MINNESOTA STATE

FACILITIES DESIGN STANDARDS

7th Edition

October 5, 2017

Use only the most current copy of these Design Standards.
Most current Edition including revisions can be found at the Minnesota State Facilities website.
http://www.finance.minnstate.edu/facilities/design-construction/resources.html

Facilities Design Standards
7th Edition
Revised July 2016

Section	Article	Title - Change	Rev. Date
Appendix 1	NA	Revised Window/CW Mfgr list	7/21/2016
Index	III	Change Tiltle to "Project Phase Requirements"	7/21/2016
II	4.2.2.8	Quality Assurance and Quality Control	7/21/2016
III	NA	Change Tiltle to "Project Phase Requirements"	7/21/2016
III	2.3.19.1	Design Development - Structural Drawings	7/21/2016
III	5.3.2	Construction Documents	7/21/2016
IV	2.9.1	DIV 00 - General	7/21/2016
IV	2.9.2	DIV 00 - General	7/21/2016
IV	3	DIV 01 - 01 33 00 Submittal Procedures	7/21/2016
IV	3	DIV 01 - 01 45 00 Quality Control	7/21/2016
IV	8.1	DIV 01 - 01 45 00 Quality Control	7/21/2016
IV	Table	DIV 01 - 04 42 00 Brick Precon Test - delete water permeance	7/21/2016
IV	1	DIV 01 - 07 27 00 Air Barrier	7/21/2016
IV	Table	DIV 01 - 07 27 00 Air Barrier - revise testing requirements	7/21/2016
IV	1	DIV 01 - 01 57 23 Temporary Storm Water Pollution Controls	7/21/2016
IV	1.6	DIV 04 -04 20 00 Masonry & Stone	7/21/2016
IV	1.8.5	DIV 04 -04 20 00 Masonry & Stone - revised	7/21/2016
IV	1.8.6	DIV 04 -04 20 00 Masonry & Stone	7/21/2016
IV	1.12	DIV 04 -04 20 00 Masonry & Stone	7/21/2016
IV	1.13	DIV 04 -04 20 00 Masonry & Stone	7/21/2016
IV	1.14	DIV 04 -04 20 00 Masonry & Stone	7/21/2016
IV	1.17	DIV 04 -04 20 00 Masonry & Stone	7/21/2016
IV	6	DIV 05 -05 12 23 Structural Steel Framing	7/21/2016
IV	1.12	DIV 07 - Thermal & Moisture Protection - General revised	7/21/2016
IV	2	DIV 07 - 07 27 00 Air Barrier - added	7/21/2016
IV	5.3 - 5.6	DIV 08 - 08 41 13 Aluminum Entrance Frames	7/21/2016
IV	misc.	DIV 08 - 08 80 00 Glazing	7/21/2016
IV	1.7	DIV 23 - HVAC - General	7/21/2016
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IV	10.1	DIV 23 - 23 05 93 Testing, Adjusting, & Balancing	7/21/2016
V	Table Contents	Materials & Use Specifications - 07 27 00 added	7/21/2016
V	Intro	01 57 23 Temporary Storm Water Pollution Controls	7/21/2016
V	page 12	2 57 23 Notice of Termination of permit	7/21/2016
V	new	07 27 00 Fluid Applied Membrane Air/Moisture Barrier	7/21/2016
V	1.2	08 41 13 Aluminum Framed Entrances - add & deletion	7/21/2016
V	1.4	08 41 13 Aluminum Framed Entrances - deletion	7/21/2016
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V	12	08 41 13 Aluminum Framed Entrances - deletion	7/21/2016
V	2.1	08 44 13 Aluminum Curtain Walls - revised	7/21/2016
V	3.4	08 44 13 Aluminum Curtain Walls - revised	7/21/2016
V	1.8	08 51 13 Aluminum Windows - revised	7/21/2016
V	2.4	08 51 13 Aluminum Windows - revised	7/21/2016
V	3.3	08 51 13 Aluminum Windows - deleted & renumbered	7/21/2016
V	7.3.3-7.3.4	08 51 13 Aluminum Windows - deleted & renumbered	7/21/2016
General	All	Changed MnSCU to Minnesota State	10/5/2017
Intro.	NA	Updated web link	10/5/2017
II	Misc.	Updated web links	10/5/2017
II	5.1.6	Deleted “Made in Minnesota Solar Program”	10/5/2017
III	Misc.	Updated web links	10/5/2017
III	3.5	Side lights in classrooms, labs, and offices	10/5/2017
IV	Misc.	Updated web links	10/5/2017
IV	DIV04-1.10	Revised freeze-thaw brick test frequency	10/5/2017
IV	DIV05	Updated minimum dimensions for consistency	10/5/2017
IV	DIV07	Flashings – Added stainless steel as primary option	10/5/2017
IV	DIV08	CW – Added Sunscreen requirement	10/5/2017
IV	DIV08	Reinstated tempered glass heat-soak testing requirement	10/5/2017
IV	DIV14	Clarified requirement for cab size to accommodate stretcher	10/5/2017
IV	DIV23	Added coded references	10/5/2017
IV	DIV23	Added Underground Storage Tank requirements	10/5/2017
V	015800	Revised Temp. Project Sign for branding updates	10/5/2017
V	071300	Below grade waterproofing – updated manufacturers	10/5/2017
V	085113	Windows – Corrected air leakage std. for operable windows	10/5/2017
V	085113	Windows - Misc. corrections	10/5/2017
Appendix 1	NA	Added Zero Net to Curtain Wall products Revised manufacturers on multiple Sonoborn products	10/5/2017
Appendix 1	NA	Added stainless steel through-wall flashing	10/5/2017
	NA		

FACILITIES DESIGN STANDARDS

i Preface

Minnesota State Colleges and Universities (hereinafter Minnesota State) is the fifth-largest system of higher education in the United States. It is comprised of 37 two-year and four-year state colleges and universities with 54 campuses located in 47 Minnesota communities. The System serves approximately 396,000 students and produces approximately 41,000 degrees, certificates and diplomas each year.

Facilities range from those at the older, venerable state universities to the most modern at many sites. Each institution strives to maintain their collegiate ambiance so that students know they are attending an institution of higher learning. Each institution has a unique identity that expresses its history, mission and personality. Whenever facility changes are made at a specific institution, that uniqueness should capture major landscape, historic and geographic features.

Collectively we are short term stewards of our state's long-term higher education assets. Buildings and campus infrastructure shall be designed and built to last for many years. Decisions concerning these assets must be grounded in solid, long-range planning and execution to reach 50 years or more into the future.

ii Introduction

The Facilities Design Standards are intended to be used by architects, consultants, and campus facilities personnel during the planning, design, and construction of new and remodeled buildings, and for maintenance of campus facilities and infrastructure throughout the Minnesota State colleges and universities system.

The purpose of these Facilities Design Standards is to communicate the basic minimum requirements to ensure that a project is complete, durable, easily maintained, safe, and compatible with existing and planned facilities. The information included contains procedures to be followed, materials to be used, or design standards which are deemed appropriate to assure the quality desired by Minnesota State now and into the future. Facilities personnel within the Minnesota State, as well as outside architects, consultants, and contractors should become familiar with these Design Standards.

The Facilities Design Standards are divided into five sections.

- Section I. The Mission Statement and the Design Principles.
- Section II. General Design Requirements.
- Section III. Summarizes the Design Phase Requirements where procedures and design phase submittal requirements are described for each phase from Schematic Design to Construction Administration.
- Section IV establishes Design Standards and criteria for all work in the 49 divisions of the Construction Specifications Institute (CSI) MasterFormat 2014, where applicable to a specific project.
- Section V contains sample specifications for some of the key divisions, which may applicable to a specific project. Not all divisions are included in this section.
- Section VI Appendices, includes approved manufacturer's product lists, definitions and a Design Standards Variance Request Form. In the future we hope to add examples of drawing details for building envelope design.

The design team shall be responsible for producing designs that comply with the Design Standards in addition to all applicable codes, ordinances, statutes, regulations, and laws. If there is a conflict with any requirement in the Design Standards, the applicable building codes shall take precedence. The Design Standards are not intended to be used as the specifications for a particular project, but shall form the basis for creating the specifications. The use and inclusion of the Design Standards, specifications, or example drawing details as part of the Contract Documents does not relieve the design team of their responsibilities or legal liability for any Contract Documents they create.

All design and construction shall comply with the Facilities Design Standards herein. There may be instances where the Design Standards may not be appropriate for a particular situation or project. In this situation, a design variance is required. Any design variance from the Design Standards must be submitted for review as a formal written request from the design team to the system office Program Manager. Design Standard variance request forms are available in the appendix or at http://www.minnstate.edu/system/finance/facilities/design-construction/pm_emanual/index.html, under 2. Project Phases, Schematic Design, SD.80, Design Standards Variance Request Form. Design variance requests should be made as early as possible, but no later than during the Design Development phase. To request a design variance from the Design Standards, the following information should be included:

- Date, Project, College/University, Name of Requestor and contact information.
- Applicable Design Standards reference(s).
- Nature of the variance request.
- Basis of the variance request, explaining the rationale to support the variance.
- Explain why this variance does not compromise the project's quality (including initial constructability, long term effects and operations factors).
- Evaluate implications for the longevity of the affected building components.
- Evaluate impact on the project first cost and on-going operating budgets.
- Documentation including photos, sketches, drawings, supporting data or reports.

This information will be reviewed by the system office, which will reply as to the acceptability of the request for design variance from the Design Standards.

If a design variance is approved, this information, including the rationale should be documented in all formal submissions (e.g. Schematic Design and/or Design Development Phase Submittal Report(s)) so that the variance is a matter of record for the specific project.

I. Design Philosophy

1. Mission Statement:

Design, construct and maintain state owned higher education buildings for maximum performance with the least cost to the taxpayer over the life of the building.

2. Design Principles:

2.1. Students' education is the first priority. Design buildings that are functional, which meet the College/University program requirements and that result in projects that are complete, usable, flexible, conducive to learning and incorporate appropriate technological advances.

2.2. Design to meet the goals of the campus Academic and Comprehensive Facilities Plans.

2.3. Design buildings that are compatible both visually and architecturally to existing buildings on the campus and sensitive to the community.

2.4. Design low maintenance, long-lived buildings that are structurally sound, adaptable to changes in academic programs and technologies, and which utilize materials and systems that are both durable and attractive.

2.5. Design buildings which are energy efficient and incorporate sustainable design principles.

2.6. Provide design that is within the available scope and budget established by the design consultant's contract.

END SECTION

II. General Requirements

1. Owner Provided Information

1.1. The Minnesota State system office Program Manager or the College/University Project Manager (Owner) will provide, or make available, the following Project information to the design team, as appropriate:

1.1.1. The most current issue of the Minnesota State Project Management e-Manual for Design and Construction, available at: http://www.minnstate.edu/system/finance/facilities/design-construction/pm_emanual/index.html

1.1.2. MnSCU Board of Trustees Policies and System Procedures, available at: http://www.mnscu.edu/board/policy/index.html

1.1.3. A copy of the most current General Conditions of the Contract for Construction, Minnesota State AIA Document A201 – 2007, as amended by the Owner, available at: http://www.minnstate.edu/system/finance/facilities/design-construction/pm_emanual/index.html

1.1.4. The most current edition of the Project Management e-Manual Documents, 3. Project Manual, Bid Documents, Division 00, Specifications, available at: http://www.minnstate.edu/system/finance/facilities/design-construction/pm_emanual/index.html

1.1.5. A written preliminary program and/or the approved Predesign document for the Project.

1.1.6. The Minnesota State Predesign Guidelines, available at: http://www.minnstate.edu/system/finance/facilities/planning-programming/predesign/index.html

1.1.7. A copy of the most current campus Comprehensive Facilities Plan document.

1.1.8. The Minnesota State Comprehensive Facilities Plan (Master Planning Guidelines) available at: http://www.minnstate.edu/system/finance/facilities/planning-programming/masterplanning/index.html

1.1.9. A copy of the Legislative reference for the Project funding appropriation and a restatement of the appropriation language that funds the Project.

1.1.10. The B3 Guidelines, available at: http://www.b3mn.org/guidelines/index.html .

1.1.11. Information technology and telecommuting standards as a minimum shall be the "Technology Guidelines: Building Infrastructure Best Practices for State-Owned Buildings", available at: http://mn.gov/admin/images/RECS-CS-AppendixB.pdf

1.1.12. A physical, topographical, and boundary property survey of the Project site (in consultation with the design professional).

1.1.13. Geotechnical borings and reports, with recommendations (in consultation with the design professional).

1.1.14. The name of the College/University Project Manager.

1.1.15. A copy of any hazardous material survey report(s) or abatement reports, as applicable. If no reports are available, the C/U Project Manager shall contract for a hazardous materials survey of the area(s) being considered for renovation, prior to the start of any renovation work.

1.1.16. List all known existing below-grade waterproofing products and their location for the purposes of compatibility tie-in and/or protection if it is anticipated that that these products may be affected by new construction. If appropriate, these existing waterproofing products shall be sampled and tested for asbestos. See 1.1.15 above.

1.1.17. .Other appropriate documents requested in writing by the design professional.

1.1.18. Facilities Space Planning Guidelines and Physical Security Design Guidelines can be found at: http://www.minnstate.edu/system/finance/facilities/studies/index.html

The design process is an iterative one following the general industry sequence of Schematic Design, Design Development, and Construction Document phases. There are requirements for submittals at each phase, which must be approved by the Owner before the next phase begins. Requirements of each submission are described in Section III.

2. Owner Reviews

2.1. Each phase of a project is reviewed by the Owner and the Owner's consultants as needed. Each phase of the design shall meet Minnesota State Facilities Design Standards and individual C/U requirements before the next phase begins.

2.2. Variances to the Design Standards shall be submitted in writing by the design team, then reviewed and authorized, if acceptable, in writing by the Minnesota State Facilities Program Manager prior to incorporation of the proposed variance into the documents. Design Standards Variance Requests must be made as early as possible, but no later than completion of the Design Development phase.

2.3. A schedule for reviews will be prepared and agreed to by the Architect/Engineer (A/E) and the Owner. The Owner, in consultation with the A/E, will determine the amount of review time needed for each project phase. The scheduled review times contemplate that each phase requires no more than one review, by the Owner and revision to bring the documents into conformance. Additional time for follow-up reviews will extend the review schedule.

3. Construction Contracts

3.1. Contracts and Construction Documents will typically be organized for single prime construction contract, unless separate prime contracts or other project delivery methods are proposed and approved in writing by the Owner.

3.2. Contracts are based on Minnesota State approved documents and forms.

3.2.1. The current edition of the Project Management e-Manual Documents, 3. Project Manual, Bid Documents, Division 00 Specifications (DIV00), available at: http://www.minnstate.edu/system/finance/facilities/design-construction/pm_emanual/index.html

3.2.2. The General Conditions of the Contract for Construction for all Projects shall be the Minnesota State AIA, Document A201- 2007, as amended by the Owner. Contact the Minnesota State Facilities Program Manager to confirm the latest amended document is included. Electronic copies of this document are available at: http://www.minnstate.edu/system/finance/facilities/design-construction/pm_emanual/index.html

4. Quality Assurance and Quality Control

4.1. Design Professional – Architect/Engineer

4.1.1. Purpose

4.1.1.1. The A/E shall develop a program to facilitate the preparation of accurate and complete, high quality Drawings, calculations, and related documents for the scope of the Work by establishing and implementing procedures, responsibilities and relationships for members of the Project design team.

4.1.1.2. The A/E shall produce products which are understandable, reliable, technically complete, and in compliance with regulatory constraints while adhering to the professional's standard of care.

4.1.2. Responsibilities

4.1.2.1. A/E design team members have responsibility for the accuracy and completeness of the Contract Documents prepared for any Minnesota State project and shall check all accordingly. Team members shall be responsible for items they are qualified to handle and refer to the next higher level those items which exceed their qualifications or for which higher level review is required.

4.1.2.2. All A/E tasks shall have an assigned approver who has the technical responsibility for the work assigned to their discipline.

4.1.2.3. The A/E Project Manager shall coordinate the disciplines involved prior to issuing any work packages for Owner review.

4.1.3. Project Design Team Coordination and Communication

4.1.3.1. The A/E shall prepare a Project Design Team directory for the Project, listing the names and contact data for key team members.

4.1.3.2. A/E design team coordination and communications are important to the success of the Project. Each team member is fully responsible for performing the functions associated with their assigned position. Each team member shall also follow the established communication channels and procedures, including reporting responsibilities.

4.1.3.3. The A/E design team shall determine and document regulatory requirements for each project milestone as required by authorities having jurisdiction (AHJ).

4.1.3.4. Communications within the Project design team are of utmost importance. Owner comments, AHJ requirements, changes in scope

and changes in schedule shall be quickly and accurately communicated to other members of the Project design team and documented. Regular Project design team and Owner meetings shall be conducted by the A/E Project Manager. The frequency of the A/E coordination meetings shall be appropriate to the Project requirements.

4.1.4. Sub-consultants

4.1.4.1. The A/E shall inform their sub-consultants of the conditions which relate to their assigned tasks.

4.1.4.2. A/E's sub-consultants shall provide the proper level of technical expertise for each work task.

4.1.5. Drawings

4.1.5.1. The A/E shall follow an internal quality assurance process for reviewing, approving and signing drawings in accordance with Minnesota State regulations and the Minnesota State Design Standards.

4.1.6. Project Manuals

4.1.6.1. The A/E shall prepare Project Manuals using the current Construction Specifications Institute (CSI) MasterFormat numbering system, as ***applicable to the specific Project requirements***. Refer to the most current CSI guide or manual for specification writing. The formats most commonly used are UniFormat, MasterFormat, SectionFormat, and PageFormat. UniFormat can be helpful during the preliminary project stages, while the remaining three will be consistently used for writing the Project Manual and the technical sections.

4.1.6.2. The recommended methods of specifying for Minnesota State are Descriptive or Performance Specifications. Proprietary Specifications may be used on a limited basis as long as they are open to substitution. Closed Proprietary Specifications cannot be used in the public bidding forum unless there are extenuating circumstances such as special Owner requirements or an unavoidable, unique product or system.

4.1.6.3. The A/E shall incorporate all pertinent aspects of any College/University (C/U) unique or special design specification requirements, if applicable.

4.1.6.4. The A/E design team's registered person(s) shall sign all project documents in accordance with Minnesota state regulations.

4.2. Contractor

4.2.1. General

4.2.1.1. The A/E design team, in consultation with the Owner, shall develop a Quality Assurance Plan specific to the Project's needs that addresses building code requirements for construction testing and observations. Refer to Standards Section IV., Divisions 01 40 00 and 01 45 23 for additional information.

4.2.1.2. The Contractor will be responsible for a quality control plan to assure quality during the construction process, which includes coordination and cooperation with the Owner's testing and inspection consultants, the A/E, and code officials.

