: Square.
5. Density 1.8 lb/cu. ft.

## 2.5 INSULATION COVER BOARD

- A. Non-combustible, water-resistant, high density closed cell polyisocyanurate core with coated glass mat facers as specified for insulation, except with the following characteristics:
  1. Thickness: 1/2-inch.
  2. Thermal Resistance (R-Value): 2.5, when tested in accordance with ASTM C518.
  4. Weight: 0.35 pounds/square foot.
  5. Surface Water Absorption: Not more than 1 percent by volume when tested in accordance with ASTM C209.
  6. Compressive Strength: Not less than 100 psi, when tested in accordance with ASTM D1621.
  7. Mold Growth Resistance: Pass ASTM D3273.

## 2.6 ACCESSORIES

- A. Cementitious Filler: Product recommended in writing by the membrane manufacturer.
- B. Temporary Roofing: Torch-applied styrene-butadiene-styrene modified base sheet with sanded face.
- C. Vapor Retarder: Torch-applied or cold-applied product suitable for use as a temporary roof, as recommended in writing by the EPDM membrane manufacturer to suit job conditions. Vapor retarder may be combined with temporary roofing. Furnish with manufacturer's recommended primer to suit job conditions.
- D. Stack Boots: Prefabricated flexible boot and collar for pipe stacks through membrane; same material as membrane.
- E. Insulation Board Joint Tape: Product recommended in writing by the board manufacturer.
- F. Membrane Bonding Adhesive: Product recommended in writing by the membrane manufacturer.
- G. Surface Conditioner for Adhesives: Product compatible with membrane and adhesives as recommended in writing by membrane manufacturer.
- H. Thinners and Cleaners: Products compatible with membrane as recommended in writing by adhesive manufacturer.
- I. Insulation Adhesive: Urethane-type product recommended in writing by the insulation manufacturer.

- J. Strip Reglets: Stainless steel, as specified in Section 07 62 00 - Sheet Metal Flashing and Trim; furnish in maximum possible lengths per location.
- K. Termination Bars and Fasteners: Stainless steel, manufacturer's standard thickness; furnish in maximum possible lengths per location.
- L. Sealants: Products recommended in writing by the membrane manufacturer.
- M. Roof Walkway Pads: Manufacturer's standard molded walkway pads with factory-applied pressure-sensitive tape.

### PART 3 - EXECUTION

#### 3.1 EXAMINATION

- A. Verify that surfaces and site conditions are ready to receive Work of this Section.
- B. Verify deck is clean and smooth, flat, free of depressions, waves, or projections, properly finished and sloped and suitable for application of roof system.
- C. Verify deck surfaces are dry and free of snow or ice.
- D. All surfaces to receive vapor retarder, temporary roofing, deck protection board, insulation, insulation protection board, membrane, or flashings shall be dry. Should surface moisture occur, provide the necessary equipment to dry the surface or in other ways prepare the deck prior to application.
- E. Verify that roof openings, curbs, and penetrations through roof are solidly set, and reglets are in place.
- F. All new and temporary construction, including equipment and accessories, shall be secured in such a manner as to preclude wind blow-off and subsequent roof or equipment damage.
- G. Verify that all roof drain lines are functioning correctly (not clogged or blocked) before starting Work. Applicator shall report any such blockages in writing (letter copy to manufacturer's technical representative) to the Architect and Contractor for corrective action prior to application of the roof system.

#### 3.2 CONCRETE DECK PREPARATION

- A. Fill surface honeycomb and variations with cementitious filler.
- B. Confirm dry deck by moisture meter with 12 percent moisture maximum.
- C. Confirm dry deck to manufacturer's satisfaction. If deck cannot achieve moisture recommendations (required for insulation adhesive application) apply temporary roofing below.

#### 3.3 METAL DECK PREPARATION

- A. Ensure gypsum roof board is properly installed, fully fastened in place, and ready to receive vapor retarder or temporary roofing.

#### 3.4 TEMPORARY ROOFING APPLICATION

- A. If concrete does not meet moisture requirements or if the weather (rain) cannot be

anticipated provide temporary roof prior to application of permanent roof.

- B. Torch-apply one layer of a roofing manufacturer approved sanded SBS modified base sheet over the entire concrete deck and turn up 6-inches at vertical edges.