4.2.1.3. Quality assurance verification work is typically contracted directly by the Owner.

4.2.2. Contractor Responsibilities

4.2.2.1. Monitor quality control over subcontractors, suppliers, manufacturers, products, services, site conditions, and workmanship to produce Work of specified quality.

4.2.2.2. Comply with manufacturers' instructions, including following each step in sequence.

4.2.2.3. Should manufacturers' instructions conflict with the Contract Documents, request clarification from the A/E, before proceeding with the Work.

4.2.2.4. Comply with specified Facilities Design Standards as minimum quality for the Work, except where more stringent tolerances, codes, or specified requirements indicate higher standards or more precise workmanship.

4.2.2.5. Perform Work by persons qualified or certified to produce the required and specified quality.

4.2.2.6. Verify that field measurements are as indicated on the approved submittals or as instructed by the manufacturer.

4.2.2.7. Secure products in place with positive anchorage devices designed and sized to withstand stresses, vibration, physical distortion, or disfigurement.

4.2.2.8. The Contractor will be responsible for supplying coordinated building enclosure shop drawings between trades of overlapping/intersecting materials.

4.2.3. Tolerances

4.2.3.1. Monitor fabrication and installation tolerance control of products to produce acceptable Work. Do not permit tolerances to accumulate.

4.2.3.2. Comply with manufacturers' tolerances. If the manufacturers' tolerances conflict with the Contract Documents, request clarification from the A/E before proceeding.

4.2.3.3. Adjust products to appropriate dimensions; position before securing products in place.

4.2.4. Building Codes and Permits

4.2.4.1. Obtain and pay for all construction permits and licenses. The Owner may assist the Contractor, when necessary, to obtain such permits and licenses.

4.2.4.2. Pay all governmental charges and inspection fees necessary for prosecution of the Work, which are applicable at the time of opening of bids. Pay all charges of utility service companies for connections to the Work.

4.2.4.3. Give all notices and comply with all laws, ordinances, building and construction codes, rules, and regulations applicable to the Work. If the Contractor observes that Specifications or Drawings are at variance therewith, give the A/E prompt written notice thereof, and any necessary changes shall be adjusted by appropriate modification.

5. Sustainable Building Guidelines

5.1. Sustainable design principles shall be incorporated into the design of facilities' projects to help ensure quality construction, reduce long-term operating costs, and reduce negative environmental impacts.

5.1.1. A/E shall follow B3 Guidelines and SB2030 Energy Standards for all new construction or major renovations projects, available at: http://www.b3mn.org/guidelines/index.html

5.1.2. Projects beginning Schematic Design after January 1, 2013 shall use Version 2.2 of the B3 Guide Lines.

5.1.3. The A/E shall be the "Guideline Leader" for tracking and submitting B3-Guideline reports at each phase of the Project.

5.1.4. Recycling Requirements: Public Entities that receive an appropriation from the state for a capital improvement project shall collect recyclable materials and transfer all recyclable materials to a recycler. (*Reference Minnesota State Statute 115A.151*)

5.1.5. Recycling of Construction and Demolition Waste is required for construction, renovation and demolition of state buildings. At least 50 percent of nonhazardous construction or demolition waste must be recycled to a construction and demolition waste recycling facility if the project is funded by bond proceeds and meets the following (*Reference Minnesota State Statute 16B327*):

5.1.5.1. Funding from bond proceeds is $5,000,000 or more.

5.1.5.2. The project is located within 40 miles of a construction and demolition waste recycling site that can handle the applicable building materials.

6. Products

6.1. Minnesota State prefers to specify three or four high quality **comparable** products. All products must be approved by the A/E and Owner prior to bidding. Do not specify "and/or", "or equal" and similar language in Part 2, Products, portion of the Project Manual Specification's Sections. During bidding period, no product substitutions will be approved for the following without the written prior approval from the Owner:

6.1.1. Masonry Through-wall Flashing (TWF)

6.1.2. Brick ties – used when penetrating (TWF or sheet air barrier membranes)

6.1.3. Mortar Toppings

6.1.4. Tile Grout – used in conjunction with Pedestrian Traffic Coating

6.1.5. Below-grade waterproofing

6.1.6. Pedestrian Traffic Coating

6.1.7. Roofing drains

6.1.8. Exterior Joint sealants

6.1.9. Exterior Joint Backer Rod

6.1.10. Aluminum entrances, windows, curtain walls

6.1.11. Door hardware (campus specific)

6.1.12. Temperature and energy management controls (campus specific)

6.1.13. Major mechanical and electrical equipment (campus specific)

6.1.14. Fire alarm systems (campus specific)

6.1.15. Security systems (campus specific)

After bidding, no substitution of products will be approved.

6.2. The A/E is responsible for incorporation of the approved products into the actual design and configuration of the Project as appropriate and must notify the owner of any discrepancies. Full compliance with the manufacturer's recommendations and material compatibility of these products, with other material components used in the building systems, shall be verified by the A/E.

6.3. Approved Products referenced in the Design Standards have demonstrated excellent, long-term performance in several applications. A list of Approved Products are provided in Appendix 1. Other products may be specified that meet the minimum performance requirements in the Design Standards.

6.3.1. It is the responsibility of the A/E to ensure specified products meet the minimum performance requirements of the Design Standards.

6.3.2. For consideration on the Approved Products list, complete a **Design Standards Revision Request Form,** available at: http://www.minnstate.edu/system/finance/facilities/design-construction/pm_emanual/index.html, under 2 Project Phases, Schematic

Design (SD), SD.85 Design Standards Revision Request Form. Submit the requested documentation to the system office.

6.3.3. Minnesota State assumes no responsibility for individual product performance or changes to the products made by the manufacturer.

7. Hazardous Materials

7.1. The A/E shall review existing conditions and discuss findings with the C/U Project Manager before beginning any design work in areas known or suspected to contain hazardous materials.

7.2. No materials that may contain asbestos, PCB's, mercury or other known hazardous materials shall be specified or used.

7.3. The C/U Project Manager may provide hazardous material surveys to the A/E for inclusion in the Project Manual/Specifications as information available to bidders, as applicable to the Project.

7.4. During construction, the C/U Project Manager shall be notified immediately if there are any areas suspected of containing asbestos or hazardous materials. Hazardous materials surveys and abatement are typically addressed by the Owner, under separate contracts with others, unless otherwise provided.

8. Site Property & Topographic Survey

8.1. If needed, the A/E shall define the scope limits and required features of the Project site property and topographic survey. The C/U Project Manager will contract with a registered surveyor and provide a completed survey to the A/E for inclusion in the Drawings.

9. Geotechnical Investigation

9.1. If needed, the A/E shall recommend the number and location of soil borings to support the structural design of the proposed Project. The C/U Project Manager will contract with a registered Geotechnical Engineering firm to perform the Geotechnical investigation, as applicable to the Project.

9.2. The entire Geotechnical report shall be included in the Project Manual as information available to bidders.

10. Utilities

10.1. The A/E shall coordinate their design with utility companies and the C/U Project Manager for connections to public or municipal water, sewer, gas, electric, and other utilities as applicable to the Project.

10.2. The A/E shall review with the Owner all existing utilities that are below the proposed building footprint and building structural loading zones. Existing utilities shall be re-routed outside the new construction structural loading zones.

10.3. The A/E shall specify that the Contractor shall pay for sewer availability charges (SAC) and all other required building utility connection charges.

10.4. The A/E shall: **1)** schedule and coordinate with the local utility companies to identify all viable utility rebate opportunities, **2)** specify equipment that meets or exceeds efficiency

standards and qualifications for utility rebate programs, **3)** specify upgraded equipment specifications that have incremental costs covered by the Project budget shall be pursued, and **4)** specify that the Contractor(s) shall be required to provide necessary documentation, including invoices, required by the utility(ies) for the purpose of processing and approving rebate applications and that the Contractor(s) shall work with the local utility company to assist the Owner in obtaining all possible utility rebates on the Project.

11. Temporary Facilities

11.1 The A/E shall consult the C/U Project Manager to determine how the Project Manual specifications shall be written for all temporary facilities, including, but not limited to: construction, electricity, heat, toilets, parking, site access, materials storage and staging, food service, facilities access and egress, and requirements for office space. The Contractor shall be responsible for all costs.

12. Estimated Construction Cost

12.1 If the A/E's estimated base bid construction cost exceeds the budgeted construction cost, the A/E shall immediately notify and consult with the Owner to bring the Project back within budget. Funds in addition to those appropriated are neither authorized nor available. Project funds cannot exceed the Capital Appropriation.

13. Bid Contingency Plan

13.1 The A/E and the Owner shall develop a bid contingency plan that includes the appropriate number of alternates tailored to the specific Project and that provides for a clear, defendable construction contract award that is in the best interests of the Owner. Deduct alternates shall be developed for Design/Bid/Build construction project delivery. Deduct Alternates shall be taken in the order listed. Add alternates shall be developed for Construction Manager at Risk (CM@r) construction project delivery.

14. Revisions to the Design Standards

14.1 Substantial updates and major revisions to the Design Standards generally occur every five years. Other updates may occur as needed as legislation, state statute, or Minnesota State policies dictate.

14.2 Revisions related to approved products, performance criteria, or process, may be considered on an annual basis by submitting the **Design Standards Revision Request Form** and the appropriate documentation. The A/E or campus facilities personnel will review each request with the Program Manager. Product manufacturers or reps may not submit requests.

END SECTION

III. Project Phase Requirements

1. Schematic Design

The A/E and the C/U Design Committee, through a series of on-site meetings, will define the Project to meet the purpose, scope and schedule defined by the Predesign, the Capital Budget Request and the legislative appropriation, as applicable to the Project.

1.1. Objectives

1.1.1. Define each building space, the required infrastructure, and its relationship to others so that the College/University's Predesign, Master Facilities Plan, and Capital Budget Request are satisfied within the budgeted construction cost.

1.1.2. Produce a written Schematic Design (SD) Phase Report and Drawings that describe all the major building systems.

1.2. Written Report Requirements

1.2.1. The Schematic Design written report shall be bound in a 3 ring binder with dated front cover and spine labels.

1.2.1.1. Insert Owner approval sheet with signature blocks for the A/E, the College/University and Minnesota State system office, to be inserted immediately following the cover sheet.

1.2.1.2. Include a Table of Contents and tabs for major sections and number all pages of the report.

1.2.1.3. Discuss responses to existing conditions. Include:

1.2.1.3.1. Response to all soils Geotechnical Report issues, including, but not limited to: excavation, backfill, expansive soils, bearing capacity, differential settlement, perched water, water table, building separation/expansion joints, and cold-weather protection.

1.2.1.3.2. Describe how the proposed site plan responds to existing and proposed vehicular traffic, pedestrians, bicycles, and circulation patterns.

1.2.1.3.3. Describe the capacity and feasibility of extending utilities and other infrastructure systems from existing campus facilities to service the proposed new construction.

1.2.1.3.4. Describe any current water infiltration, other infrastructure or structural problems related to existing conditions of the project and proposed repairs or construction solutions to address them.

1.2.1.4. Discuss architectural building program and design issues. Include:

1.2.1.4.1. Building configurations, structure, massing, and fit with existing buildings and the Facilities Master Plan.

1.2.1.4.2. A list of space requirements for the proposed Project, including function, size, and relationship to other spaces. Include space for utility systems, building mechanical, electrical and telecommunications equipment and systems, recycling containers, vending machines, custodial closets, maintenance spaces, and multi-cultural use spaces as applicable. Include a table in the SD Report that compares the Predesign and the Capital Budget Request to the proposed Schematic Design space requirements, in Gross Square Feet (GSF) for all areas.

1.2.1.4.3. Include auxiliary spaces having special mechanical, electrical and telecommunications needs, such as boiler and chiller rooms, mechanical equipment rooms, electrical distribution and telecommunications rooms, elevator equipment rooms, custodian service rooms, science labs, photo labs, copy/duplicating equipment, food service or kitchens, technology and vocational laboratories, performance venues, athletic or recreational facilities and swimming pools. Identify applicable codes and standards used as a basis for the design, as well as limitations of the proposed design that will affect the use of the spaces. Include recycling areas per B3-Guidelines.

1.2.1.4.4. Discuss Owner's operations materials delivery and shipping or receiving requirements as applicable to the Project.

1.2.1.4.5. Discuss elevators, both passenger and freight, as applicable to the Project.

1.2.1.4.6. Discuss the C/U's Furniture/Fixtures and Equipment (FF&E) requirements, both built-in and free-standing. Describe plans to complete the definition, design, procurement and installation of all FF&E.

1.2.1.5. Discuss Major Building Systems. Include:

1.2.1.5.1. Description of proposed architectural exterior elevations, walls, partitions, roofs, major structural systems, mechanical (plumbing, fire protection, HVAC and temperature controls), electrical (lighting, power, fire alarm, security, and telecommunications) systems.

1.2.1.5.2. Provide basic design parameters for mechanical and electrical systems. Include mechanical design temperature criteria for various building zones by season and power and lighting systems design criteria.

1.2.1.5.3. Provide Energy Modeling results, with comparison to ASHRAE baselines for new construction and comparison to existing buildings for renovations.

1.2.1.5.4. Report areas within the proposed construction work area that are known or suspected to contain hazardous materials (such as asbestos containing materials (ACM), lead, mold, mercury, PCB's, etc., based on review of any applicable hazardous material survey reports. With assistance from the C/U Project Manager, coordinate abatement schedule with the overall Project design and construction schedules.

1.2.1.5.5. Describe floor to floor, floor-to-ceiling and floor-to-structure clearances related to architectural, structural, mechanical, electrical, and other building system requirements. Confirm that ceiling heights and mechanical room spaces are sufficient for installation and service of equipment, corresponding piping, ductwork, and conduit.

1.2.1.6. Discuss Project Schedule and Costs. Include:

1.2.1.6.1. The Project Schedule from the start of design through bidding, construction and Owner occupancy. Include times in the Schedule for Schematic Design, Design Development, and Construction Documents Owner reviews and approvals. Project Schedule must be reflective of the C/U's Project Schedule maintained in Enterprise Project Management System (EPMS).

1.2.1.6.2. Statement of estimated construction cost broken down by the CSI Master Format, 49 divisions. Estimate must be reflective of the C/U's budget and maintained in EPMS.

1.2.1.6.3. Provide a Project schedule in bar chart form and include milestone dates. Coordinate Schedule dates with the C/U's academic schedule and project schedule maintained in the EPMS.

1.2.1.7. Include a Quality Assurance Plan for all testing, observation, and quality control needed for the Project. Use the standard chart format found in Section V., 01 14 00 – Quality Requirements, page 5.

1.2.1.8. Include written copies of the Design Standards Variance Requests for all variance requests which have been forwarded to date to the Minnesota State Program Manager. The Design Standards Variance Request Form can be found at: http://www.minnstate.edu/system/finance/facilities/design-construction/pm_emanual/index.html, the Project Management e-Manual Documents, 2. Project Phases, Schematic Design, SD.80.

1.2.1.9. Include the following in appendices:

1.2.1.9.1. List of all applicable codes and standards and the currently applicable edition dates.

1.2.1.9.2. A copy of the Geotechnical investigation(s) Report.

1.2.1.9.3. A copy of the complete Schematic Design Construction Cost Estimate. If independent cost estimator is utilized, cost estimate shall be on estimating firm's letterhead.

1.2.1.9.4. Documentation of preliminary review meetings and discussions with the state and local building code officials and the local fire marshal.

1.2.1.9.5. B3 Guidelines: Submit a fully expanded status report summary. Provide a list of the documentation uploaded and reference the applicable guideline.

1.2.1.10. Discuss project related commissioning requirements as noted in Section IV., Division 23, 11.4.

1.3. Drawing Requirements:

1.3.1. General: All plan drawings shall have north arrows and all drawings shall have a graphic scale so that when plans are reproduced, the scale can still be determined. Minimum 1/8" = 1'-0" scale of all areas, ¼" = 1"-0" for areas where clearances are critical, i.e. bathrooms, toilets, stairs and mechanical rooms.

1.3.2. Drawing Sizes

1.3.2.1. 11" x 17" format drawings shall be bound into the Schematic Design Report. Contact the C/U Project Manager and Minnesota State Program Manager for additional drawing requirements for review.

1.3.3. Title Sheet

1.3.3.1. Include the names of the A/E design team and all consulting firms involved in the Project, an Index of Drawings, preliminary code analysis, and building statistics (number of floors, GSF/floor, total GSF, roof area, and building height(s), summarized separately for remodeled and new areas).

1.3.4. Existing Site Survey

1.3.4.1. Include a copy of all Project site boundary and topographic property surveys, provided by others.

1.3.5. Site Plan

1.3.5.1. Provide site plans showing utility connections, routings, sewage systems, and storm drains. Show where existing utilities will be relocated beyond the new construction structural loading zones.

1.3.5.2. Include north arrow, construction limits, sidewalks, streets, parking lots, handicapped access, landscaped areas, contours, drainage, grading characteristics, and utilities, utility tunnels. Show relationship of new to existing.

1.3.6. Architectural Floor Plan Drawings

1.3.6.1. Identify room functions. Provide separate furniture and equipment floor Layouts Plans to scale, as applicable. Clearly illustrate access,

including handicapped and exiting. Provide preliminary demolition plans.

1.3.6.2. Space must be provided for the collection, separation, and temporary storage of recyclable materials within or adjacent to all new or significantly remodeled buildings or structures that contain 1,000 square feet or more. (See Chapter 1303.1500, Minnesota Provisions of the State Building Code for additional requirements).

1.3.7. Roof Plan Drawings

1.3.7.1. Indicate all adjacent existing and new roof areas as to type of roof construction and elevations.

1.3.8. Exterior Elevations

1.3.8.1. Illustrate exterior wall features, elements, dimensions, materials, control joints, expansion joints, and relationship to existing structures.

1.3.8.2. Show fresh air intake locations in relation to building exhaust, auto exhaust, cooling towers, loading docks and other pollutant sources. Show air intake elevations and their relation to grade.

1.3.9. Major Building Sections

1.3.9.1. Include a least one transverse and one longitudinal building cross section through the existing and proposed new building areas. Indicate finished floor and roof elevations.

1.3.10. Wall Sections and Other Details

1.3.10.1. Illustrate foundations, primary structural systems, principle exterior wall construction (including through-wall flashings), waterproofing, roof systems, vapor barriers, exterior doors and windows. Show wall details at not less than 3"=1’-0” scale. Provide 3"=1’-0” scale isometric details of all non-right angle and curved construction elements with variance request.

1.3.11. Mechanical and Electrical Drawings

1.3.11.1. Provide schematic floor plans of mechanical and electrical equipment rooms, showing adequate space for general access and for removal, repair, and maintenance.

1.3.11.2. Provide preliminary HVAC ductwork system floor plans. Include the locations of outside air supply and exhaust air in relation to each other, loading dock, engine exhaust stacks, plumbing vents, exhaust fans, and other contamination sources.