### 3.4 VAPOR RETARDER APPLICATION

- A. Prime surfaces in compliance with manufacturer's written instructions and recommended rate of application.
- B. Apply vapor retarder in compliance with the manufacturer's printed instructions.
  - 1. Extend vapor retarder over entire roof deck and onto adjacent surfaces as indicated.
  - 2. Shingle lap adjacent sheets to shed water in direction of drainage, not less than 3-inches at sides and not less than 6-inches at ends.
  - 3. Completely seal vapor retarder membrane to perimeter construction and to items penetrating membrane.

### 3.5 INSULATION APPLICATION

- A. Embed each layer of insulation in adhesive in full contact, in accordance with insulation manufacturer's written instructions and recommended rate of application.
- B. Lay boards with edges in moderate contact without forcing. Cut insulation to fit neatly to perimeter blocking and around penetrations through roof.
- C. Lay subsequent layers of insulation with joints staggered minimum 6-inches from joints of preceding layer.
- D. Place tapered insulation to the required slope pattern in accordance with manufacturer's written instructions.
- E. Tape joints of insulation in accordance with insulation manufacturer's instructions.
- F. At roof drains, use factory-tapered boards to slope down to roof drains over a distance of 18 inches.
- G. Do not apply more insulation than can be covered with membrane in same day.

### 3.6 INSULATION PROTECTION BOARD APPLICATION

- A. Apply insulation protection board in adhesive in full contact, in accordance with insulation manufacturer's written instructions and recommended rate of application.
- B. Lay boards with joints staggered minimum 6-inches from joints of roof insulation.
- C. Comply with additional requirements specified for insulation application.

### 3.7 MEMBRANE APPLICATION

- A. Place and roll out membrane, free from wrinkles or tears. Place sheet into place without stretching.
- B. Shingle lap joints on sloped deck in direction of drainage to shed water.
- C. Apply adhesive to substrate at manufacturer's recommended rate. Fully embed membrane in adhesive except in areas directly over or within 3-inches of expansion

- joints. Fully adhere one roll before proceeding to adjacent rolls.
- D. Overlap edges and ends and seal seams with seam tape as required by the manufacturer to seal permanently waterproof. Apply uniform bead of sealant to seam edge.
  - E. At intersections with vertical surfaces:
    - 1. Extend membrane up a minimum of 8-inches onto vertical surfaces.
    - 2. Install Reinforced Universal Securement Strip (RUSS) at angle change per manufacturer's recommendation.
    - 3. Fully adhere membrane up vertical surface to manufacturers approved termination.
      - a. At parapets and curbs: Adhere roofing to vertical surface and carry roofing up and over parapet.
  - F. Install stack boots at roof penetrations and seal flanges to membrane.
  - G. Coordinate installation of roof drains and sumps and related flashings.
  - H. Walkway Pads:
    - 1. Install walkway pas at access points to the roof, to each roof drain, around rooftop equipment requiring maintenance, and where indicated.
      - a. If installation of walkway pads over field fabricated membrane splices or within 6-inches of a splice edge cannot be avoided, adhere another layer of flashing over the splice and extending beyond the walkway pad a minimum of 6-inches on either side.
    - 2. Clean, prime, and otherwise prepare roofing and adhere walkway pads to the roofing membrane in compliance with the manufacturer's written instructions and accepted Shop Drawings. Space each pad at minimum of 1-inch and maximum of 3-inches from each other to allow for drainage.

### 3.8 FIELD QUALITY CONTROL

- A. See Section 01 45 00 - Contractor Quality Control for general requirements for field quality control and inspection.
- B. Require site attendance of manufacturer's technical representative daily during application of the Work.

### 3.9 CLEANING

- A. Remove adhesive and bituminous markings from finished surfaces.
- B. In areas where finished surfaces are soiled by Work of this Section, consult manufacturer of surfaces for cleaning advice and conform to their documented instructions.
- C. Repair or replace defaced or damaged finishes caused by Work of this Section.
- D. Ensure roof drains are functioning correctly after completion of roofing work.

### 3.10 PROTECTION

- A. Protect roofing and flashings from damage due to construction operations with durable sheet materials.

- B. Where construction work and traffic must continue over finished roof membrane, protect surfaces using walkway pads and additional durable materials.