1.3.11.3. Show the locations of all major mechanical and electrical systems equipment, pumps, boilers, chillers, expansion tanks, heat exchangers, water heaters, energy recovery units, cooling towers, transformers, switchgear, generators, elevator equipment, etc. applicable to the Project.

2. Design Development

The A/E develops and refines the scheme selected during Schematic Design to define the size and character of the architectural, civil, structural, mechanical and electrical systems, selects the materials and develops the room finish schedule, and provides preliminary Specifications.

2.1. **Objectives**

2.1.1. Refine the Schematic Design documents in the context of the College/University's program, Owner's review of the Schematic Design, the Facility Design Standards, and the budgeted construction cost.

2.1.2. Communicate clearly the technical criteria, characteristics, and quality of each material, system or space identified in the Schematic Design phase.

2.1.3. List all appropriate quality control standards.

2.1.4. Produce a written Design Development (DD) Phase Report and Drawings that describe all major building materials and systems in conformance with the designer's contract.

2.2. **Written Report Requirements**

2.2.1. The Design Development written report shall include the following information:

2.2.1.1. Table of Contents

2.2.1.2. Summarize, describe and explain significant changes from the Schematic Design submittal

2.2.1.3. Provide a letter that all SD Review Comments have been addressed in the Design Development Phase Documents. Provide written explanation for any SD Review Comments not addressed in the Design Development Documents.

2.2.1.4. Include copies of all Design Standards Variance Requests which have been submitted to the Minnesota State Program Manager. The Design Development Report is the deadline to submit any variance requests for the Project.

2.2.1.5. Document discussions with state and local building code officials regarding conformance of the design with applicable codes.

2.2.1.6. Describe technical design solutions of unique spaces, for example: acoustical control, climate control, lighting control, security, power, communications and special requirements.

2.2.1.7. Provide draft Project Manual Specifications for all sections, including manufacturers and standards. Provide complete Sections for quality control, concrete, masonry, interior and exterior waterproofing, roofing, exterior windows and curtain walls. List specific installation procedures, essential for quality control.

2.2.1.8. Confirm curtain wall fabricator and provide manufacturer's certification of their authorized fabricator in accordance with Section V, 08 44 13.

2.2.1.9. Mechanical & Electrical Issues:

2.2.1.9.1 Include a copy of the Heating Plant Study and the Chilled Water Plant Study as applicable to the Project, as further described in Section IV., Divisions 23-5.1 and 23-5.3 respectively of the Design Standards.

2.2.1.9.2 Provide a separate report section containing a complete copy of all calculations performed for sizing mechanical and electrical building equipment. The report shall include all assumptions, design parameters and criteria, as well as code requirements used as a basis for performing the calculations.

2.2.1.9.3 Provide completed calculations and design data which demonstrate that code required IAQ 23-8.3 guidelines and ASHRAE design standards have been followed.

2.2.1.9.4 List the number of building occupants served by each air handling system and specify minimum outside air quantity in CFM for each supply fan connected to an outdoor intake air louver. Demonstrate the balance between exhaust air and the minimum volume of mechanically supplied fresh air.

2.2.1.9.5 Identify each instance where equipment size or design has led to limitations on equipment installation or service; and identify each instance where equipment, duct, and piping configurations have been compromised by raised ceilings, large glass areas, atriums, mezzanines, or other design conditions. Where M & E solutions require deviations from the Design Standards, the A/E shall submit a Design Standards Variance Request. Also see 2.2.1.3 for related information.

2.2.1.9.6 Verify the HVAC unit filtration sequence: pre-filter, secondary filter, heating coil, cooling coil, fans for every air handling unit. Provide reasons if altered from this sequence.

2.2.1.9.7 Describe the basic electrical power supply and distribution systems. Include voltage parameters, load assumptions, short circuit assumptions, equipment sizing assumptions and emergency/standby power equipment assumptions.

2.2.1.9.8 Describe the basic grounding system and all required connections to service entrance, building steel, UFER ground, grounding electrode or counterpoise loop. Include grounding riser diagram for clarity. Include

telecommunications grounding to meet TIA-607A and TIA-607-B.

2.2.1.9.9 Describe lighting design parameters, criteria and a list of interior and exterior light levels and lighting system types. Discuss switching and lighting systems, including the use of occupancy sensors, building management systems, photocell and time clock controls. Describe voltage parameters and emergency egress lighting assumptions using generator, lighting inverter or battery backup. Battery backup is not preferred due to maintenance cost and reliability.

2.2.1.9.10 Provide manufacturer's cut-sheets for light fixtures indicating wattage lamp type, size, and service life.

2.2.1.9.11 Describe the existing and new energy management, building management, temperature controls, fire detection and alarms and building security systems.

2.2.1.9.12 Describe provisions for service entrance, data closets, racks, backboards, grounding, cable trays and access for all telecommunications equipment. Include provisions for cabling throughout the Project areas. Clarify if telecommunication and data systems scope to be by others. Coordinate all Owner requirements with the C/U Project Manager. Reference Technology Guidelines - Building Infrastructure Best Practices for State Owned Buildings at: http://mn.gov/admin/images/space_management_techguidelines.pdf

2.2.1.9.13 Provide power distribution load calculations for all electrical distribution equipment including switchgear, switchboards, panelboards, motor control centers, etc.

2.2.1.9.14 Provide voltage drop calculations for all power circuits. Voltage drop calculations to comply with ASHRAE 90.1 energy standards. Feeder conductors shall be sized for a maximum voltage drop of 2% at design load and branch circuit conductors sized for 3% at design load.

2.2.1.9.15 Provide lighting calculations for foot candle point by point loading and overall watts per square foot for each building type and space to verify compliance with all energy efficiency codes and standards.

2.2.1.9.16 Discuss the further development of the C/U's FF& E requirements. Describe FF& E specific requirements, systems, criteria, and features.

2.2.1.9. Project Schedule:

2.2.1.9.1. Update the Project Schedule with additional data. Include Owner's DD and CD reviews, completion of CD documents, recommended bidding time, and construction. Discuss academic calendar, project funding and seasonal limitations for construction. As applicable, identify construction phases and Owner occupancies. Project Schedule must be reflective of the C/U's Project Schedule.

2.2.1.9.2. Coordinate hazardous materials abatement (by others), as applicable to the overall Project schedule.

2.2.1.10. Project Costs:

2.2.1.10.1. Provide a statement of estimated base bid construction cost broken down by CSI MasterFormat divisions and a statement of the expected cost of each deduct alternate. Also provide costs per gross square foot. Estimate must be equal to or less than the construction Cost of the Work, excluding alternates.

2.2.1.10.2. Include a preliminary list of proposed alternates.

2.2.1.10.2.1. <u>Deduct alternates shall be provided for design/bid/build construction project delivery. Deduct shall be</u> listed in order of acceptance as discussed with the College/University.

2.2.1.10.2.2. <u>Add alternates shall be provided for Construction Manager at Risk (CM@r) construction project delivery.</u>

2.2.1.11 Quality Assurance:

2.2.1.11.1 Meet with the Owner and/or the Owner's testing consultants during Design Development to work out critical details, specifications or testing requirements to be incorporated prior to final Design Development submittal.

2.2.1.11.2 Following the meeting(s) with the Owner's testing consultants, include an updated and refined Quality Assurance Plan in required chart format, with a complete description of all testing and observations procedures and level of observations for each appropriate Section. Refer to Standards Section V., Divisions 01 40 00 and 01 45 23 of these Design Standards for additional information.

2.2.1.11.3 Consider starting exterior brick pre-qualification testing during the Design Development phase of the Project. See Division 04 – Masonry of Section IV. This testing has a long lead time and will need to be completed early in the construction phase.

2.2.1.12 B3 Guidelines

2.2.1.12.1 Submit a fully expanded status report summary. Provide a list of the documentation uploaded and reference the applicable guideline. Provide preliminary Commissioning Plan.

2.2.1.13 Energy Modeling

2.2.1.14 Provide Energy Modeling results, with comparison to B3 baselines for new construction, and comparison to existing building for renovations.

2.3 Drawing Requirements

2.3.1 General Drawing Requirements

2.3.1.11 Include north arrow on all plans.

2.3.1.12 Key plans shall be on all floor plans

2.3.1.13 Font size shall be minimum 10 pt. on full size drawings.

2.3.1.14 Graphic scale must be shown on all scaled drawing.

2.3.1.15 Photos of existing conditions are encouraged

2.3.2 Title Sheet

2.3.1.1 Include an updated Index of Drawings, updated building statistics from Schematic Design, and Project Location Plan.

2.3.2 Building Summary and Code Analysis

2.3.3 Construction phasing and sequencing plan

2.3.4 Existing Site Survey

2.3.5 Site Drawings

2.3.5.1 Show new and existing: walks, streets, parking, parking striping, construction limits, and handicapped access. Show relationship of new to existing.

2.3.6 Civil Drawings

2.3.6.1 Include utilities and site demolition work.

2.3.6.2 Include site contours, drainage, utilities and utility connections, utility tunnels, rough grading and pavements.

2.3.6.3 Show the scope of the building perimeter drain tile system as applicable to the Project.

2.3.6.4 Storm Water Pollution Protection Plan (SWPPP)/ Erosion Control Plans

2.3.7 Landscape Drawings

2.3.7.1 Demolition Plan

2.3.7.2 Site Layout Plan

2.3.7.2.1 Site Layout Details

2.3.7.3 Grading Plan

2.3.7.4 Landscape Details

2.3.7.5 Planting Plan

2.3.8 Demolition Floor Drawings

2.3.9 Architectural Floor Drawings

2.3.9.1 Use minimum 1/8" = 1’-0” scale of all areas. Use minimum ¼" = 1’-0” for areas where dimensions or clearances are critical, for example: restrooms, stairs, and utility and equipment rooms.

2.3.9.2 Interior room elevation drawings.

2.3.9.3 Identify partition types, doors, windows, elevators, atriums open to below areas, chases, shafts and structural elements. Coordinate with all mechanical, HVAC, plumbing and electrical systems.

2.3.9.4 In existing buildings, identify areas of work that will require asbestos abatement to precede construction. Include a narrative in the Design Development written Report and refer to the Hazardous Material Survey(s) for further information as applicable.

2.3.10 Roof Drawings

2.3.10.1 Overall roof plan showing adjacent roofs (if applicable) and provide elevations of all roof areas, including non-construction areas.

2.3.10.2 Include critical roof details, parapets, roof to wall details, roof penetration details, mechanical curb and roof drain details at 3” = 1’-0” scale.

2.3.10.3 Indicate drainage (high and low points of roof membrane surface and slopes); identify primary roof drainage and secondary roof drainage (overflows); and show roof access, roof-mounted equipment, roof control joints, roof expansion joints, roof penetrations and roof curbs.

2.3.10.4 Show fresh air intakes and building exhaust locations.

2.3.11 Reflected Ceiling Plans Drawings

2.3.11.1 Show areas of finishes, soffits, and changes in height, light fixtures, and diffusers.

2.3.11.2 Identify all areas that do not utilize lay-in ceilings. Include access panels noted to indicate location and size for above-ceiling building systems and equipment maintenance.

2.3.12 Provide completed Room Finish Schedule.

2.3.13 Building Elevations Drawings

2.3.13.1 Show all building elevations, through-wall flashing locations (including end dams and step flashings), control and expansion joints, doors, windows and curtain-wall areas.

2.3.14 Building Sections Drawings

2.3.14.1 Show excavation sub-cut elevations, drain tile, and footing elevations.

2.3.14.2 Include major building sections.

2.3.15 Waterproofing Drawings: Provide separate drawings showing the entire scope for below grade exterior membrane waterproofing (Section V., Division 07 13 00), if applicable to the Project. Include details showing elevations, terminations, transitions, penetrations, etc.

2.3.15.1 Foundation Plan and/or Floor Plan

2.3.15.2 Elevation Plan/Sections/Details

2.3.16 Pedestrian Traffic Coating Drawings: Provide separate drawings showing the entire scope for interior pedestrian traffic coatings (Section V., Division 07 18 13), if applicable to the Project. Include details showing elevations, terminations, transitions, penetrations, etc.

2.3.16.1 Pedestrian Traffic Coating Floor Plan(s)

2.3.16.2 Pedestrian Traffic Coating Details

2.3.17 Interior and Exterior Wall Section Drawings

2.3.17.1 Include major building interior and exterior wall sections.

2.3.17.2 Show masonry ties, through-wall flashings and air barriers.

2.3.18 Detail Drawings

2.3.18.1 Show all the following details at 3" = 1'-0" scale:

2.3.18.1.1 Interior and exterior waterproofing systems and terminations. Air sealing details shall clearly delineate the air barrier at other similar openings.

2.3.18.1.2 Drain tile systems.

2.3.18.1.3 Roof details at parapet walls, mechanical curbs, and other roof penetrations. Show transition to double through-wall flashings, including parapets and steep roof slopes.

2.3.18.1.4 Control and expansion joint details.

2.3.18.1.5 Through-wall flashing details at each type of wall, opening, relief angle and roof system. Details for all typical conditions, unique conditions, and different system interfaces. Show tie-in to existing systems or different configurations and materials. Illustrate inside and outside corners, end dams, continuous rope wicks and if present, step flashings.

2.3.18.1.6 Sills, thresholds, jambs, and heads of each type of door, louver, window and curtain-wall type. The window and curtain-wall details shall illustrate the relationship to the

wall surround, thermal breaks, weeps, anchorage, vapor barriers, and thru-wall flashings.

2.3.18.1.7 Provide isometric details of all non-right angles and curved construction.

2.3.19 Structural Drawings

2.3.19.1 Structural Title Sheet

2.3.19.2 Foundation Plan Sheets

2.3.19.3 Structural Framing Plan Drawings

2.3.19.3.1 Include location and size of primary and secondary members.

2.3.19.4 Structural Roof Framing Plan Drawings

2.3.19.4.1 Include location and size of primary members and location and amount of structural slope(s).

2.3.19.5 Sections and Details

2.3.20 Mechanical Drawings

2.3.20.1 Mechanical Floor Pans

2.3.20.1.1 Include floor plans for each major system, at 1/8”= 1'-0” scale minimum, to match architectural, showing clearances for repair and maintenance in all locations. <u>All ductwork Drawings shall be drawn to dimensional scale</u>, not single line. Show thermostat control zone areas.

2.3.20.1.2 Include floor plans and sections for every mechanical equipment room or space at 1/4” = 1’-0” scale minimum, including sections through all equipment and systems.

2.3.20.2 Fire Protection Plans

2.3.20.3 Plumbing Floor Plans

2.3.20.4 Waste and Water Riser Diagrams

2.3.20.5 Mechanical Distribution –HVAC Floor Plans and Riser Diagrams

2.3.20.6 Mechanical Equipment Schedules and Details

2.3.21 Electrical Drawings

2.3.21.1 Electrical Title Sheet/Symbols/Abbreviations/Index

2.3.21.2 Electrical Site Plan

2.3.21.2.1 Include exterior lighting, power and telecommunication systems.

2.3.21.2.2 Include location of electrical service entrance, transformers and pads, vaults, manholes, and junction boxes.

2.3.21.3 Electrical Interior Plans

2.3.21.3.1 Include overall floor plans, at 1/8” = 1’-0” scale minimum to match architectural, showing power, grounding, lighting, emergency lighting, and alarm systems.

2.3.21.3.2 Electrical Lighting Floor Plans

2.3.21.3.3 Electrical Power Distribution Plans

2.3.21.3.4 Electrical Communications Plans

2.3.21.3.5 Electrical Distribution Plan and Riser Diagrams

2.3.21.3.6 Electrical Schedules including panel boards, equipment schedules and light fixture schedules

2.3.21.3.7 Electrical Installation Details for support, mounting, penetrations and seals, motor control schematics, grounding, lightning protection, etc.

2.3.22 Technology Drawings

2.3.22.1 Technology Index Sheet

2.3.22.2 Technology Floor Plans

2.3.22.3 Technology Details

3. Construction Documents

Construction Documentation: The phase of design where all elements necessary for the construction of the Project, including all graphics and written information are assembled.

3.1. Objectives:

3.1.1. Refine the Design Development documents into a coordinated package considering the review comments, these Design Standards, program and budget.

3.1.2. Produce comprehensive, unambiguous Construction Documents (CD) with complete information so that the interpretation for bid, award, and construction requirements will be the same for all bidders.

3.2. Written Report Requirements:

3.2.1. The Construction Documents written Report shall include the following information:

3.2.1.1. Statement of Probable Construction Cost

3.2.1.1.1. Provide a statement of probable base bid construction cost by CSI MasterFormat divisions. Probable base bid construction cost shall not exceed the Owner's budgeted construction cost. Include separate costs for each deduct alternate proposed.

3.2.2. State Building Code Division Plan Review

3.2.2.1. Submit a copy of the State Building Code Division plan review application that has been mailed to the Division.

3.2.3. Local Fire Marshal Review

3.2.3.1. Submit a copy of the local Fire Marshal's written approval of the fire detection and fire alarm design and that the Fire Alarm System is in adherence with codes and standards.

3.2.4. Statement of Code Compliance

3.2.4.1. Submit a letter to the Owner stating the final design conforms to all applicable building codes.

3.2.5. Statement of Changes

3.2.5.1. Submit a letter to the Owner explaining changes from the approved Design Development documents.

3.2.5.2. Provide written responses to all Design Development Review Comments. Provide written explanation for any Review Comments not incorporated in to the Construction Documents.

3.2.6. B3 Guidelines

3.2.6.1. Submit a fully expanded status report summary. Provide a list of the documentation uploaded and reference the applicable guideline.

3.2.7. Energy Modeling

3.2.7.1. Provide updated Energy Modeling results, with comparison to ASHRAE baselines for new construction, and comparison to existing building for renovations.

3.2.8. Complete Set of Construction Documents

3.2.8.1. The A/E shall prepare and provide all Drawings and Project Manual Specifications necessary to convey the exact scope of the Work and full intent of the Construction Documents.

3.2.9. Drawings and Graphical Presentations

3.2.9.1. Include the necessary schedules, notes, details, and isometric drawings so that all materials and Work are described and all components are coordinated.

3.2.9.2. Space designated for recycling must be identified on plans submitted for a building permit.

3.2.10. Project Manual

3.2.10.1. Include a final Table of Contents and a final Drawing Schedule.

3.2.10.2. Provide a complete Project Manual expanded from the Design Development submittal.

3.2.10.3. Provide Project Manual Division 0 in accordance with Minnesota State required forms and requirements.

3.2.10.4. Provide Project Manual Division 1, coordinated to the C/U's and Minnesota State requirements.

3.2.10.5. Provide technical specifications for each division and section with particular emphasis on language so that the prescribed quality of all materials, products, components, and workmanship requirements throughout the project are clear and unambiguous.

3.2.10.6. Provide the power distribution system Short Circuit Study as applicable to the Project as further described in Section IV., Division 26-3.

3.2.10.7. Discuss project related commissioning requirements as noted in Section IV; Division 23, 11. 23 08 00 - Commissioning (Cx). Coordinate commissioning specifications with Commissioning authority, as required.

4 Bidding

Bidding: The phase where the Bidding Documents are advertised to solicit bids from Contractors for the Project.

4.1 Advertising:

4.1.1 The A/E shall create the Advertisement for Bid and coordinate the posting of the ad with the C/U Project Manager. The ad will be posted on the Minnesota State QuestCDN private interface at: www.questcdn.com. Ads may also be posted on the Minnesota Department of Administration Materials Management Division web site http://www.mmd.admin.state.mn.us/solicitations.htm by the C/U Project Manager or in a local newspaper.

4.2 Distribute Documents for Bidding:

4.2.1 At the start of the bid period, the A/E shall also deliver the Bidding Documents to the Minnesota Department of Labor and Industry and/or appropriate code officials having jurisdiction for final reviews.

4.3 Pre-Bid Meeting:

4.3.1 The A/E shall attend the Pre-Bid Meeting to describe the scope of the Project and to answer questions. The A/E shall respond to questions and provide clarifications and interpretations of the Bidding Documents in the form of addenda to all prospective bidders and Bidding Document holders.

4.4 Bid Opening:

4.4.1 The A/E shall assist the C/U Project Manager at the bid opening and shall prepare a Tabulation of Bids spreadsheet within two days after the bid opening. The A/E shall include the A/E's final Estimated Cost of Construction amount and forward the Tabulation of Bids to the C/U Project Manager and the Minnesota State Program Manager.

4.4.2 The A/E shall post the bid results to QuestCDN.

4.5 Review Bids:

4.5.1 The A/E shall review the bids, check references of the apparent low bidder and provide a written recommendation of contract award to the C/U Project Manager and the Minnesota State Program Manager.

4.6 Post Bid Results:

4.6.1 **After bid award, the A/E must post the bid results on the QuestCDN site.**

5 Construction Administration

Construction Administration: The phase of the Project in which the A/E shall be a representative of and shall advise and consult with the Owner and provide administration of the Contract between the Owner and the Construction Contractor. A full list of A/E authorities, duties and responsibilities are contained in the AIA B101 or B103 documents, Agreement between the Owner and Architect, as amended by the Owner and in the AIA A201 – 1997 Edition – Electronic Format document, General

Conditions of the Contract for Construction, as amended by the Owner. The A/E shall refer to their executed Agreement for detailed information regarding their comprehensive responsibilities.

5.1 Meetings:

5.1.1 The A/E shall schedule and conduct the Pre-Construction Meeting and shall be responsible for preparing an agenda, recording discussions and distributing the meeting minutes.

5.1.2 The A/E shall schedule and conduct Construction Progress Meetings and shall be responsible for preparing an agenda, recording discussions and distributing the meeting minutes. These meetings will be held every week or every other week as determined by the Agreement. (Does not apply for Minnesota State AIA Document B103 Agreement)

5.1.3 The A/E shall schedule and conduct special Construction Administration meetings including Pre-Installation meetings on critical systems and assemblies and other meetings as deemed necessary. (Does not apply for Minnesota State AIA Document B103 Agreement)

5.2 Interpretations and Clarifications of the Contract Documents:

5.2.1 The A/E shall respond to Requests for Information (RFI's) from the Contractor for interpretations and/or clarification of the Contract Documents. If the A/E's response does not result in a change the Contract Sum or Contract Time to the Project, the A/E may respond with a written Architect's Supplemental Instructions (ASI). If a change in either the Contract Sum and/or Contract Time is required, the A/E shall prepare a Proposal Request (PR), requesting the Contractor provide a proposal to complete the change under consideration.

5.3 Evaluations of the Work:

5.3.1 The A/E shall conduct periodic on-site observations of the Project to evaluate and record progress and conformance with the Contract Documents. Perform construction observations and site visits necessary to interpret and clarify the Work for the Contractor.

5.3.2 The Owner's Consultants may conduct full-time or periodic observations of specific systems as determined during the design phase, in accordance with Section IV, 01 45 00, Quality Control. Daily field reports with photos and test results will be submitted to the Minnesota State Program Manager, C/U Project Manager and A/E as applicable.

5.4 Certify Payments to Contractor:

5.4.1 The A/E shall review and take action on the Contractor's monthly Applications for Payment within 5 business days of receipt.

5.5 Submittals Review:

5.5.1 Provide a list of submittals to be provided by the Contractor and review shop drawings, product data and samples to verify conformance with the Contract Documents and design intent.

5.6 Changes in the Work:

5.6.1 The A/E shall initiate and prepare Architect's Supplemental Instructions, Construction Change Directives, and Change Orders.

5.7 B3 Guidelines:

5.7.1 Submit all required Checklists and Support Forms required by the B3 Guidelines to include the preliminary Operations Commissioning Plan.

5.8 Substantial Completion:

5.8.1 Punch List:

5.8.1.1 The A/E shall schedule and conduct an inspection and shall prepare a comprehensive list of items to be completed or corrected by the Contractor prior to final payment.

5.8.2 Certificate of Occupancy:

5.8.2.1 The A/E shall assist the Contractor in obtaining a Certificate of Occupancy from the local officials having jurisdiction over the Project.

5.8.3 Certificate of Substantial Completion:

5.8.3.1 The A/E shall issue a Certificate(s) of Substantial Completion(s) after the Owner has received the Certificate of Occupancy and the Owner and the A/E have agreed that Substantial Completion of the Project or a portion thereof has been reached.

5.9 Final Completion

5.9.1 Final Inspection:

5.9.1.1 Upon notification by the Contractor or upon receipt of a Final Pay Application, the A/E shall schedule an inspection and verify completion of all punch list items. The A/E shall approve the final Application for Payment upon acceptance of the Work and verification of the following items:

5.9.1.2 Training:

5.9.1.2.1 The A/E shall verify with the C/U Project Manager that all required Owner's operating personnel training has been provided for the systems and equipment installed as part of the Project.

5.9.1.3 O&M Manuals

5.9.1.3.1 The A/E shall verify with the C/U Project Manager that all Operating and Maintenance (O&M) Manuals have been received as described in the Project Manual.

5.9.1.4 Warranties:

5.9.1.4.1 The A/E shall verify that all required warranties specified in the Project Manual have been submitted by the Contractor with the final Application for Payment.

5.9.1.5 IC-134's:

5.9.1.5.1 The A/E shall verify that the Contractor has submitted all required certified IC-134 forms, "Withholding Affidavit for Contractors" with the final Application for Payment.

5.9.1.6 Record Drawings:

5.9.1.6.1 The A/E shall obtain the red-lined (as-built) Record Drawings set from the Contractor and shall provide a complete set of Record Drawings to the Owner as described in the Agreement between the Owner and Architect.

5.10 10 Month Inspection

5.10.1 The A/E shall schedule and conduct a 10 month Inspection following the Substantial Completion(s) of the Project. The A/E shall inform the Contractor, the Owner, and the Owner's Representative promptly after the Inspection in writing of the results and appropriate recommendations of this review.

5.11 Post Occupancy

5.11.1 The A/E may be requested to participate in a Post Occupancy Evaluation (POE) of the Project. The Post Occupancy Evaluation will be conducted by an independent consultant 10 to 18 months following Substantial Completion. The A/E may be requested to provide information, answer a questionnaire or may be asked questions by the consultant about the Project execution, any problems or issues, what was done right and what needs to be improved, etc.

END SECTION

IV. Design Standards

Table of Contents

Division 00 - General

Section IV covers design standards for producing a sustainable, energy efficient, long-lived buildings that are structurally sound, adaptable to changes in academic programs and technologies, and which utilize materials and systems that are both durable and attractive, and are both visually and architecturally compatible to existing buildings on the campus and sensitive to the community.

1. General

    1.1. Design to produce high quality spaces reflective of sound stewardship that are sustainably designed, affordably built, efficient to operate, and that advance the institution's academic programs.

    1.2. The A&E shall inquire about the long-range plans for the facility and incorporate long-range plans into the design when practical.

    1.3. Design services shall be performed by or under the direction of a Professional Engineer licensed in the state of Minnesota. Reference MN Statute 326.02.

        1.3.1. Consider specialty consultants for Telecommunications and Security if additional expertise is necessary for the project. Telecommunications consultants should have the Registered Communications Distribution Designer (RCDD) certification from the Building Industry Consulting Service International (BICSI). Security consultants should have the Physical Security Professional (PSP) certification through the American Society of Industrial Security (ASIS).

    1.4. "Division 00" of the Project Manual shall be developed by the A/E in collaboration with the Owner. Consult with the Owner and review the finished documents for coordination and completeness.

    1.5. Project specific forms will be provided or made available by the Owner. Owner standard contract forms are available at "Contracts" on the Minnesota State web page at: http://www.minnstate.edu/system/finance/facilities/design-construction/pm_emanual/index.html

2. Exterior Design

    2.1. Buildings shall be constructed of materials rated as non-combustible. Building and site materials shall be Ultraviolet (UV) light resistant and compatible with adjacent materials.

    2.2. The exterior design shall be the result of the examination of alternatives by the A/E design team in consultation with the Owner. Alternatives shall be generated until the Owner is satisfied that the design principles have been achieved.

        2.2.1. All design alternatives proposed by the A/E team shall be in conformance with the Facilities Design Standards.

    2.3. A/E shall coordinate with the Mechanical Engineer to meet B3 energy requirements for overall whole building performance, including eliminating any unnecessary thermal bridging.

    2.4. Indentations and extensions outward in wall planes, design features containing non-right angle plans or curves are not allowed. The objective is to have the building be straightforward to construct, without complex footing designs or flashing details.

2.5. If design features with curves and non-right angle planes are proposed, a Design Standards Variance Request shall be submitted. If approved, these features shall be fully analyzed and drawn during the Design Development phase at intersections and other complex areas using isometric drawing details to resolve problems of complexity, constructability, and cost.

2.6. All canopies, screen walls, retaining walls and similar non-heated exterior features directly adjacent to the building shall be free standing structures, not connect structurally to the building.

2.7. Avoid designing and integrating sub-components from one system that will require complete removal to access another sub-component that will require maintenance, repair and/or replacement.

2.8. The exterior wall shall be designed so that moisture dissipates and subsequent moisture from weather or occupancy does not accumulate on any element of the wall system over the life of the building. For various projects, the A/E may need to prepare, analyze and submit results of hygrothermal analysis, for a five-year time period to demonstrate the drying capability and confirm no moisture build-up from season to season, of exterior wall design with a design standards variance request if:

2.8.1. The location of the insulation and/or the vapor barrier within the wall assembly does not conform to these standards.

2.8.2. Required to do so in the design team RFP or Contract.

2.8.3. Building usage is considered a high relative humidity building such as a natatorium, museum, greenhouse, archives, etc.

2.8.4. Building usage is considered an atypical interior condition such as a cold storage facility or ice arena.

2.8.5. Remodeling/renovation projects, where the wall assembly does not conform to these standards or if the proposed new usage will result in higher relative humidity.

2.9. Minnesota State Standard exterior walls are brick veneer cavity wall.

2.9.1. The back-up wall shall be concrete masonry units or cast-in-place concrete. CMU shall not be used below grade in either the back-up wall or exterior veneer.

2.9.2. Metal studs are not allowed at exterior walls of occupied spaces or where wall is clad with masonry veneer. Metal stud walls at the exterior of unoccupied spaces, not clad with masonry, shall be designed and engineered by the A/E and not delegated to the contractor. The design shall include all connections and clear indication of where anticipated differential movement will occur. Connections, control and expansion joints shall be closely coordinated with other exterior envelope components to ensure continuity of the air/vapor/moisture and thermal properties.

2.9.3. Barrier walls, mass walls and thin veneer systems, such as EIFS (exterior insulation and finish systems), insulated metal composite panel, and precast

concrete panels are not allowed at exterior walls. Stucco may be used only for exterior soffits.

2.9.4. Minimum of 2” clear and free air cavity (vertical drainage plane) behind the cladding is required. The air-cavity shall either be designed as a standard cavity wall system or a pressure equalized rain screen wall system.

2.9.5. The wall cavity shall include high thermal, moisture tolerant, continuous, and code compliant insulation that meets or exceeds the current state energy standards.

2.9.6. Wall design shall include durable and long lasting through-wall flashing and a weep/drainage system above and below all windows, above doors, louvers, shelf angles, soffits, roofs, grade, and etc. Align the brick coursing/opening so a head joint occurs on both sides of the opening immediately above the lintel. If the head joint differs to meet the above standard, the stainless drip will not be symmetrical.

2.9.7. Walls shall be designed to control vapor drive and thermal conductance.

2.9.8. A fluid applied continuous air/moisture barrier is required to protect the masonry backup wall. Reference Section V, Div. 7, 07 27 00, Fluid Applied Membrane Air/Moisture Barrier.

2.9.9. The design shall include the code required air/moisture barrier to be either vapor permeable or impermeable based on the A/E’s analysis that original construction moisture dissipates and subsequent moisture from weather or occupancy does not accumulate in any one element of the wall system.

2.9.10. The entire building air/moisture barrier shall consist of a combination of materials and systems to resist the passage of air into or out of the conditioned or semi-conditioned space. The air moisture barrier system and all transitions shall be clearly detailed and specified to ensure its durability, continuity and it compatibility when interfacing with other building components. The transition and compatibility of these systems is critical to the long term performance and low cost maintenance of Minnesota State facilities.

2.9.11. For new additions and renovations, the existing exterior walls and its existing air/moisture/vapor management system shall be field verified and thoroughly reviewed and analyzed to allow a tie-in and integration of the air/moisture/vapor management system.

2.10. Clear and complete exterior wall details must show all of the exterior wall elements.

2.11. High Parapet construction (greater than 36”) are allowed provided the lowest through-wall flashing membrane is a minimum of 8” above the highest intersecting roof edge or roof expansion/control joint. High masonry parapets shall be independently supported on a continuous relief angle with soft joint below.

2.12. No wood framing or blocking is allowed in exterior walls. Exception: roof parapets.

2.13. Refer to and comply with the current Minnesota State Exterior Masonry Design Standards for additional requirements.

http://www.minnstate.edu/system/finance/facilities/design-construction/resources.html

2.14. Low Slope, sloped to drain 4-ply Built-Up Roof (BUR) system is the Minnesota State standard roof system. Alternate designs for sloped roofs shall be reviewed with the Minnesota State System Office Program Manager.

2.15. All primary roof drains shall discharge to storm sewer systems.

2.16. If installing new equipment on the roof, such as solar panels, cooling towers, air handling units, etc., provide a sleeper curb structure with a minimum clearance of 36" from the roof membrane to bottom of structure, to allow for unobstructed drainage, roof maintenance and future roof replacement. Telecommunications antennae shall be mounted on the exterior wall and not mounted on the roof. If cable trays and telecommunication cabinets or housings are required in association with telecommunications antennae they shall be sleeper curbs if required to be mounted on the roof.

2.17. Refer to and comply with the current Minnesota State Roof Design Standards for additional requirements at:

http://www.minnstate.edu/system/finance/facilities/design-construction/resources.html

2.18. Exterior doors other than main entrances shall be insulated hollow metal doors.

3. Interior Design

3.1. Functional layout and physical relationships for spaces shall be used to prepare an efficient, economical and functional floor plan for approval by the C/U Project team.

3.2. Spaces having similar heights shall be grouped together.

3.3. Same or similar functional spaces shall be grouped horizontally and vertically by service requirements, as much as possible. For example, toilet facilities and mechanical/ electrical/telecommunications rooms shall be grouped together horizontally and vertically.

3.4. Circulation areas shall provide direct access to functional spaces without elaborate circulation patterns. Perpendicular interior corridors are desirable.

3.5. Offices, classrooms, and labs shall have a sidelight or window in door to allow visual access to the corridor and to allow visual security. Areas of refuge should be established within classrooms. These should be outside the line of sight from doorways or sidelights.

3.6. Vestibules shall be included at all entrances. A minimum of one exterior and one interior door shall be handicapped accessible with powered door operators.

3.7. Interior corridors shall typically be double-loaded. Corridors shall serve at least two or more spaces. If corridors are gypsum construction, they shall have stainless steel corner guards at all corners a minimum of four feet in height from floor.

3.8. Unless limited by existing conditions, design a minimum of 48" clearance from the top of ceilings to the lowest point of the structural system above, allowing space for ductwork systems, piping, wiring, cable trays and maintenance access.

3.9. Allow adequate spaces for waste collection, recycling storage, maintenance equipment and recycling containers adjacent to corridors. Include space for maintenance waste and/or recycled materials.

3.10. If applicable, identify building expansion areas.

3.11. Building design shall be barrier-free in accordance with Americans with Disabilities Act Accessibility Guidelines requirements. Include and identify on plans the critical clearances.

3.12. Consider the use of chair rails in rooms that have moveable seating.

3.13. Spaces for janitor closets with mop sinks shall be provided on each floor. Provide water resistant wall and floor protection around service sinks in janitor closets.

3.14. All flooring materials shall be evaluated with the C/U Project Manager.

3.15. Vertical ladders and ships ladders are prohibited for access to areas where maintenance personnel need to carry tools and/or materials.

4. Coordinate interior building design with B3 Guidelines, Section I.7 to prevent harmful acoustic conditions promote positive soundscape.

Division 01 – General Requirements

01 00 00 – General Requirements

1. Prepare Section 01 11 00, Summary of Work and other Division 1 sections required by specific Project conditions.

01 23 00 – Alternates

1. On Design-Bid-Build projects, Deduct Alternates shall be taken in the numerical order in which they are listed, starting with Deduct #1. On CM@r projects, alternates are typically additions.
2. Alternates shall address portions of the Work that are reasonably discreet and identifiable.

01 31 19 – Project Meetings

1. Specify all Project meetings required and/or anticipated. Include schedule for meetings, location, responsibilities, those expected in attendance and agenda items. The A/E, Contractor's project manager and field superintendent, and the Owner shall attend all meetings. The A/E shall conduct all meetings and prepare minutes of all meetings. For CM@r projects the CM@r will conduct the all meetings and prepare meeting minutes during construction.
2. Project meetings shall include Pre-Construction, quality control, Pre-Installation and regular progress review meetings at weekly or two-week intervals as determined by the CU Project Manager.
3. The following Pre-Installation meetings are, at the discretion of the Owner, to be scheduled the same day as regular progress review meetings:

   3.1. Quality control meeting.

   3.2. Building Envelope Pre-Installation Meeting and Mock-up.

   3.3. Excavation, backfill.

3.4. Concrete formwork, placing, and back-shoring.

3.5. Concrete topping.

3.6. Waterproofing.

3.7. Masonry mockup: Mortar, masonry, through-wall flashing, and air/vapor barrier.

3.8. Roof and roof sheet metal flashing.

3.9. Windows and curtain wall installation.

3.10. Sealants.

3.11. Cabinetry and casework.

3.12. Specialty flooring.

3.13. Systems or custom furniture.

01 33 00 – Submittal Procedures

1. Each Contractor Application for Payment shall include an updated Construction Schedule and any other special requirements.
2. The A/E shall define the requirements and procedures for all Contractor submittals. See General Conditions, AIA A201, as amended by the Owner, for additional information. Coordinate these requirements with the C/U Project Manager.
3. The Contractor will be responsible for reviewing and coordinating building enclosure shop drawings of sub-contractors providing or installing overlapping and intersecting materials/work.