END OF SECTION

## SECTION 310000 – EARTHWORK

### PART 1 - GENERAL

#### 1.01 SUMMARY

- A. These standards and procedures apply to the use of excavated materials and the installation of the earthwork materials.
- B. This section includes but is not limited to the following:
  - 1. Mass excavation and disposal for building
  - 2. Excavation and backfillings for footings
  - 3. Excavation and backfilling of trench within building lines
  - 4. Excavation and backfilling for underground mechanical and electrical utilities and buried mechanical and electrical appurtenances
  - 5. Preparation of subgrade for building slabs, walls, walkways and pavements
  - 6. Structural backfill for foundation and walls
  - 7. Final grading together with placement and preparation of topsoils for lawns and plantings
- C. Related Sections:
  - 1. 015700 Temporary Erosion and Sediment Control
  - 2. 315639 Tree Protection
  - 3. 321216 Asphalt Paving
  - 4. 321217 Cement Curb and Gutter
  - 5. 329113 Soil Preparation
  - 6. 331000 Water Utilities
  - 7. 333000 Sanitary Sewer Utilities
  - 8. 334060 Storm Drainage and Containment
  - 9. 334613 Foundation Drainage
  - 10. Attached Geotechnical Report by PanGEO dated March 13, 2009 (for reference only).

#### 1.02 DEFINITIONS

- A. Not used.

#### 1.03 SUBMITTALS

- A. Make submittals in accordance with 013300.
- B. Submit for review and approval prior to placement.
  - 1. Product data for each proposed product.
  - 2. Gradation for each proposed product.
  - 3. Moisture density curves, which indicate the optimum moisture content, for each proposed product.

#### 1.04 STANDARD SPECIFICATIONS

- A. All work to be performed and materials to be used shall be in accordance with the following codes, regulations and standards:
  - 1. 2014 Standard Specifications and Standard Plans for Road, Bridge and Municipal Construction, as published by the City of Seattle (COS), unless otherwise indicated herein.
    - a. The Contractor shall have one copy of the Standard Specifications and Standard Plans at the job site.
    - b. The Standard Specifications apply only to performance and materials and how they are to be incorporated into the work. The legal/contractual relationship sections and the measurement and payment sections do not apply to this document.
  - 2. ASTM Test method D1557 modified for density of soils.

#### 1.05 QUALITY ASSURANCE

- A. Soil Testing
  - 1. The Owner will engage a Geotechnical Consultant to test soil materials proposed for use in the work and for quality control testing during excavation and fill operations.
  - 2. Samples of materials shall be furnished to the Geotechnical Consultant by the Contractor at least one week before their anticipated use.
  - 3. Under this contract, smooth out areas for density tests and otherwise facilitate testing work as directed by the Owners Geotechnical Consultant.
- B. Shoring Systems: Pre-engineered systems, clearly labeled as such, may be used.

### PART 2 - PRODUCTS

#### 2.01 STRUCTURAL FILL

- A. Structural Fill placed outside of the building footprint shall be imported, uniformly graded material, free of organics and debris, and meeting the requirements for Mineral Aggregate Type 17 (bank run gravel) per City of Seattle Standard Specification 9-03.16.

#### 2.02 NONSTRUCTURAL FILL

- A. Shall be imported well graded granular material free of organics and debris. Maximum particle size 4 inches and no more than 30 percent fines (material passing No. 200 sieve). Material shall be capable of being compacted as specified under the weather conditions prevailing at time of construction.

#### 2.03 PIPE BEDDING

- A. Pipe Bedding shall be Controlled Density Fill (CDF) per City of Seattle Standard Specification 9-01.5 where indicated on the Drawings.
- B. Rigid storm and sanitary sewer pipe (ductile iron, concrete and steel casing) shall be bed with Mineral Aggregate Type 9 per City of Seattle Standard Specification 9-03.16.
- C. Flexible pipe shall be bed with Mineral Aggregate Type 22 per City of Seattle Standard Specification 9-03.16.



- D. Ductile Iron water main shall be bed with Mineral Aggregate Type 6 or 7 per City of Seattle Standard Specification 9-03.16.

#### 2.04 BACKFILL FOR WALLS

- A. Backfill for walls shall be imported uniformly graded material free of organics and debris meeting the requirements for Mineral Aggregate Type 17 (bank run gravel) per City of Seattle Standard Specification 9-03.16.

#### 2.05 CAPILLARY BREAK

- A. Capillary break: Shall meet COS Standard Specifications Requirement requirements for Mineral Type 22.