   3.1 Contractor shall submit building enclosure shop drawings that include substrate information, adjacent materials, air barriers, flashings, sealants, and sequencing requirements that are coordinated between the affected trades and ready for execution in the field.

   3.2 Where exterior building enclosure elements intersect, product data and material compatibility test results shall accompany shop drawings of all affected sub-contractors.

   3.3 Contractor shall carefully review and coordinate sub-contractor shop drawings prior to submission to the A/E. Building enclosure shop drawings lacking substrates, adjoining materials or statement "by others" shall be grounds for A/E rejection.

01 35 13 – Special Project Procedures

Fully describe any special procedure or schedule. Consider and review with the C/U Project Manager such items as: special coordination of the Work with the academic calendar, College/University use of premises, special hours of the Work, coordination with other contractors such as hazardous material abatement or Owner-directed construction, Project progress reviews at weekly/bi-weekly intervals, and Pre-Installation meetings.

01 40 00 – Quality Requirements

1. Design Codes and Standards

   1.1. Design and specification of all Work shall be in accordance with the latest laws and regulations of the state of Minnesota, with applicable federal government and local codes and ordinances, with applicable design codes referenced in the Code, subject to code

amendments, and with latest adopted edition of codes and industry standards referenced herein. Following is a summary of organizations with codes and standards referenced herein:

1.1.1. Minnesota State Building Code and Energy Code

1.1.2. Minnesota Accessibility Code

1.1.3. B3 Guidelines, including Sustainable Building 2030 Energy Standards

1.1.4. Minnesota State Fire Code

1.1.5. Life Safety Code, Latest Edition, by National Fire Protection Agency

1.1.6. OSHA - Occupational Safety and Health Administration

1.1.7. ASTM – American Society for Testing and Materials

1.1.8. ANSI – American National Standards Institute

1.1.9. UL - Underwriters' Laboratories, Inc.

1.1.10. FM – Factory Mutual

1.1.11. ACI – American Concrete Institute

1.1.12. AISC – American Institute of Steel Construction

1.1.13. ASCE – American Society of Civil Engineers

1.1.14. *AAMA - American Architectural Manufacturers Association*

1.1.15. SDI – Standard Deck Institute

1.1.16. IBC – International Building Code

1.1.17. ASHRAE – American Society of Heating, Refrigerating, and Air- Conditioning Engineers, Inc.

1.1.18. MPCA – Minnesota Pollution Control Agency

1.1.19. TMS – The Masonry Society

1.1.20. MSJC – Masonry Standards Joint Committee

1.2. Recommended and recognized standards from other organizations shall be used where required to serve as guidelines for design, fabrication, and construction when not in conflict with standards referenced herein.

2. Special Inspections and Testing

2.1. Specify special inspections and testing required by the Minnesota State Building Code for which the Owner will be responsible for hiring an independent testing laboratory to perform to perform the testing and inspections during construction phase.

01 45 00 – Quality Control

1. Quality assurance testing shall be indicated in each Specification division defining the type of test and method; test frequency; test pass/fail tolerance; and action required for failed tests.

2. Provide a consolidated spreadsheet referencing all testing and observations required for the Project. Refer to Section 01 40 00 and 01 45 23 for testing and observation requirements.

3. The Contractor shall designate an experienced quality assurance/control on-site person responsible the various building enclosure components. When constructing the exterior shell, framing and back-up wall, the Contractor shall coordinate with their sub-contractors throughout its construction to ensure that critical intersecting building envelope substrates are installed in accordance with Minnesota State FDS, Construction Documents, specified tolerances and conditions acceptable to their sub-contractors and manufacturers.

4. The Contractor, notwithstanding the requirements of General Conditions, AIA A201 Subparagraph 3.10.4, shall provide a minimum of 5 working days' notice to appropriate Owner consultants before starting Work requiring observation or testing, and a minimum of 3 working days' notice thereafter for each testing and observation for the continuation of the Work items, and a reasonable date and time fixed for such observation and testing. If the Work is covered up prior to any required testing or observation, it shall be uncovered for review at the Contractor's expense.

5. The observation and testing agencies are not authorized to release, revoke, alter or enlarge requirements of the Contract Documents or approve, reject or accept any portions of the Work.

6. The Contractor shall schedule and coordinate all Pre-Construction and Construction testing and observation. Provide safe access to testing/observation areas and secure and protect samples and testing equipment. Provide all necessary scaffolding, lifts, enclosures, temporary heat, etc., required by the Owner's observation or testing agencies in order to perform their work. Make any repairs required due to testing or observation procedures. Provide and transport to the Owner's testing facility all materials to be tested for testing and observations. The Contractor is responsible for the costs of each.

7. Observation and testing services shall assist in verification of certain aspects of the Work for probable compliance with the requirements specified and indicated for the Owner. These services shall not relieve the Contractor of responsibility for compliance with the Contract Document requirements.

8. When any testing or observations indicate that the Work is in non-compliance with the Contract Documents, then all retesting and re-observations shall be performed by the Owner's testing or observation agencies, regardless whether the original test was the Contractor's responsibility. All costs for retesting and re-observations, including additional services of the A/E, A/E's consultants and the Owner's consultants, are the Contractor's responsibility and shall be deducted from the Contract amount by deductive Change Order.

   8.1 Specify that the Contractor shall maintain and update an Owner Consultant Observation Log listing outstanding items indicated by the Owner's consultant's field reports and submittal reviews. The subject log shall be reviewed and updated at each progress meeting by all key stakeholders. Only after the A/E has reviewed and accepted the corrected action for the outstanding item shall these items be indicated as complete on the subject log.

9. Specify that the testing company shall distribute copies of the tests to the A/E, the Owner, General Contractor, structural engineer, building official and the Owner's consultant (s).

10. The following schedule identifies the Owner's consultants' participation in the observation and testing process.

Consultants' Participation in Observation and Testing

	Tests Specified	Owner's Field Consultant (Observation)	Owner's Testing Lab(s) (Testing)	Owner's Testing Lab(s) (Observation)	Owner's Roof Consultant	Owner's Window Consultant (Observation & Tests)
Earthwork	X		X	X		
Soil Grouting	X		X	X		
Storm Drainage Utilities	X		X	X		
Concrete Reinforcing	X		X			
Cast-In-Place Concrete	X		X			
Masonry Mortaring	X	X	X			
Unit Masonry	X	X	X			
Structural Steel	X		X	X		
Steel Roof Deck	X		X	X		
Steel Floor Deck	X		X	X		
Metal Fabrications	X		X	X		
Sheet Waterproofing	X	X				
Traffic Coatings	X	X				
Applied Fireproofing	X		X	X		
Air/Vapor Barriers	X	X				
Built-Up Roofing	X				X	
Elastomeric Membrane Roofing	X				X	

	Tests Specified	Owner's Field Consultant (Observation)	Owner's Testing Lab(s) (Testing)	Owner's Testing Lab(s) (Observation)	Owner's Roof Consultant	Owner's Window Consultant (Observation & Tests)
Flashing and Sheet Metal	X	X			X	
Roof & Wall Specialties & Accessories	X	X			X	
Joint Protection	X	X				
Aluminum Windows	X		X			X
Glazed Aluminum Curtain Wall	X		X			X
Test/Adjust/Balance HVAC	X	X				

01 45 23 – Required Testing and Inspection Services

03 30 00 - Cast-in-Place Concrete

1. The Contractor shall submit the concrete mix designs. The mix designs shall be designed and signed by a professional engineer employed by a qualified independent laboratory; said laboratory to be other than the Owner's testing laboratory. The structural engineer shall approve concrete mix designs after consideration of the entire Pre-Construction test results.
2. Submit aggregate test reports, batch plant uniformity testing and concrete mix designs (including mix component certifications and tests and all Pre-Construction testing) to the A/E and structural engineer thirty (30) days before scheduled concrete placement.
3. Submit mix design for each type and strength of concrete. Proportion designs in accordance with Section 5.3, "Proportioning on the Basis of Field Experience or Trial Mixtures, or both," of ACI 318. Design mixes for twenty-eight (28) day average compressive strengths according to ACI 301, Table 4.2.3.3.b. No concrete shall be placed until mix designs and Pre-Construction testing have been approved by the A/E. Previous test data for mix design, aggregate testing and batch plant uniformity testing may be used if they have been performed within two (2) years with no changes to source material or production processes.
4. Concrete Testing
   - 4.1. The Owner will contract with the Owner's Independent Testing Laboratory (OITL), experienced in testing of concrete materials and mixtures, to perform materials evaluation tests on proposed aggregates (if current certification is not available), to test new proposed concrete mixes, review ingredients and performance tests of proposed mixes, and to perform tests.
   - 4.2. OITL shall test normal weight concrete aggregates for compliance with ASTM C33 and additional requirements for exterior horizontal concrete.
   - 4.3. OITL shall test lightweight aggregates for compliance with ASTM C33.
   - 4.4. Require prior to concrete placement, Pre-Construction trial batches for each mix design (batched by the Project batch plant for testing by the OITL, exclusive of any testing done by the Contractor) and other Pre-Construction testing and reviews performed and reported by the OITL. The mix designs shall be batched, tested and approved in writing by the A/E along with other Pre-Construction testing prior to site placement of concrete. Test results from the OITL shall be submitted to the A/E for approval before the first concrete placement. Concrete mixes shall be designed according to ACI 211.1. Test batches shall be made for each type and strength of concrete submitted for approval. The twenty-eight (28) day average compressive strengths shall be tested and comply with ACI 301, Table 4.2.3.3.b. For example, for specified concrete design strengths in the range of 3,000 psi to 5,000 psi, the 28-day average compressive strength of proposed mixes shall exceed the specified strength by 1,200 psi.
5. Specify observations by the Special Inspector and testing by the OITL during all structural concrete placements, as required by code.
6. Specify testing by OITL during all other concrete placements (non-structural).

03 30 00 - Cast-in-Place Concrete: Pre-Construction Testing

Description	Method of Test	Standard/Criteria (Pass/Fail)	Frequency	Action Required (If Failure Occurs)
A. Cement	ASTM C150	Review certification to document conformance. Chemical and physical requirements of ASTM C150. Test if current certificate is not available for all requirements.	One sample for each proposed cement type.	Cement not accepted
B. Aggregate	ASTM C33	Review tests to document conformance to the requirements of ASTM C33. Test if current test is not available for all requirements.	One sample for each proposed aggregate.	Aggregate not accepted.
C. Potential Reactivity	Examination of concrete with same aggregate and similar cementitious materials with similar alkali levels and ASTM C295 (petrographic), ASTM C289 and ASTM C1260	Perform examination of concrete structures and conduct all three ASTM test procedures, if current test report is not available.	One sample for each proposed aggregate.	OITL evaluate suitability of aggregate and provide recommendation as to its acceptability.

2. Admixture	ASTM C494	Review manufacturer's certification to document conformance to ASTM C494. Verify compatibility of admixtures to work together.	Manufacturer's certifications reviewed prior to start of project for each admixture.	Admixture not accepted.
3. Mix Design: A. Proportioning	ACI 201 ACI 211	Prepare a test batch for each design mix provided by the Contractor. The Project batch plant to batch design mixes. Conduct all tests. One trial batch and testing for each proposed design mix.	One trial batch for each proposed concrete mix.	Re-design mix.
B. Acceptance	ACI 301	Review proposed mix designs to verify design includes the following info: mix number, specified compressive strength (at 28 days), maximum water/cement ratio, mix proportions, size of coarse aggregate, slump (with and without high range water-reducing agent), air content, specified admixtures and 28 day average compressive strength over design.	Every mix design.	Mix design not accepted.

4. Reinforcement, Epoxy Coated Bars, Coated Tie Wire, and Chairs:	ASTM A775 ASTM A615	Review certifications to document conformance. The tensile strength of the epoxy-coated bar shall meet the requirements set forth under ASTM A615. The epoxy coat shall have a film thickness 8 to 12 mils after fully cured. There shall not be more than an average of 2 holidays per linear foot of coated bar. The plant and rebar must comply with ASTM A775 / A775M. OITL to review production plant reports for all the preceding.	Test for thickness of coating shall be made on a minimum of two bars of each size used. Bend test of coating flexibility for coating shall be conducted on at least one bar of each size used. Holiday testing of coating shall be made on at least ½ of the bar-stock (normally at the manufacturer's plant). One tension test and one bend test (for all black and coated Project rebar) shall be made of each size bar.	Bar not accepted.
5. Reinforcing Bars:	ASTM A615	60 ksi yield grade requirements of ASTM A615.	One tensile and bend test per bar size and each type to be used in Work.	Do not accept lot of bars.
6. Concrete Uniformity:	ASTM C94 Annex A-1	Review certification documents for conformance to Specifications. Check limits for variation in unit weight, air content, slump,	One per plant per 2 years or fraction thereof.	Do not accept source for concrete.

		coarse aggregate content, and compressive strength. Test if current certification is not available for all the requirements.		

03 30 00 - Cast-in Place Concrete: Construction Testing

Description	Method of Test	Standard/Criteria (Pass/Fail)	Frequency	Action Required (If Failure Occurs)
1.Sampling Fresh Concrete: A. Slump	ASTM C143	All concrete slumps shall not exceed design slump. Refer to Specifications.	Test at the point of discharge each and every truck. Test before and after HRWR added on site, if applicable.	Concrete not accepted.
B. Air Content	ASTM C173 (Volumetric) or ASTM C231 (Pressure)	Air content shall be in range of design mixes. Refer to Specifications.	One test at start of each day's pour and every 50 cy thereafter in conjunction with casting of compressive strength specimens. Air content test every truck with air-entrained concrete.	Concrete not accepted.
C. Concrete Temperature	ACI 306R-88	Refer to the minimum placement temperatures in ACI 306R, table 3.1. Placement temperatures shall not be higher than the minimums by 20° F.	Test each truck as concrete arrives when air temperature is 40° F or below and when 80° F and above.	Concrete not accepted.
D. Casting of Compressive Strength Specimens	ASTM C31	Specimens cast by a certified ACI Level I technician.	One set of four standard cylinders at start of day's pour and every 50 cy thereafter for each type of concrete for laboratory curing.	N/A
E. Unit Weight and Yield	ASTM C138	The concrete mixture shall yield a minimum of 27 cu ft. per cy.	One test at start of each day's pour for each class of concrete and every 50 cy thereafter.	Adjust mix design for proper yield.

Description	Method of Test	Standard/Criteria (Pass/Fail)	Frequency	Action Required (If Failure Occurs)
F. Compressive Strength Testing	ASTM C39	Must meet or exceed design compressive strength for each particular concrete class.	One set (1-7 day, 2-28 day and one hold) at the frequency of item D above.	Additional testing and/or concrete rejected.
G. Concrete Delivery	OITl check delivery ticket to verify correct mix placed at correct location.	Air-entrained concrete shall be discharged within 60 minutes from time of initial mixing. Non-air entrained concrete shall be discharged within 90 minutes.	Every truck.	Concrete not accepted.
2. Batch Plant Inspection:	ASTM C94	ACI Level I technician present at batch plant to verify batching tolerance is not exceeded (random basis).	Random basis. Review plant certifications once during construction.	Concrete not accepted.
3. Floor Flatness and Levelness:	ASTM E1155	Refer to Project Specifications.	All interior slabs and critical exterior flat work. Floor levelness does not apply to cambered or inclined surfaces.	A/E/Owner to determine corrections.

04 00 00 - Masonry Mortar

1. Mortar and grout mix designs and material certifications for each component (cement, lime, and aggregate) are required submittals prior to Pre-Construction testing. The mix design submittals shall be prepared and signed by a professional engineer employed by a qualified independent laboratory.
2. Mortar shall be specified by ASTM C270, Proportions except where compressive strength is required by the A/E Structural Engineer, and then mortar is specified by property.
3. If ASTM C270, Property mix is deemed necessary by the A/E Structural Engineer, then property specified mortar needs to be tested in the laboratory and not the field.
4. If pre-blended mortar is submitted, proposed batch weights with reduced mix proportions and manufacturer's compressive strength test data are required prior to Pre-Construction testing. During construction, submit batch weight records for each batch to the A/E for review and comparison to the submittals.
5. The responsible designer (A/E or structural engineer consultant) shall review the mix design submittal prior to the Pre-Construction testing. After consideration of the Pre-Construction test results, the responsible designer provides final mix design approval.
6. The 7-day Pre-Construction test results must be reviewed prior to the start of mortar production.
7. The Contractor shall coordinate and schedule with the Owner's field consultant and the Owner's testing laboratory for all field sampling.
8. The Owner's testing laboratory shall verify site-mixed mortar and grout proportions during the Pre-Construction and construction sampling.
9. The Owner's field consultant shall observe and document the Owner's testing laboratory procedures during each field sampling.
10. The Owner's testing laboratory shall submit the test results to the Owner's field consultant for review and comment.
11. The Owner's field consultant shall verify materials delivered to the site, note ambient and material temperatures, and observe workmanship.
12. The Owner's field consultant shall reject any materials delivered to the site that do not meet specifications.
    a. New construction and additions will be periodic, but schedule for specific points of construction.
    b. Restoration or repair (including reroofing projects) will be full-time observation.
13. For through-wall flashing installation, the Owner's field consultant shall document installation of:
    a. Flashing membrane lengths and laps, or if in one piece above opening.
    b. Top termination, end dams, and corners.
    c. Brick ties and rope weeps.

04 00 00 - Mortar and Grout: Pre-Construction Requirements and Tests

NOTE: Do not specify testing of materials that will not be used in the construction.

Description	Test Method	Standard/Criteria (Pass/Fail)	Frequency	Action Required (If Failure Occurs)
Mortar Mix Design				
Gradation and quality of sand	ASTM C144	Meet ASTM C144 requirements.	One sample of source material for site-mixed mortar. Review previous sand test data for each mortar type of pre-blended dry mortar mix. [1]	Do not accept sand or pre-blended dry mortar mix.
Mortar aggregate ratio	ASTM C780	Proportions per ASTM C 270. Use to prequalify the mortar mix design.	Three samples for mortar aggregate ratio for each mortar type. Contractor to mix batch in the field with sufficient water for masonry work.	If mortar aggregate ratio of site-mixed mortar is inappropriate, adjust proportioning methods and retest. If mortar aggregate ratio is inappropriate for pre-blended mortar, reject materials.

[1] Test data reports must be no older than 6 months.

Description	Method of Testing	Standard/Criteria (Pass/Fail)	Frequency	Action Required (If Failure Occurs)
Grout Design				
Gradation and quality of aggregates	ASTM C404	Meet ASTM C404 requirements.	One sample of fine and one sample of coarse aggregate source material for site-mixed grout. Review previous aggregate test data for each grout type of pre-blended or ready-mixed grout. [1]	Do not accept aggregates or pre-blended or ready-mixed grout.
Temperature, slump, and compression testing	ASTM C1019	Meet MSJC Specification for Masonry Structures, TMS 602/ACI 530.1/ASCE 6 for temperature limitations. Meet ASTM C476, strength specification, for slump limitations. Project Structural Engineer to specify compressive strength requirements.	Four samples prepared in the field with masonry pinwheels. Cardboard box sample containers are not allowed. One sample broken at 7 days and three samples broken at 28 days.	Adjust mix design and/or proportioning methods of site-mixed grout and retest at Contractor's expense. Reject pre-blended or ready-mixed grout.

[1] Test data reports must be no older than 6 months.

04 00 00 Mortar and Grout: Construction Requirements and Tests

NOTE: Do not specify testing of materials that will not be used in the construction.

Description	Method of Test	Standard/Criteria (Pass/Fail)	Frequency	Action Required (If Failure Occurs)
Mortar Mix Production				
Gradation and quality of sand	ASTM C144	Meet ASTM C144 requirements. Compare results to pre-construction test results.	One sample of source material per delivery for site-mixed mortar. For pre-blended mortar, review recent sand test data[1] or secure a sample from the manufacturer. For large projects in construction for one year or more, resubmit test data or sample every 6 months.	Review results with A/E if different from pre-construction test results.
Mortar aggregate ratio	ASTM C780	Proportions per ASTM C 270.	Daily during production per mixing site. A/E may elect to reduce frequency due to consistent results. Prior approval by Minnesota State is required to reduce frequency.	For site-mixed mortar, improve material measurement procedures in the field. For pre-blended mortar, review results with A/E.

[1] Test data reports must be no older than 6 months.

Description	Test Method	Standard/Criteria (Pass/Fail)	Frequency	Action Required (If Failure Occurs)
Grout Design				
Gradation and quality of aggregates	ASTM C404	Meet ASTM C404 requirements.	One sample of fine and one sample of coarse aggregate source material per delivery for site-mixed grout. For pre-blended or ready-mixed grout, review recent aggregate test data[1] or secure a sample from the manufacturer. For large projects in construction for one year or more, resubmit test data or sample every 6 months.	Review results with A/E if different from pre-construction test results.
Temperature, slump, and compression testing	ASTM C1019	Meet MSJC Specification for Masonry Structures, TMS 602/ACI 530.1/ASCE 6 for temperature and slump. Project Structural Engineer to specify compressive strength requirements.	One set of four samples every 5,000 sq. ft. of wall, prepared in the field with masonry pinwheels. Cardboard box sample containers are not allowed. One sample broken at 7 days and three samples broken at 28 days.	Owner's testing laboratory to interpret results, compare with pre-construction results, and discuss with Project Structural Engineer. Increase testing frequency at the Contractor's expense. Project Structural Engineer to determine further action.

04 20 00 - Unit Masonry & Stone

1. Basis of design for Minnesota State's exterior cladding is clay brick. Unit brick and exterior stone as decorative elements or in limited quantities through accepted variances, shall meet all physical requirements identified in the following tables.
2. Pre-Construction testing for this Section will be completed by the Owner's Testing Laboratory for this Project, paid for by the Owner, and approved by the A/E in writing prior to the start of masonry work on site.
3. The Contractor shall submit certifications (masonry unit and accessories) mock-up shop drawings, and all other Pre-Construction test results performed by the Owner's Testing Laboratory to the A/E for approval prior to the start of masonry work on site.
4. The Contractor shall coordinate and schedule all related trades (waterproofing, masonry, air barrier, windows, etc.) and the Owner's field consultant for construction of the mock-up. The Owner's field consultant shall observe and document the substrate preparation for each subsequent system, transitions of all systems, and installation of the air barrier, through-wall flashings, window, masonry details, and roof edge.
5. The structural masonry shall be observed and tested based on the building codes, Structural Engineer's and Owner's requirements, and the Quality Control Plan approved by the building officials. Specify the requirements (Quality Control Plan) for observations and testing. The observation agency and the test laboratory are retained by the Owner.
6. For new construction and additions, specify that periodic through-wall flashings observations, including laps, related brick ties, rope weeps, and end dams; shall be reviewed by the Owner's field consultant. For double through-wall flashing replacement in existing construction and reroofing projects, specify that all through-wall flashing work will be observed full-time during construction.
7. The Contractor is required to coordinate and schedule site visits with the Owner's field consultant, providing a minimum of 5 working days' notice prior to observation. In addition to the minimum of 5 working days' notice, the General Contractor must also contact the Owner's field observer immediately if work is cancelled due to weather or other unexpected conditions.
8. In addition to verifying materials delivered to the site, noting ambient and material temperatures during the day, and observing the work; through-wall flashing observation and documentation at an existing construction project shall include: water tight seal-off construction, through-wall flashing securement, and site securement at the end of each day
9. The Contractor is responsible to protect the through- wall flashing installation. Any through-wall flashing damage during construction and Owner's field consultant fees related to observing repair of the damage are the responsibility of the Contractor.

04 20 00 CLAY brick masonry: Pre-Construction Requirements and Tests

Description	Test Method	Standard/Criteria (Pass/Fail)	Frequency	Action Required (If Failure Occurs)
Physical Test of Unit Properties				
Compressive strength, absorption, saturation coefficient, initial rate of absorption (IRA), and efflorescence	ASTM C67	Meet ASTM C216 requirements for Grade SW, Type FBS or FBX. Check project specifications for required brick Type. If saturation coefficient is greater than 0.78, cold water absorption shall be no more than 5%. IRA shall be between 5 and 20 g/min/bedding face. Bricks shall be rated "not effloresced".	For small projects, review previous test data for each clay brick type from brick manufacturer. [1] For large projects, test one set of 10 brick for each different clay brick used.	Do not accept brick if any physical property is not met.
Freeze-thaw testing	ASTM C67	Meet requirements of ASTM C67.	Consider requiring for large significant projects with sufficient lead time. Obtain prior direction and approval by Minnesota State for conducting the test.	Do not accept brick.
Test of Assemblages				
Flexural bond strength	ASTM C1072	For Type N mortar, 75 psi on average of five joints.	Three test specimens of six bricks each for each type of mortar and clay brick masonry unit.	Adjust mortar mix design. If required values cannot be achieved by adjusting the mortar

Description	Test Method	Standard/Criteria (Pass/Fail)	Frequency	Action Required (If Failure Occurs)
		For Type S or M mortar, 100 psi on average of five joints. No individual value less than 85% of the requirement for the average value.	The Contractor shall mix mortar and construct specimens in the testing facility where the specimens will be tested, using the materials that will be used in the construction.	mix design, consider using a different brick.

[1] Test data reports must be no older than 18 months.

04 20 00 CLAY brick masonry: Construction Requirements and Tests

Description	Test Method	Standard/Criteria (Pass/Fail)	Frequency	Action Required (If Failure Occurs)
Physical Test of Unit Properties				
Absorption and saturation coefficient	ASTM C67	Meet requirements of ASTM C216, Table 1 for Grade SW. If saturation coefficient exceeds 0.78, cold water absorption shall not exceed 5%.	For large projects, test one set of 10 brick for each different brick used for every 100,000 units or each manufacturer's run; whichever is less.	Notify the A/E.
Initial rate of absorption (IRA)	Field test using eye dropper and 12 drops of water in a circle the size of a quarter.	If water is absorbed within one minute, brick must be pre-wetted before laying.	Daily during hot weather; weekly otherwise.	Prewet clay brick per MSJC Specification for Masonry Structures, TMS 602/ACI 530.1/ASCE 6.
Hot and Cold Weather Practices				
Hot weather (Ambient temperatures equal to or greater than 90F)	Observe and document methods and temperatures.	Comply with MSJC Specification for Masonry Structures, TMS 602/ACI 530.1/ASCE 6 for fog spraying at least three times a day until the masonry work is three days old.	Identify maximum temperatures daily and nightly.	Notify the A/E if work is potentially damaged or shows damage as a result of exposure. A/E and Project Structural Engineer to determine whether further testing is required and remedial action at the Contractor's expense.

Cold weather (Ambient temperature in the next 48 hours is equal to or less than 40F)	Observe and document methods and temperatures.	Provide a heated enclosure during laying of new masonry units, tuck pointing, and masonry cleaning. Comply with MSJC Specification for Masonry Structures, TMS 602/ACI 530.1/ASCE 6 for protection and preparation of materials.	Identify minimum and maximum temperatures daily and nightly.	Notify the A/E if work is potentially damaged or shows damage as a result of exposure. A/E and Project Structural Engineer to determine whether further testing is required and remedial action at the Contractor's expense.
Test of Assemblages				
Flexural bond strength	ASTM C1072	For Type N mortar, 75 psi on average of five joints. For Type S or M mortar, 100 psi on average of five joints. No individual value less than 85% of the requirement for the average value.	Three test specimens of six bricks each for each type of mortar and clay brick masonry unit, twice during the first week of masonry construction and once every 5,000 sq. ft. of wall area or floor level; whichever is greater. The Contractor shall mix mortar and construct specimens in the field, left to cure undisturbed and exposed to similar atmospheric conditions as the Work.	Adjust mortar mix design and retest at Contractor's expense.
Water permeance	ASTM C1601	Water penetration of not more than 1.0 gal/hr/12 sq. ft.	If workmanship appears to be unacceptable, test the wall section in question.	Accept or reject portion of work as compared to test panel.

			Consult with A/E and Minnesota State for approval to conduct test.	All costs and fees associated with failed tests and rework will be at Contractor's expense.

04 22 00 CMU: Pre-Construction Requirements and Tests

Description	Test Method	Standard/Criteria (Pass/Fail)	Frequency	Action Required (If Failure Occurs)
Physical Test of Unit Properties				
Compressive strength, absorption, and density	ASTM C140	Meet requirements of ASTM C90 and unit compressive strength specified by the Project Structural Engineer.	Review previous test data from supplier[1] and test one set of 6 full size CMU for each weight classification and size.	Do not accept CMU.
Test of Assemblages				
Compressive strength of prisms	ASTM C1314	Project Structural Engineer to specify compressive strength requirements of masonry (f'_m). Fabricate, store on site for 48 hours, and transport to lab per ASTM C1314.	One set of 3 prisms for each weight classification of block and type of mortar. The Contractor shall mix mortar and grout, and fabricate test prisms in the testing facility where the test will occur. Fabrication shall be in accordance with ASTM C1314 using the materials that will be used in the construction. Where actual construction is partially grouted, two sets of prisms shall be made: one grouted and the other non-grouted. Test at 28 days. For small projects, request a waiver from Minnesota State to use the unit strength method in lieu of testing.	Adjust mortar and grout mix designs, use different CMU, and/or redesign wall for lower load carrying capacity.

04 22 00 CMU: Construction Requirements and Tests

Description	Test Method	Standard/Criteria (Pass/Fail)	Frequency	Action Required (If Failure Occurs)
Physical Test of Unit Properties				
Compressive strength, absorption, and density	ASTM C140	Meet requirements of ASTM C90.	One set of 6 CMU tested for each type and size during the first week of masonry construction. Thereafter, follow with testing of 6 units from each lot of 10,000 units; 12 units from each lot between 10,000 and 100,000 units; above 100,000 units test 6 units for each 50,000 units.	Notify Project Structural Engineer.
Hot and Cold Weather Practices				
Hot weather (Ambient temperatures equal to or greater than 90F)	Observe and document methods and temperatures.	Comply with MSJC Specification for Masonry Structures, TMS 602/ACI 530.1/ASCE 6 for fog spraying at least three times a day until the masonry work is three days old.	Identify maximum temperatures daily and nightly.	Notify the A/E if work is potentially damaged or shows damage as a result of exposure. A/E and Project Structural Engineer to determine whether further testing is required and remedial action at the Contractor's expense.
Cold weather (Ambient temperature in the next 48 hours is equal	Observe and document methods and temperatures.	Provide a heated enclosure during laying of new masonry units, tuck pointing, and masonry cleaning.	Identify minimum and maximum temperatures daily and nightly.	Notify the A/E if work is potentially damaged or shows damage as a result of exposure. A/E and Project Structural Engineer to determine whether further

Description	Test Method	Standard/Criteria (Pass/Fail)	Frequency	Action Required (If Failure Occurs)
to or less than 40F)		Comply with MSJC Specification for Masonry Structures, TMS 602/ACI 530.1/ASCE 6 for protection and preparation of materials.		testing is required and remedial action at the Contractor's expense.
Test of Assemblages				
Compressive strength of prisms	ASTM C1314	Based on requirements of the project's Contract Documents. Fabricate, store on site for 48 hours, and transport in accordance with ASTM C1314.	One set of 3 prisms for each weight classification of CMU and type of mortar, for every 5,000 sq. ft. of wall. Test at 28 days. Where actual construction is partially grouted, two sets of prisms shall be made: one grouted and the other non-grouted. For small projects, request a waiver from Minnesota State to use the unit strength method in lieu of testing.	Project Structural Engineer to evaluate effect of the low strength on the constructed project and assess whether remedial action will be required.

[1] Test data reports must be no older than 18 months.

04 40 00 DIMENSION STONE (LIMESTONE, GRANITE, MARBLE, QUARTZ-BASED STONE, SERPENTINE, AND TRAVERTINE): Pre-Construction Requirements and Tests

Description	Test Method	Standard/Criteria (Pass/Fail)	Frequency	Action Required (If Failure Occurs)
Physical Test of Unit Properties				
Absorption	ASTM C97	Meet requirements of ASTM C568 for the specified classification of limestone; ASTM C615 for granite; ASTM C503 for the specified classification of marble; ASTM C616 for the specified classification of quartz-based; ASTM C1526, exterior classification, for serpentine; and ASTM C1527, exterior classification, for travertine.	Five test specimens of each dimension stone type.	Do not accept dimension stone.
Density	ASTM C97	Meet requirements of ASTM C568 for the specified classification of limestone; ASTM C615 for granite; ASTM C503 for the specified classification of marble; ASTM C616, for the specified classification of quartz-based; ASTM C1526, exterior classification, for serpentine; and ASTM C1527, exterior classification, for travertine.	Five test specimens of each dimension stone type. The same test specimens as those used for absorption may be used for density testing.	Do not accept dimension stone.
Compressive strength [1]	ASTM C170	Meet requirements of ASTM C568 for the specified classification of limestone; ASTM C615 for granite;	Twenty test specimens; five for testing wet parallel to rift; five for testing dry parallel to rift; five	Do not accept dimension stone.

Description	Test Method	Standard/Criteria (Pass/Fail)	Frequency	Action Required (If Failure Occurs)
		ASTM C503 for the specified classification of marble; ASTM C616 for the specified classification of quartz-based; ASTM C1526, exterior classification, for serpentine; and ASTM C1527, exterior classification, for travertine.	for testing wet perpendicular to rift; and five for testing dry perpendicular to rift.	
Modulus of rupture [1]	ASTM C99	Meet requirements of ASTM C568 for the specified classification of limestone; ASTM C615 for granite; ASTM C503 for the specified classification of marble; ASTM C616 for the specified classification of quartz-based; ASTM C1526, exterior classification, for serpentine; and ASTM C1527, exterior classification, for travertine.	Twenty test specimens; five for testing wet parallel to rift; five for testing dry parallel to rift; five for testing wet perpendicular to rift; and five for testing dry perpendicular to rift.	Do not accept dimension stone.
Flexural resistance [1]	ASTM C880	Meet requirements of ASTM C615 for granite; ASTM C503 for the specified classification of marble; ASTM C1526, exterior classification, for serpentine; and ASTM C1527, exterior classification, for travertine. Not required for limestone and quartz-based stone.	Five test specimens of each dimension stone type.	Do not accept dimension stone.

Description	Test Method	Standard/Criteria (Pass/Fail)	Frequency	Action Required (If Failure Occurs)
Capacity and deflection of cladding system [1]	ASTM C1201	As determined by the Project Structural Engineer.	Five full-size test specimens for each type and thickness of dimension stone and variation in anchorage; of sufficient size and extent to determine the performance of all typical components; constructed and anchored to the supporting backup structure as required by the actual construction.	Modify anchorage type and spacing. Retest.
Anchor Capacity [1]	ASTM C1354	As determined by the Project Structural Engineer. The required factor of safety applies to all aspects of the anchorage.	For each combination of stone and anchor to be evaluated, test at least five specimens. Where edge connections are used, a set of five specimens shall be tested with connections made in each of the two perpendicular edges. When the test results exhibit high variability, consult with the Project Structural Engineer to statistically determine the number of test specimens required.	Modify the anchorage type and spacing. Retest.

[1] Only required when dimension stone is used as cladding that is not bedded in mortar and is supported for gravity and lateral loads on metal anchors. Prior approval of the testing from Minnesota State is required

04 40 00 DIMENSION STONE (LIMESTONE, GRANITE, MARBLE, QUARTZ-BASED STONE, SERPENTINE, AND TRAVERTINE): Construction Requirements and Tests

Description	Test Method	Standard/Criteria (Pass/Fail)	Frequency	Action Required (If Failure Occurs)
Physical Test of Unit Properties				
Absorption [2]	ASTM C97	Meet requirements of ASTM C568 for the specified classification of limestone; ASTM C615 for granite; ASTM C503 for the specified classification of marble; ASTM C616 for the specified classification of quartz-based; ASTM C1526, exterior classification, for serpentine; and ASTM C1527, exterior classification, for travertine.	Five test specimens of each dimension stone type. Test specimens from every fifth block of stone removed from the quarry.	A/E to consider impact of absorption characteristics.
Density [2]	ASTM C97	Meet requirements of ASTM C568 for the specified classification of limestone; ASTM C615 for granite; ASTM C503 for the specified classification of marble; ASTM C616, for the specified classification of quartz-based; ASTM C1526, exterior classification, for serpentine; and ASTM C1527, exterior classification, for travertine.	Five test specimens of each dimension stone type of any regular form (same as for pre-construction testing). The same test specimens as those used for absorption may be used for density testing. Test specimens from every fifth block of stone removed from the quarry.	A/E to consider impact of density.

Description	Test Method	Standard/Criteria (Pass/Fail)	Frequency	Action Required (If Failure Occurs)
Compressive strength [2, 3]	ASTM C170	Meet requirements of ASTM C568 for the specified classification of limestone; ASTM C615 for granite; ASTM C503 for the specified classification of marble; ASTM C616 for the specified classification of quartz-based; ASTM C1526, exterior classification, for serpentine; and ASTM C1527, exterior classification, for travertine.	Twenty test specimens (same as for pre-construction testing). Test specimens from every fifth block of stone removed from the quarry.	A/E to consider impact of compressive strength.
Modulus of rupture [3]	ASTM C99	Meet requirements of ASTM C568 for the specified classification of limestone; ASTM C615 for granite; ASTM C503 for the specified classification of marble; ASTM C616 for the specified classification of quartz-based; ASTM C1526, exterior classification, for serpentine; and ASTM C1527, exterior classification, for travertine.	Twenty test specimens (same as for pre-construction testing). For large projects, test specimens from every fifth block of stone removed from the quarry.	A/E to consider impact of modulus of rupture; flexural resistance may govern.
Flexural resistance [3]	ASTM C880	Meet requirements of ASTM C615 for granite; ASTM C503 for the specified classification of marble; ASTM C1526, exterior classification, for serpentine; and ASTM C1527, exterior classification, for travertine.	Five test specimens of each dimension stone type (same as for pre-construction testing). For large projects, test specimens from every fifth block of stone removed from the quarry.	A/E to consider impact of flexural resistance.