#### 2.06 TRENCH BACKFILL

- A. Trenches not indicated to receive controlled density fill (CDF) backfill shall be backfilled with Structural Fill.

#### 2.07 BACKFILL FOR FOUNDATIONS

- A. Foundations shall be placed on native material or compacted structural fill. Backfill around the foundations shall be either CDF or Mineral Aggregate Type 17 as in COS Standard Specifications.

#### 2.08 CONTROL DENSITY FILL (CDF)

- A. Control Density Fill (CDF) shall conform with Section 2-10.2(3)A of the COS Standard Specifications.

#### 2.09 BASE COURSE

- A. Base course shall conform with the requirements for Mineral Aggregate Type 2 as specified in Section 9.03.9(3) of the COS Standard Specifications.

#### 2.10 GRAVEL BACKFILL FOR DRAINS

- A. Gravel Backfill for Drains shall be Mineral Aggregate Type 28 (3/4 inch washed gravel) per City of Seattle Standard Specification 9-03.16.

### PART 3 - EXECUTION

#### 3.01 EXCAVATION

- A. Unauthorized excavation consists of removal of materials beyond indicated subgrade elevations or dimensions without specific direction of the Owner's Representative. Unauthorized excavation, as well as remedial work directed by the Owner's Representative, shall be at no change in contract amount.
  - 1. Under footings, foundation bases, or retaining walls, fill unauthorized excavation by extending the indicated bottom elevation of the footing or base to the excavation bottom. The bottom of the excavation must be at least as wide as the sum of the depth of unauthorized excavation and the footing width.
  - 2. Elsewhere, backfill and compact unauthorized excavations with structural fill as specified herein.

- B. Because very dense glacial till exists below the site, larger than typical excavating equipment and/or the use of rippers may be necessary to loosen the very dense till. Additionally, randomly occurring cobbles and boulders are common within glacial till deposits, and the contractor shall be prepared to remove such obstructions as necessary to complete work.
- C. Overexcavation: In certain areas where soft spots occur in the subgrade, satisfactory sub-grade shall be achieved by overexcavation and replacement with structural fill material or lean mix concrete.
  - 1. Location and extent of soft spot areas to be verified by Owner's Geotechnical Consultant in the field.
- D. Stability of Excavations:
  - 1. Slope the sides of excavations to comply with local codes and ordinances having jurisdiction.
  - 2. Shore and brace where sloping is not possible because of space restrictions or stability of material excavated.
  - 3. Maintain sides and slopes of excavations in a safe condition until completion of backfilling.
- E. Shoring and Bracing: Provide shoring and bracing to comply with local codes and authorities having jurisdiction. Provide materials for shoring and bracing, such as sheet piling, uprights, stringers and cross-braces, in good serviceable condition. Maintain shoring and bracing in excavations regardless of the time period excavations will be open. Carry down shoring and bracing as the excavation progresses.
- F. Dewatering: Prevent surface water and subsurface or ground water from flowing into excavations and from flooding the project site and surrounding area.
  - 1. Do not allow water to accumulate in excavations. Remove water to prevent softening of foundation bottoms, undercutting footings and soil changes detrimental to stability of subgrades and foundations. Provide and maintain pumps, well points, sumps, suction and discharge lines and other dewatering system components necessary to convey water away from excavations.
  - 2. Establish and maintain temporary drainage ditches and other diversions outside excavation limits for each structure to convey water. Do not use trench excavations as temporary drainage ditches.
- G. Material Storage: Stockpile excavated materials as required. Place, grade, shape and cover stockpiles for proper drainage and to prevent accumulation of excess moisture.
  - 1. Locate and retain soil materials away from edge of excavations.
  - 2. Dispose of excess soil material and waste materials legally off-site.
- H. Excavation for Buildings and Retaining Walls
  - 1. Conform to elevations and dimensions shown within a tolerance of plus or minus 0.10-foot, and extending a sufficient distance from footings and foundations to permit placing and removal of concrete formwork, installation of services, other construction, and inspection.
  - 2. In excavating for footings and foundations, take care not to disturb the bottom of the excavation. Excavate by hand to final grade just before concrete reinforcement is placed. Trim bottoms to required lines and grades to leave solid base to receive concrete. Compact base to the density required and allow testing of compaction prior to constructing concrete forms.