Description	Test Method	Standard/Criteria (Pass/Fail)	Frequency	Action Required (If Failure Occurs)
		Not required for limestone and quartz-based stone.		

[2] Only required for projects that require large quantities of dimension stone. Obtain prior direction and approval by Minnesota State for conducting the test.

[3] Only required for projects that require large quantities of dimension stone that is not bedded in mortar and is supported for gravity and lateral loads on metal anchors. Obtain prior direction and approval by Minnesota State for conducting the test.

05 00 00 - Structural Framing, Metal Decking, and Metal Fabrication

1. The Owner will retain an independent testing agency or the structural engineer of record (SER) to perform the observations and testing of this Section.
2. As an alternate to fabricator certification, the Contractor may pay for full-time inspection during the fabrication of the Project steel. This inspection shall be conducted by the Owner's inspection company (at the fabrication plant). In addition, the fabrication plant shall also be acceptable and approved in writing by the structural engineer, A/E, and building official. Do not proceed with the Work until the A/E has provided final written approval.

All Metal Sections: Source and Field Testing

Description	Method of Test	Standard/Criteria (Pass/Fail)	Frequency	Action Required (If Failure Occurs)
1. Bolted Connections	Specification for Structural Joints Using ASTM A325 or A490 Bolts.	100% of friction connection bolts shall be torqued to provide the mini-mum required tension as per AISC and 100% connections inspected. Use direct tension indicator washers. Verify tension with Wilhelm-Skidmore prior to start of job. For bearing type bolted connections 100% of bearing type bolts and 100% connections visually inspected. Two bolts of each type to be tested for chemical, hardness, and tensile properties in accordance with the respective ASTM designation.	As pass/fail criteria.	Connection rejected. Retightened bolts and retest.

Description	Method of Test	Standard/Criteria (Pass/Fail)	Frequency	Action Required (If Failure Occurs)
2. Fillet Welds	AWS D1.1 Figure 5.4 and Table 6.1 (visual)	The weld shall have an acceptable weld profile, with no cracks or porosity. There shall be adequate fusion and less than acceptable amounts of undercut.	100% of all fillet welds.	Connection rejected. Repair weld and re-inspect.
3. Full and Partial Penetration Welds	AWS D1.1 – Section 6 (Ultrasonic)	Only acceptable amounts of discontinuities shall be found on the ultrasound scope.	100% of all full and partial penetration welds.	Connection rejected. Repair weld and re-inspect.
4. Decking Welds	AWS D1.3 – Section 4.5	Welds shall be visually reviewed for the locations, size, and length. Also their bond shape, reinforcement, and undercut shall be acceptable.	100% of all deck welds.	Connection rejected. Weld repaired and re-inspected.
5. Stud Shear Connectors	AWS D1.1 Section 7	Welds shall be visually acceptable with a full 360° weld. Studs shall have acceptable sounding. Conduct bend test according to AWS D1.1, Section 7 without any signs of failure.	100% of studs sounded with maul and 100% welds observed. Conduct bend test according to AWS D1.1, Section 7.	Studs that fail shall be replaced, re-inspected and re-sounded. Also, the replacement and additional studs for failed bend tests studs to be re-bent to the angles required without any signs of failure.
6. Fabrication Plant and Project Erection	IBC (Chapter 17)	Test laboratory to review if special inspection required and perform the work if required.		

07 27 00 - Air Barriers

Air/moisture barrier submittals shall be submitted and reviewed prior to Building Envelope meeting and mock-up construction. Shop drawings shall be project specific and coordinated with other trades.

1. Letters of compatibility and adhesion testing shall be completed and submitted prior to the Building Envelope meeting and mock-up construction.
2. The air/moisture barrier manufacturer's representative shall be present for the Building Envelope meeting and mock-up construction.
3. The Contractor shall coordinate and schedule the Owner's field consultant to review the substrate prior to air barrier installation on the mock-up and during construction. Subsequently, the Owner's field consultant shall observe air barrier installation, laps, transitions, and repair of penetrations on the mock-up and at several locations and heights of each exterior elevation.

07 27 00 AIR BARRIER: CONSTRUCTION TESTING

Description	Method of Test	Standard/Criteria (Pass/Fail)	Frequency	Action Required (If Failure Occurs)
1. Membrane to substrate tensile adhesion	ASTM D 4541,	As identified in manufactures specifications based on the substrate.	Two tests at the mock-up after the air barrier has cured. (Test transition membrane and air barrier membrane on mock-up. If window is present, test adhesion of the transition membrane within the window return.) If workmanship appears to be unacceptable, test the wall transitions in question. Include additional testing of mock-up if the substrate is anything other than Minnesota State standard. Consult with A/E and Minnesota State for approval to conduct test.	Determine cause of failure and repair. Accept or reject portion of work as compared to manufactures published/submitted adhesion rates based on the substrate. All costs and fees associated with failed tests and rework will be at Contractor's expense.
1. Air tightness of membrane seams and penetrations	ASTM E1186 4.2.7,	No visible leakage for non-permeable membranes.	Three tests at the mock-up after the air barrier has cured. (Test transition membrane at back-up masonry wall control joint; air barrier around embedded masonry tie; air barrier	Seal leakage area with compatible sealant and retest. If significant percentage of failures occur, review installation procedures.

			around post installed masonry tie/anchor. Periodic testing completed by wall consultant during weekly observations. If workmanship appears to be unacceptable, test the wall/penetration transitions in question. Consult with A/E and Minnesota State for approval to conduct test.	

07 80 00 - Fireproofing

The Owner's Testing Laboratory will perform minimum spray fireproof testing per the following table:

07 80 00 Sprayed-on Fireproofing: Construction Testing

Description	Method of Test	Standard/Criteria (Pass/Fail)	Frequency	Action Required (If Failure Occurs)
1. Thickness and Density of Sprayed Fire-Resistive Material	ASTM E605 IBC 1704.11 Perform both methods independently on different areas.	Required thickness and minimum individual and density values as listed in the appropriate U.L. design to meet design fire rating.	Test both methods independently.	Insufficient thickness areas shall be re-sprayed and tested. Low densities may be corrected with changes in spraying procedures, re-spray replacing and retested. Remove and replace unacceptable areas.
2. Cohesion/ Adhesion of Sprayed Fire-Resistive Materials	ASTM E736 IBC 1704.11 Perform both tests independently.	Refer to Specifications.	Not less than one test from a column, beam and deck for each 10,000 sq. ft. of floor area or fraction thereof or for each floor if floor smaller than 10,000 sq. ft.—for the minimum testing for each test method.	Remove and replace unacceptable areas.

Description	Method of Test	Standard/Criteria (Pass/Fail)	Frequency	Action Required (If Failure Occurs)
3. Asbestos Testing		Polarized light microscopy. Zero percent asbestos.	Five bag samples prior to start of work and 3 times during application. Test for asbestos content dry (before adding water to fireproofing).	Reject material.

07 90 00 - Sealants (for exterior applications): Pre-Construction Testing

Description	Method of Test	Standard/Criteria (Pass/Fail)	Frequency	Action Required (If Failure Occurs)
1. Peel Strength Testing	N/A	Each substrate type in which sealant is to be in contact shall be reviewed or tested by the manufacturer(s) prior to and during the Pre-Installation meeting. A peel test on at least one substrate shall be performed by the manufacturer(s) during the meeting. The Contractor shall supply a list of all substrates for exterior sealants.	As discussed in standard.	Written approval shall be provided by the manufacturer(s) discussing each substrate and compatibility. Primer is required for specified exterior applications. Manufacturer(s) shall to provide type and application.

070900 - Sealants: Construction Testing

Description	Method of Test	Standard (Pass/Fail)	Frequency	Action Required (If Failure Occurs)
1. Surface Preparation	N/A	A/E to review sealant substrate on-site with manufacturers' and Owner's representatives to observe that surface preparation was acceptable. Placed concrete, mortar, and grout require 28 days of field curing before sealant or primer application.	Once for each substrate type.	Complete surface preparation.
2. Application Review	N/A	Check that primers have been used. Review applications for sealant joint wetting, tooling, shoulder bond, and general cross-section configuration. Also review identifications and mixing time (typically 5 to 7 minutes).	Spot-check basis for each type of substrate.	Remove unsound sealant and adjust application.

31 00 00 - Earthwork

1. Specify the following:

    1.1. The Owner shall retain the services of an independent testing laboratory to perform on-site geotechnical observation during rough grading, stripping, excavating, filling, and backfilling operations. Do not commence or perform any of this Work without the presence of the testing laboratory. Notify the testing laboratory 5 working days in advance of commencing rough grading, stripping excavating, filling and backfilling operations. Provide a minimum of 3 working days following initial notification.

    1.2. The Owner shall retain the services of an independent testing laboratory to perform analysis of fill materials and in-place density testing. Testing procedures, frequency, and requirements for fill materials and placements shall be specified in Section 02200 of the Project Manual.

    1.3. The Owner's geotechnical testing laboratory shall advise the Contractor and the A/E of any existing conditions, materials or operations that, in their professional opinion, will not produce specified results. The testing laboratory will perform the following operations:

        1.3.1. Observe and evaluate soil conditions at the bottom of all excavations; determine limits of excavation where applicable. Evaluate excavation depth and width needed and document size of excavation based on Contractor's staking. Perform hand auger borings to sample and evaluate soils located beneath base of excavation. Classify soil as per ASTM D2488 and ASTM D2487.

        1.3.2. Qualify on-site and borrow soils for suitability to Project requirements.

    1.4. Observe, evaluate and report Contractor's operations within context of soil limitations and Project requirements.

    1.5. Choose location and conduct in-place soil density tests on fill and backfill materials.

    1.6. When applicable, determine quantities of excavation and/or fill for payment.

    1.7. Evaluate and report if actual soils bearing values meet soil-bearing values on which building design is based.

    1.8. Document a comparison between the original soil testing report and borings and that found. Also, report the oversize excavation and depth of excavation

    1.9. Perform analysis of fill materials.

31 00 00 Earthwork: Minimum Schedule of Tests

Description	Method of Test	Standard/Criteria (Pass/Fail)	Frequency	Action Required (If Failure)
1. Bottom of excavation testing and observation to verify suitability for intended use.	Hand auger boring with Soil Classification per ASTM D2487 and D2488; Soil consistency/density testing includes in-place density and core penetrometer testing.	Judgment by Geotechnical Engineer that conditions satisfy design parameters, including settlement characteristics and bearing capacity.	When all structural excavations are completed and prior to fill, backfill and concrete placement.	Additional excavation and/or surface compaction.
2. Fill and Backfill Material Testing: A. Mechanical Analysis	ASTM D422	Results within specified percentage ranges for different size particles for each fill type.	1 per 1000 tons or 550 cu. yds. (which ever produces the most tests), or fraction thereof for each soil type.	Reject fill type or retest.
B. Modified Proctor	ASTM D1557	Test required in conjunction with density test for determination of compaction levels.	1 per soil type.	N/A.
C. In-place Density Test	ASTM D1556 or D2922	Minimum specified compaction level (as compared to Modified Proctor).		Reject - additional compaction or removal/ replacement required. Then retest.

31 00 00 Earthwork: Minimum Schedule of Tests

Description	Minimum Percentage Modified Proctor	Minimum Tests/Unit Area/Lift
Natural Sub-Grade (cohesion less soils)	90%	1/500 sq. yds. and at every column pad and every 50’ under wall/strip footings and fraction thereof (both).
General Building Fill	95%	1/100 sq. yd. and fraction thereof.
Fill Under Building Foundations & Oversize	95%	1 per every 50’ under wall/strip footings and fraction thereof and every column pad.
Exterior Building Backfill(Non-Structural Areas)	90%	1/500 sq. yd. and fraction thereof.
Fill Under and Within 10' of Paved and Concrete Areas (Exterior)	95%	1/500 sq. yd. and fraction thereof.
ape Fill Areas (Non-Structural)	90%	1/1000 sq. yd. and fraction thereof.

32 12 00 Asphalt Concrete Paving: Pre-Construction Testing

(For projects greater than 1,000/sq ft.)

Description	Method of Test	Standard/Criteria (Pass/Fail)	Frequency	Action Required (If Failure Occurs)
1. Mix Design and Gradation	ASTM D1559 (Marshall Method of Mix Design) ASTM C136 and C117 (Aggregate).	Refer to Specification for requirements.	One mix design for each type of mix with aggregate gradations.	Adjust mix design (aggregate).
2. Asphalt Cement	ASTM D5 (Penetration) AASHTO T49.	Review manufacturer's product certification for acceptance. Test if current certification not available.	Review certification for each shipment.	Do not accept asphalt cement.

32 12 00 Asphalt Paving: Construction Testing

(for projects greater than 1000 sq. ft.)

Description	Method of Test	Standard/Criteria (Pass/Fail)	Frequency	Action Required (If Failure Occurs)
1. Density	ASTM: D979 (cores).	Minimum of 95% of the density of the maximum Marshall density.	One per 500 tons or fraction thereof per course, per day, minimum of 3 tests per installation per course.	ve and replace.
2. Marshall Properties	ASTM D1559.	nix design criteria.	Two tests each day of paving.	Adjust plant mixing. Reject if more than 2 consecutive failing tests.

Description	Method of Test	Standard/Criteria (Pass/Fail)	Frequency	Action Required (If Failure Occurs)
3.Extraction /Gradation	D2172 C136 &	Meet asphalt cement content and aggregate gradation criteria as established by mix design.	Two tests each day of paving. Secured with sample for Marshall.	as above.
4. Thickness (During paving only)	N/A	Use ruler or other device to spot-check compacted thickness during paving.	Once per 100 lineal feet of paving.	Adjust paver screen height.
perature	N/A	Temperature to range at delivery as specified.	Once per 200 sq. ft. per day.	Adjust temperature at batch plant.

33 40 00 Storm Drainage Utilities: Field Testing and Observations

Description	Method of Test	Standard/Criteria (Pass/Fail)	Frequency	Action Required (If Failure Occurs)
ss-Section	N/A	Review that the drain tile cross-section system was installed in accordance with Project documents.		Notify A/E and Contractor.
ation	N/A	Verify drain tile elevation.		Notify A/E and Contractor.
ormance Test	N/A	Test with water flow or check the drain tile lines before backfilling to assure free flow.		Notify A/E and Contractor.
regate	ASTM as specified.	All aggregate to meet gradation requirements.		Change material & retest.

Division 01:

01 50 00 – Temporary Facilities and Controls

1. Define responsibilities and describe each relevant area. Include:

    1.1. Fencing, site security, site staging and site storage areas within the construction limits.

    1.2. Temporary utilities: water, power, lighting, heating, ventilation and toilets.

    1.3. Temporary heat: installation, operation, safety checks (identify frequency with Owner), and removal.

    1.4. Field office with heating, air conditioning, lights, phone, copier as required. Space shall be available for the Owner, consultants, A/E, and testing lab personnel.

2. Prohibit Contractor's use of all new and existing HVAC systems during construction.

3. Specify temporary enclosures for safety, security, thermal, weather, moisture, dust protection, and/or noise protection as required for new and existing spaces/systems/components.

4. Specify continuous protection of new and existing roofs.

5. Specify site maintenance/control of erosion, mud, snow, debris, etc.

6. Specify that the Contractor shall develop appropriate site and building(s) access and egress plans that are coordinated with the A/E and the C/U Project Manager.

01 57 23 – Temporary Storm Water Pollution Controls

1. Colleges and Universities are required to follow Minnesota State Board Policy & Procedures, Guideline 5.24.2.2, for Construction Storm Water Permit Compliance. Reference Minnesota Pollution Control Agency guidelines for construction storm water at: https://www.pca.state.mn.us/water/construction-stormwater.

    1.1. Applies to construction projects that anticipate disturbing more than 1 acre of soil

    1.2. Develop and implement written plans and procedures as part of their construction storm water general permit application.

    1.3. Require the General Contractor and other parties responsible for construction activities to submit site plans prior to the start of construction, for review and approval by the college or university in accordance with the institution's written site plan review procedures, including an opportunity for public input.

    1.4. The site plans must incorporate the erosion and sediment controls and waste control best management practices (BMP) as applicable to the project as found in Section V, 01 57 23 – Temporary Storm Water Pollution Controls.

    1.5. Provide written procedures for conducting site inspections to ensure compliance. Include checklists or other written means to document site inspections.

    1.6. Provide written Enforcement Response Procedures (ERPs) to document violations and enforcement steps to compel compliance.

    1.7. Avoid or minimize impacts to wetlands, protected waters, and environmentally sensitive areas and comply with the campus MS4.

1.7.1. Minnesota State maintains Municipal Separate Storm Sewer System (MS4) permits for twenty one of its campuses. These permits require the involved Minnesota State campuses to implement Best Management Practices (BMPs) as detailed in the campus-specific Storm Water Pollution Prevention Program (SWPPP). Specify requirements of the National Pollutant Discharge Elimination System (NPDES), General Storm Water Permit for Construction Activity requirements for erosion and sediment control and storm water management, site inspections, solid and hazardous waste management, dewatering activities, and final stabilization on construction site. Requirements apply if project disturbs more than 1 acre-or pose a risk to water resources. Specified requirements shall be in accordance with college's or university's MS4 storm water management plan.

1.8. Incorporate requirements of National Pollution Discharge Elimination System (NPDES), General Storm Water Permit for Construction Activity (2013) requirements for erosion and sediment control and storm water management.

1.9. Site Drainage shall be designed to comply with the B3 Guidelines (B3), section S2 for Storm Water Management required performance criteria for Runoff Ratio and Runoff Quality.

1.10. Conform to the requirements of the B3 Guidelines, Section S.6 for Erosion and Sedimentation Control.

1.11. Conform to the requirements of the B3 Guidelines, Section S.1, for Avoiding Critical Sites if the site selection has not already been

1.12. Conform to the requirements of the B3 Guidelines, Section S.3, for Soil Management.

2. Reference Section V, 01 57 00, Temporary Storm Water Pollution Controls.

01 58 00 – Temporary Project Signage

1. Site Signage:

   Include Temporary Project Site Signage per specifications as found in Section V., 01 58 00, Temporary Project Signage, for all projects funded by General Obligation Bond (Capital Projects) and Revenue Bonds and may be required on projects funded by other funds as determined by the campus or university

01 70 00 – Execution and Closeout Requirements

1. Specify the format and number of Record Drawings to be provided by the Contractor and Subcontractor(s).
2. Specify the Contractor shall provide on-site instructions in the operation of mechanical, electrical, and building systems installed by the Project Work.
3. Specify the Contractor is responsible to obtain Certificate(s) of Occupancy from the building officials having jurisdiction.
4. Specify the Contractor shall provide all guarantees, warranties, Record Drawings, Operation & Maintenance instruction manuals, and shop drawings to the A/E for the Owner.