3. Place footings on native soils, or properly compacted fill material. Where existing soft materials are encountered below footings, overexcavate as required by the Owner's Geotechnical Consultant or until dense native soil is encountered and backfill with lean concrete. The minimum lateral limits of the overexcavation and lean concrete backfill beneath footings shall be defined by a line extending downward and out from the outer edge of the footing at an angle of 1H:1V. Maintain side slopes as required by authorities having jurisdiction.
  - I. Excavation for Pavements: Cut surface under pavements to comply with cross-sections, elevations and grades as shown within a tolerance of plus or minus 0.10-foot.
  - J. Excavation for Planting Areas: Conform to cross-sections, elevations and dimensions shown, within a tolerance of plus or minus 0.10-foot.
  - K. Excavation for Trenches
    1. Excavate trenches to the depth indicated or required. Carry the depth of trenches for piping to establish the indicated flow lines and invert elevations.
    2. Where rock is encountered, carry the excavation 6 inches below the required elevation and backfill with a 6-inch layer of bedding material.
    3. Grade bottoms of trenches as indicated, notching under pipe bells to provide solid bearing for the entire body of the pipe.
  - L. Cold Weather Protection: Protect excavation bottoms against freezing when atmospheric temperature is less than 35 degrees F.
- 3.02 SUBGRADE VERIFICATION
- A. Following site preparation and excavation for the building, paved surfaces and roadways, the exposed subgrades shall be observed and approved by the Owner's Geotechnical Consultant.
  - B. Overexcavate any soft, loose or disturbed soils identified by the Geotechnical Consultant and replace with compacted structural fill.
  - C. If required by Geotechnical Consultant, provide equipment and labor for proofrolling.
- 3.03 BACKFILL AND FILL
- A. For backfill of all excavations use material sampled and tested by the Owner's Geotechnical Consultant.
  - B. All fill used for the following shall be structural fill:
    1. Fill beneath footings and foundations.
    2. Backfill against footings, foundations and structural walls, except 18 inches of gravel backfill for walls shall be placed immediately adjacent to structures for drainage, unless otherwise shown on the drawings.
    3. Backfill against site walls, except 12 inches of gravel backfill for drains shall be placed immediately adjacent to wall for drainage, unless otherwise shown on the drawings.
    4. Fill beneath building slabs.
    5. Fill within 3 feet vertically of base of pavements and extending 3 feet horizontally beyond edge of base of pavement between sloping dam and at a slope of 2H:1V.
    6. Fill in utility trenches above pipe bedding unless otherwise noted on the drawings
  - C. Fill beneath areas to be landscaped shall be nonstructural fill.

- D. Backfill excavations as promptly as work permits, but not until completion of the following:
  - 1. Acceptance by Owner's Representative of construction below finish grade including, where applicable, waterproofing, dampproofing, piping, conduits and perimeter insulation.
  - 2. Inspection, testing, approval and recording locations of underground piping and conduits. Coordinate locations with surveyor for as-built survey.
  - 3. Removal of concrete formwork.
  - 4. Removal of shoring and bracing and backfilling of voids with satisfactory materials.
  - 5. Removal of trash and debris.
  - 6. Permanent or temporary horizontal bracing is in place on horizontally supported walls.
- E. Ground Surface Preparation
  - 1. Remove vegetation, debris, unsatisfactory soil materials, obstructions and deleterious materials from ground surface prior to placement of fills. On existing sloped surfaces, steeper than 1 vertical to 4 horizontal, cut benches into hillsides of 10 feet minimum width and 5 feet maximum height.
  - 2. When existing ground surface has a density less than that specified under "Compaction" for the particular area classification, break up the ground surface, pulverize, moisture-condition to within 3 percent of the optimum moisture content, and compact to required depth and percentage of maximum density.
- F. Placement and Compaction: Allowable thickness of fill lifts will depend on the material type and compaction equipment used. In no case place backfill and fill materials in layers more than 8 inches in loose depth for material compacted by heavy compaction equipment, and more than 4 inches in loose depth for material compacted by hand-operated tampers. For fill deeper than 3 feet below the base of pavements, lifts may be 12 inches maximum in loose depth.
  - 1. Before compaction, moisten or aerate each layer as necessary to provide the optimum moisture content within 3 percent of optimum moisture content.
  - 2. Compact each layer to required percentage of maximum dry density or relative dry density for each area classification.
  - 3. Do not place backfill or fill material on surfaces muddy, frozen, or containing frost or ice.
  - 4. Place backfill and fill materials in such a manner as to prevent wedging action of backfill against structures.
  - 5. Placement of materials: The Contractor shall place materials so that they do not damage new or existing utility lines, footing drains, protections boards or insulation, or waterproofing.
  - 6. Buried utilities: The Contractor shall place a traceable marking tape above buried utilities.

### 3.04 COMPACTION

- A. General:
  - 1. Compact all fill and backfill to prevent subsequent settlement.
  - 2. No compaction will be allowed within the designated tree protection zones.
  - 3. Control soil compaction during construction providing minimum percentage of density specified for each area.
  - 4. Water settling or jetting will not be permitted as a means of compaction.
  - 5. Furnish heavy rollers or compactors except as follows:
    - a. Use pneumatic hand tampers for trenches less than 3 feet in width and areas not accessible to heavy equipment,

- b. Compact areas within 5 feet of footing, foundations and wall with hand vibrators.
- B. Percentage of Maximum Density Requirements: Compact soil to not less than the following percentages of maximum dry density determined in accordance with ASTM D 1557 ("Modified Proctor"):
  - 1. Structures: Compact top 12 inches of subgrade where exposed, and each layer of backfill or fill material to 95 percent of maximum dry density.
  - 2. Building Slabs and Steps: Compact top 12 inches of subgrade and each layer of backfill or fill material to 95 percent of maximum dry density.
  - 3. Lawn or Unpaved Areas: Compact top 12 inches of subgrade and each layer of backfill or fill material to 85 percent of maximum dry density.
  - 4. Walkways: Compact top 12 inches of subgrade and each layer of backfill or fill material to 95 percent of maximum dry density.
  - 5. Pavements: Compact top 12 inches of subgrade and each layer of backfill or fill material to 95 percent of maximum dry density.
  - 6. Utility Bedding and Backfill: Compact each layer of bedding and backfill to 95 percent of maximum dry density.
  - 7. Granular Fill Placed Against Subgrade Walls: Compact to 90 percent of maximum with small hand-operated equipment to avoid overcompaction.
  - 8. Other areas of structural fill: Compact top 12 inches of subgrade and each layer of backfill or fill to 95 percent of maximum dry density.
- C. Moisture Control: Where subgrade or layer of soil material must be moisture conditioned before compaction, uniformly apply water to surface of subgrade, or layer of soil material. Prevent free water from appearing on surface during or subsequent to compaction operations.
  - 1. Remove and replace, or scarify and air dry, soil material too wet to permit compaction to specified density.
  - 2. Soil material removed because it is too wet to permit compaction may be stockpiled or spread and allowed to dry. Assist drying by discing, harrowing or pulverizing until moisture content is reduced to a satisfactory value.

### 3.05 GRADING

- A. General: Uniformly grade areas of work including adjacent transition areas. Smooth finished surface within specified tolerances, compact with uniform levels or slopes between points where elevations are shown, or between such points and existing grades.
- B. Grading Outside Building Lines: Grade areas adjacent to building lines to drain away from structures and to prevent ponding. Finish surfaces shall be free from irregular surface changes.
- C. Compact as specified and to required elevation. Provide final grades within a tolerance of 1/2-inch when tested with a 10-foot straightedge.
- D. Compaction: After grading, compact surfaces to the depth and percentage of maximum density for each area classification.

### 3.06 EARTHWORK FOR UTILITIES

- A. Trench excavation, bedding, and backfill for storm drains, sanitary sewers, water services, hydrants, and detention facilities shall conform with applicable sections of the City of Seattle Standard Specifications.

- B. Pipe bedding for storm and sanitary sewers shall be Class B per City of Seattle Standard Plan No. 285.
- C. Pipe bedding for water mains shall be installed per City of Seattle Standard Plan 350.
- D. All trenches within the traveled portion of public right-of-way and on site, as indicated on the drawings, shall be backfilled with CDF.

### 3.07 WET WEATHER PROVISIONS

- A. Schedule earthwork operations to minimize the potential for erosion, siltation, and disturbance of site soils.
- B. Perform earthwork operations in discrete areas as required to minimize the exposure of disturbed soils to wet weather. Site soils have a high fines content and are moisture sensitive.
- C. Compact exposed soil to reduce the infiltration of rain water.
- D. Direct surface water away from fills and excavations.
- E. Provide temporary pumping equipment to keep excavations and construction free of water.
- F. Soils that become too wet for compaction shall be removed and replaced with compacted structural fill.

### 3.08 DISPOSAL OF EXCESS AND WASTE MATERIALS

- A. Transport acceptable excess excavated material to temporary stockpile areas on the Owner's property. Remove any unused excess excavated material from the site, and dispose of legally off the Owners property, prior to final inspection.
- B. Remove waste materials, including unacceptable excavated material, trash and debris, and dispose of legally off the Owner's property.

### 3.09 FIELD QUALITY CONTROL

- A. Quality Control Testing During Construction: Allow Owner's Geotechnical Consultant to observe, test and approve subgrades and fill layers before further construction work is performed.
- B. Footings for structures and retaining walls shall be observed by the Geotechnical Consultant for bearing capacity verification prior to concrete placement. Compaction tests shall be performed if in the opinion of the Geotechnical Consultant they are necessary.
- C. If subgrades or fills which have been placed are below specified density, provide corrective work as specified at no additional expense.

### 3.10 PROTECTION

- A. Protect newly graded areas from traffic and erosion. Keep free of trash and debris.
- B. Repair and reestablish grades in settled, eroded, and rutted areas to specified tolerances.
- C. Reconditioning Compacted Areas: Where completed compacted areas are disturbed by subsequent construction operations or adverse weather, scarify surface, reshape, compact to

required density and provide other corrective work as specified, with retesting, prior to further construction.

END OF SECTION

## SECTION 321216 – ASPHALT PAVING

### PART 1 - GENERAL

#### 1.01 SUMMARY

- A. The work includes constructing asphalt concrete pavement for the pedestrian paths, roadways and parking areas as indicated on the Drawings. It also includes constructing asphalt-treated base beneath the new roadways and parking areas as indicated on the Drawings.
- B. Related Sections:
  - 1. 310000 Earthwork

#### 1.02 DEFINITIONS

- A. Not used.

#### 1.03 SUBMITTALS

- A. Make submittals in accordance with section 013300
- B. Submit for review and approval prior to placement.
  - 1. Product data for each proposed product.

#### 1.04 STANDARD SPECIFICATIONS

- A. All work shall conform with the 2014 Standard Specifications and Standard Plans for Road, Bridge and Municipal Construction, as published by the City of Seattle (COS), unless otherwise indicated herein.
- B. The Contractor shall have one copy of the Standard Specifications and Standard Plans at the job site.
- C. The Standard Specifications apply only to performance and materials and how they are to be incorporated into the work. The legal/contractual relationship sections, and the measurement and payment sections do not apply to this document.

### PART 2 - PRODUCTS

#### 2.01 ASPHALT CONCRETE

- A. Asphalt Concrete shall be Hot Mix Asphalt (HMA) Class 1/2 inch per City of Seattle Standard Specification Sections 5-04, 9-02, and 9-03.8.

#### 2.02 TACK COAT

- A. Tack coat shall conform to the requirements of Section 5-04.3(4)B4a of the COS Standard Specifications.

#### 2.03 ASPHALT-TREATED BASE

- A. Asphalt-treated base shall conform to Section 4-06 of the COS Standard Specifications. Asphalt shall be PG64-22 conforming to Section 9-02.1(4) of the COS Standard Specifications.



### PART 3 - EXECUTION

#### 3.01 ASPHALT CONCRETE PAVEMENT

- A. Asphalt concrete pavement shall be constructed in conformance with Section 5-04.3 of the COS Standard Specifications, except as modified herein. Prime coat is not required and tack coat is required as specified therein.
- B. Asphalt concrete pavement more than 3 inches thick shall be placed in multiple layers. Each layer shall not exceed 3 inches in thickness, or be less than 2 inches. Asphalt concrete pavement 3 inches thick or less may be placed in one layer.

#### 3.02 ASPHALT TREATED BASE

- A. Asphalt-treated base shall be constructed in conformance with Section 4-06.3 of the COS Standard Specifications.

END OF SECTION

## SECTION 331000 – WATER UTILITIES

### PART 1 - GENERAL

#### 1.01 SUMMARY

- A. The work includes installation of waterlines, valves, and appurtenances.
- B. Related Sections:
  - 1. 115639 Tree Protection
  - 2. 310000 Earthwork

#### 1.02 DEFINITIONS

- A. Not used.

#### 1.03 SUBMITTALS

- A. Make submittals in accordance with section 013300
- B. Submit for review and approval prior to placement.
  - 1. Product data for each proposed product.

#### 1.04 STANDARD SPECIFICATIONS

- A. All work shall conform with the 2014 Standard Specifications and Standard Plans for Road, Bridge and Municipal Construction, as published by the City of Seattle (COS), unless otherwise indicated herein.
- B. The Contractor shall have one copy of the Standard Specifications and Standard Plans at the job site.
- C. The Standard Specifications apply only to performance and materials and how they are to be incorporated into the work. The legal/contractual relationship sections, and the measurement and payment sections do not apply to this document.

### PART 2 - PRODUCTS

#### 2.01 PIPE AND FITTINGS

- A. Water distribution piping shall be ductile iron pipe. Ductile iron pipe shall be thickness Class 52 conforming to AWWA C 151. Pipe shall have a cement mortar lining conforming to AWWA C 104. Pipe shall use restrained joints unless shown otherwise on the drawings.
- B. Gate valves shall conform to City of Seattle Standard Specification 9-30.3.
- C. Provide valve box and operating nut extension for each gate valve shown on the Drawings. Valve boxes shall conform to City of Seattle Standard Specification 9-30.3(5).
- D. Anchorages: Provide anchorages for tees, wyes, crosses, plugs, bends, valves, and hydrants. After installation, apply full coat of asphalt or other acceptable corrosion retarding material to surfaces of ferrous anchorages.

1. Concrete Blocking: Per Standard Plans No. 330a, 330b, 331a, 331b.
2. Joint Restraint: Per Standard Specification Section 7-11.3(6) D.

- E. Restrained joint pipe shall be push-on pipe with EBAA Iron Megalug Series 1700 Restraint Harness or approved equal.
- F. Restrained joint mechanical fittings shall be restrained with EBAA Iron Megalug Series 1100 or approved equal.

## 2.02 VALVES

- A. Resilient seated gate valves shall conform to AWWA C509 and Section 7-12.2 of the COS Standard Specifications.

## 2.03 AIR/VAC VALVES

- A. Air/Vacuum valves shall be combination air release/air vacuum valves designed to operate with potable water under pressure to permit discharging a surge of air from an empty line when filling and relieve the vacuum when draining the system. The valves shall also release an accumulation of air when the system is under pressure.
- B. This shall be accomplished in a single valve body designed to withstand 300 psi.
- C. The body and cover shall be cast iron conforming to ASTM A 48, Class 30. Floats shall be stainless steel conforming to ASTM A 240 and designed to withstand 1,000 psi.
- D. Seats shall be Buna N rubber. Internal parts shall be stainless steel or bronze.
- E. This shall be accomplished in a single valve body designed to withstand 300 psi.
- F. The body and cover shall be cast iron conforming to ASTM A 48, Class 30. Floats shall be stainless steel conforming to ASTM A 240 and designed to withstand 1,000 psi.
- G. Seats shall be Buna N rubber. Internal parts shall be stainless steel or bronze.

## 2.04 CONCRETE

- A. Unreinforced concrete shall be commercial class 3000 conforming to Section 6-02.3(2)B of the COS Standard Specifications.

## 2.05 FIRE HYDRANTS

- A. Fire hydrants shall conform with City of Seattle Standard Specification 9-30.5.

## PART 3 - EXECUTION

### 3.01 TRENCHES

- A. Trenches shall be excavated, bedded, and backfilled in conformance with Section 7-09.3 of the COS Standard Specifications.

### 3.02 PIPES AND VALVES

- A. Pipes and valves shall be installed in conformance with Section 7-09.3 and 7-12.3 of the COS Standard Specifications. Valve boxes shall be installed on all valves.

3.03 SERVICE CONNECTIONS

- A. Service connections shall be installed in conformance with Section 7-15.3 of the COS Standard Specifications.

3.04 FIRE HYDRANTS

- A. Fire hydrants shall be installed in conformance with Section 7-14.3 of the COS Standard Specifications.

3.05 TESTING AND FLUSHING

- A. Testing and flushing procedures shall be per NFPA 24.

END OF SECTION