01 73 29 – Cutting and Patching

1. Coordinate and describe as necessary all cutting and patching requirements in the Specifications and Drawings. Avoid duplication or conflicts between the architectural and engineering work as it relates to cutting and patching.
2. Include provisions for dust and noise control and protection of adjacent buildings, roofs, structures and finishes.

01 81 16 – Performance Requirements

3. Environment and Safety

   3.1. Provide support and protection systems where required to protect public, workers, and existing and new utilities, property and structures. The design of support and protection systems shall be the responsibility of the Contractor and shall conform to OSHA and campus specific safety requirements.

   3.2. **Hot Permits:** A Hot Works Permit is required for any temporary operation that involves open flames or produces heat and/or sparks. Such operations include, but are not limited to, brazing, cutting, grinding, soldering, thawing pipe, torch-applied roofing, and welding. The permit is intended to 1). Prevent the building fire detection system from accidentally activating 2). Control losses from accidentally igniting state property and 3). Ensure the safety of all building occupants while hot works procedures are being performed. These precautions are in accordance with 29CFR1910 Subpart Q (OSHA), the Minnesota Fire Code, and NFPA SIB. Obtain hot permits from the campus Project Manager. Permits are valid for a 24 hour period and must be requested for every 24 hour period that the activity occurs.

   3.3. Petroleum Storage Systems - In areas near existing or former heating plants or fueling stations, check with the Owner and the MPCA regarding petroleum storage system requirements.

   3.4. Conform to the requirements of the B3 Guidelines, Section S.1, for Avoiding Critical Sites if the site selection has not already been completed.

   3.5. Conform to the requirements of the B3 Guidelines, Section S.3, for Soil Management.

   3.6. Comply with the requirements of B3 Guidelines, Section M.3, Waste Reduction and Management.

   3.7. Conduct a final clean-up by independent green cleaning service using cleaning products that meet the Green Seal GS-37 standard, floor cleaners complying with CA Code of Regulations maximum VOC content, and disposable paper products, supplies and trash bags meeting the minimum requirements of US EPA's Comprehensive Procurement Guidelines

   3.8. Comply with the requirements of B3 Guidelines, Section M.2; Evaluation of Environmentally Preferable Materials.

Division 02 – Existing Conditions

1. 02 21 00 -Site Property and Topographic Survey

1.1. Site Photographs

1.1.1. Provide photographs of the site and adjacent structures before construction for comparison to post-construction conditions.

1.2. The Owner will provide a topographic site survey conducted by a licensed land surveyor to the AE. Site property and topographic surveys shall be conducted prior to or during the Schematic Design phase to determine or verify as-built conditions of existing construction and to prevent or minimize changes to design during construction.

1.3. Survey shall provide the following minimum information:

1.3.1. Site limits of survey.

1.3.2. Requirements of survey reference to municipal, county, state or USGS datum.

1.3.3. Accuracy of measurements.

1.3.4. Items that are to be surveyed.

1.3.5. Locations of critical centerlines or surfaces of structures or equipment to be located by survey.

1.3.6. Requirements to locate underground utilities in plan and elevation. Require surveys into manholes and inverts of all utilities.

1.3.7. Requirements to obtain “as-built” drawings or survey drawings from utility companies.

1.3.8. Survey drawing requirements including increment of topographic contours and computer aided drafting format.

1.3.9. Staking, setting of pins, monuments and bench marks.

2. 02 22 00 - Monitoring Existing Construction

2.1. Existing construction shall be monitored to detect and prevent detrimental effects from construction activities.

2.2. Where construction activities could damage existing construction that is sensitive to vibrations or settlement:

2.2.1. Photograph existing construction (where appropriate) to record actual conditions prior to start of construction.

2.2.2. Conduct a base conditions survey before the start of construction to locate critical reference points for detection of movement(s).

2.2.3. Conduct a survey of reference points during and after construction activities to detect movement(s).

2.2.4. Establish criteria for the Contractor to stop the Work and obtain directive.

3. 02 24 00 - Environmental Assessment

3.1. Environmental Contamination:

3.1.1. Confirm the need for a Minnesota Phase I Environmental Site Assessment

3.1.2. Comply with recommendations or requirements of any existing environmental site assessment(s)

3.2. Radon:

3.2.1. If new building or addition will have occupied spaces below grade, Owner shall test for radon, prior to or during the Schematic Design phase and shall provide test results to the A/E for incorporation of appropriate radon mitigation design if required.

4. 02 32 00 - Geotechnical Investigation

4.1. The Owner will provide a geotechnical investigation report conducted by a licensed geotechnical engineer to the AE, based on location and quantity of borings specified by the A/E that are specific to the building configuration. The A/E shall prepare geotechnical performance specifications containing:

4.1.1. Description of proposed structures and loadings.

4.1.2. Boring locations, depths and sampling requirements.

4.1.3. Penetration or soil pressure resistance test requirements.

4.2. Geotechnical responsibilities shall include the following:

4.2.1. Laboratory tests, analyses and classifications of materials.

4.2.2. Recommendations of:

4.2.2.1. Types of foundations.

4.2.2.2. Excavation construction (maximum side slopes and soil retention systems) and oversized excavation requirements.

4.2.2.3. Embankment construction.

4.2.2.4. Fill, backfill, and drainage materials and recommended non-compacted uniform lift thickness.

4.2.2.5. Dewatering procedures.

4.2.3. Recommendations of design parameters including, but not limited to:

4.2.3.1. Allowable soil bearing pressures for spread footings and mats.

4.2.3.2. Allowable pile or caisson bearing and uplift capacities.

4.2.3.3. Allowable pile or caisson horizontal loads at foundation level.

4.2.3.4. Dynamic properties of piles or caissons.

4.2.3.5. Lateral earth pressure coefficient for active, at-rest and passive conditions for existing soils and backfill materials.

4.2.3.6. Coefficient of friction between soil and foundations for sliding resistance.

4.2.3.7. Anticipated settlement for foundation types.

4.2.3.8. Minimum frost depth and cold weather protection.

4.2.3.9. Design ground water elevations and ground water protection.

4.2.3.10. Natural soil and backfill material density (dry or saturated), angle of internal friction and cohesion values.

4.2.3.11. Subgrade material, compaction, and value of Westergaard's modulus of subgrade reaction for design of concrete slabs on grade.

4.2.3.12. Recommended subgrade materials, compaction, and subdrains for design of pavements.

4.3. Effects of change in moisture content on settlement, bearing capacity, shrinkage or swelling of clays.

5. 02 41 00 - Demolition

5.1. Verify hazardous materials surveys for asbestos, lead, mercury, silica dust, etc. have been completed by the College/University and final abatement reports are available prior to start of demolition.

5.2. Include procedures should asbestos or other hazardous materials be encountered. Procedures shall include stopping Work immediately in the affected area and notifying the A/E Design Firm and the C/U Project Manager.

5.3. Specify allowed procedures of demolition and material recycling. Exclude use of wrecking ball, blasting, or burning where appropriate.

5.4. Recycling of Construction and Demolition Waste is required by for construction, renovation and demolition of state building after January 1, 2011. At least 50 percent of nonhazardous construction or demolition waste must be recycled to construction and demolition waste recycling facility if the project is funded by bond proceeds. (*Reference Minnesota State Statute 16B327 for additional requirements*)

5.5. Certain equipment and material may be removed and reinstalled as indicated on Drawings and specified herein. Contractor shall remove such items, store if required, and reinstall as indicated. In the event of loss or damage to such material or equipment, Contractor shall replace items without additional cost to Owner.

5.6. Specify materials and equipment to be salvaged during demolition. Specify details for cleaning, refurbishing, stockpiling, and if to be reinstalled. Indicate Owner's agreed upon stockpile location. Salvageable materials, except items specified to remain property of Owner, shall become property of Contractor and shall be removed from Site as Work progresses.

5.7. Specify access and egress from building or site, if occupied.

5.8. Specify coordination of time and manner of demolition work to assure continued operation of existing facilities.

5.9. Provide required general sequence of demolition to ensure stability of the structure throughout the demolition process. Require that the Contractor is responsible to determine step-by-step procedures and obtain technical expertise as needed to ensure safe and controlled demolition.

5.10. Include provisions for watertight conditions and details in projects where new construction abuts existing and in projects that repair or restore an existing building.

5.11. Specify temporary enclosure requirements to protect existing facilities and new construction work in progress from weather and unfavorable temperatures.

5.12. Include provisions for dust and noise control and protection of adjacent buildings, roofs, structures, and finishes.

5.13. Specify procedures for concrete and asphalt demolition that will minimize damage to existing concrete and reinforcing bars to be exposed and re-used. Procedures shall:

5.13.1. Require saw-cutting of all edges of asphalt and concrete pavement demolition.

5.13.2. Consider the use of hand held jack hammers.

5.13.3. Consider drilling lines of holes to provide weakened planes.

5.13.4. Consider the use of expansive materials.

5.14. Promptly re-use, salvage, recycle, or dispose of demolished materials. Do not allow demolished materials to accumulate or be stored on-site.

5.15. Specify the restoration or repair of any damaged roads, sidewalks, curbs, utilities, or plant material to match conditions existing before start of the Work; the C/U Project Manager shall review repair work with the Contractor for acceptance.

5.16. Comply with the requirements of B3 Guidelines, Section M.3, Waste Reduction and Management.

Division 03 – Concrete

03 11 00 – Concrete Forming

1. All form coatings or release agents, sealers, curing agents, surface coatings, concrete treatments and similar materials applied to concrete or concrete blocks receiving waterproofing or thru-wall flashings shall have prior written approval from the appropriate waterproofing and thru-wall flashing manufacturers. This includes manufacturers of floor waterproofing treatments such as mechanical penthouses, equipment rooms, shower rooms, etc. above occupied space(s).
2. All supported concrete shall attain a minimum compressive strength of 100% of the 28-day strength (with field cured cylinders) prior to form removal. The Contractor shall coordinate with the OITL the number of field cured cylinders (at least per ACI 306R, 6.2), testing dates, and all costs associated with the field-cured cylinders.
3. For each unsupported structural type of cast-in-place concrete, specify the minimum strength or minimum time required before removal of formwork is allowed.
4. Where formwork is complex or restraining significant loads specify that formwork shall be designed by a licensed professional engineer retained by the Contractor.
5. The Owner prefers backshoring rather than reshoring. However, ACI 347-14 cautions that this type of Work shall be performed under careful supervision by the Contractor. The A/E shall review this with the Owner during the design phases of the Project. Also, define maximum areas in which forms can be removed before installing backshores or reshores. Specify that backshores and reshores shall be installed immediately as forms are removed and within the same day
6. Specify back-shoring formwork requirements and limitations imposed by design. Specify the maximum areas for which forms may be removed before installing backshores. Backshores must be installed immediately as forms are removed and within the same day.

03 20 00 – Concrete Reinforcing

1. **<u>The use of welded wire fabric is not permitted</u>**
2. The Special Inspector or the OITL shall observe all rebar before any structural concrete is placed. All rebar (including dowels) shall be in place and secured with observations and re-configuration completed prior to delivery of concrete. For walls and columns, rebar shall be observed before forms are closed.
3. All reinforcing steel and accessories shall be specified as epoxy-coated for concrete exposed to weather or high water table, including, but not limited to: exterior perimeter building walls, foundation walls, footings, stoops, retaining walls, roofs, stairs, exterior slabs, sidewalks, curbs, and loading docks. Epoxy-coated reinforcing steel shall also be considered for other long term durability applications or conditions. Epoxy-coated reinforcing and accessories shall conform to ASTM A775.
4. Repair of damaged epoxy coating – When required, damaged epoxy coating shall be repaired with patching material conforming to ASTM A775. Repair shall be done in accordance with the patching material manufacturer's recommendations. ASTM A775 for plant repairs. ASTM D3963 for field repairs.

5. Synthetic Fiber reinforcement is permitted. Shall conform to ASTM C1116, Type III.
6. For walls reinforced on both faces, specify spreader bars and chairs to surfaces of forms on each side at spacing not to exceed 8' in either direction. For walls with single layers of reinforcement, specify chairs to each side at spacing not to exceed 8' in either direction. Also, specify spreaders for footings with two or more layers of reinforcement.
7. Include a table for lap length requirements of various rebar sizes for black and epoxy rebars for the various concrete compressive strengths used. Specify bar splice lap lengths on the Drawings.
8. Specify the structural requirements for epoxy rebar (lap length, etc.) The epoxy coating plant shall be CRSI certified (second party certification program). The Contractor shall provide written certification for the A/E's written approval prior to coating the rebar.
9. Specify the following:

    9.1 Fabrication

    9.2 All reinforcement shall be bent cold unless otherwise permitted by the A/E

    9.3 Placing (Field Installation)

    9.3.1. Epoxy-coated reinforcing and accessories bars supported from formwork or ground shall rest on coated wire bar supports, or on bar supports made of dielectric material or other acceptable materials. Wire bar supports shall be coated with dielectric material for a minimum distance of 2 inches from the point of contact with the epoxy-coated reinforcing bars. Reinforcing bars used as support bars shall be epoxy-coated. In walls having epoxy-coated reinforcing bars, spreader bars where specified, shall be epoxy-coated. Proprietary combination bar clips and spreaders used in walls with epoxy-coated reinforcing bars shall be made of corrosion-resistant material.

    9.3.2. Epoxy-coated reinforcing bars shall be fastened with nylon-, epoxy-, or plastic-coated tie wire, or other acceptable materials.

    9.3.3. Splices of reinforcing bars shall be made only as permitted by the Contract Documents, and as authorized by the A/E.

    9.3.3.1. Welded splices – When required or permitted, all welding of reinforcing bars shall conform to AWS D1.4. Unless otherwise permitted, welding of crossing bars (tack welding) for assembly of reinforcement is prohibited.

    9.3.3.2. Suitable ventilation shall be provided when welding epoxy-coated reinforcing bars.

    9.3.3.3. After completion of welding on epoxy-coated reinforcing bars, coating damage shall be repaired. All welds, and all steel splice members when used to splice bars, shall be coated with the same material used for repair of coating damage.

    9.3.3.4. Mechanical connections – When required or permitted, mechanical connections shall be installed in accordance with the splice device manufacturer's recommendations.

9.3.3.5. After installing mechanical connections on epoxy-coated reinforcing bars, coating damage shall be repaired. All parts of mechanical connections used on coated bars, including steel splice sleeves, bolts, and nuts shall be coated with the same material used for repair of coating damage.

9.3.4. Reinforcing bars partially embedded in concrete shall not be field bent, except as indicated on the Contract Documents and permitted by the A/E. When heat is used to field bend epoxy-coated reinforcing bars, provide suitable ventilation. When epoxy-coated reinforcing bars are field bent, coating damage shall be repaired.

9.3.5. Unless permitted by the A/E, reinforcing bars shall not be cut in the field. When epoxy-coated reinforcing bars are cut in the field, the ends of the bars shall be coated with the same material used for repair of coating damage.

03 30 00 – Cast-in-Place Concrete

1. Design:

1.1. Shall comply with:

1.1.1. Minnesota State Building Code.

1.1.2. "Building Code Requirements for Structural Concrete – ACI 318" as published by the American Concrete Institute (ACI), as amended by the Code.

1.1.3. Other applicable ACI standards as published in the "ACI Manual of Concrete Practice"

1.1.4. Other applicable design standards.

1.2. Design shall include:

1.2.1. Specify the thickness of concrete between the reinforcing bars and concrete surfaces.

1.2.2. Locations and provisions for conduit runs, sleeves, embeds, floor drains, cleanouts, and accessories.

1.2.3. Placement, toppings, repairs if needed, curing, form removal, shoring, etc. to achieve Project requirements for levelness and flatness (deflection).

1.2.4. Specify shrinkage criteria for slabs, beams, joists, etc.

1.2.5. Crack control measures.

1.2.6. Corrosion resistance.

1.2.7. Durability.

1.2.8. Bar spacing and congestion relief.

1.2.9. Constructability review.

1.3. Foundation walls shall be cast-in-place concrete only.

1.4. Post-tensioned concrete is not allowed.

1.5. Cambered decks for cast concrete structures are not allowed.

1.6. If synthetic fiber reinforcement is used in concrete, then specify additional preparation required to receive new finish materials.

1.7. Specify all flooring, waterproofing. air barrier, and thru-wall flashings substrates shall be free of coatings, form release agents, sealers, curing agents, treatments, and the like, unless written prior approval of the products used is obtained from the specified flooring, waterproofing or thru-wall flashing manufacturers. This requirement applies to Sections 03 30 00, 04 20 00, 07 13 00, and 07 18 13, 07 27 00 and all other appropriate Sections.

1.8. Coordinate the finish and cure time of all concrete substrates to receive waterproofing with the waterproofing manufacturer's requirements.

1.9. Specify that all vertical exterior walls to receive waterproofing and air barrier shall be free of voids, embedded ties, loose material and all honeycombing shall be patched and prepared as required prior to receiving air barrier.

1.10. Specify vapor barrier below interior slabs on grade.

1.10.1. Placement of the vapor barrier within the subfloor section shall be analyzed and determined based on the flooring system, subgrade conditions and floor finish.

1.10.2. Vapor barrier shall be 15 mils meeting ASTM E1745 Standard Specification for Plastic Water Vapor Retarder, Class A (less than .01 perms). Stego Wrap 15 mil Class A by Stego Industries, Griffoyn Type-105 by Reef Industries or equivalent.

1.10.3. Overlap seams a minimum of 6" and seal seams with tape per manufacturer's recommendations. Seal all penetrations per manufacturer's recommendations.

1.10.4. Detail or verify that the vapor barrier successfully transitions to the air barrier system on the exterior walls.

1.10.5. Based on Owner supplied environmental reports, additional sub slab depressurization systems may be required under the vapor barrier.

1.11. Construction Tolerances:

1.11.1. Specify all finishes and tolerances for level, plumb, and slopes. Also, provide tolerance for finished floor elevation as compared to floor elevations on Drawings.

1.11.2. Specify flatness and levelness for slabs and coordinate with floor finish flatness requirements. The A/E shall review the floor flatness (FF) and floor levelness (FL) requirements with the Owner. Typically FF and FL designations would be used and measured by the Owner's testing laboratory, with pairs of F-numbers provided for both Overall and Minimum Local.

1.11.3. Specify 1/8" per foot minimum slope-to-drain on concrete finish for all slabs with floor or trench drains in larger floor areas, such as shops. Specify 1/8"

per foot slope-to-drain within 18” radius around floor drains in smaller areas such as rest rooms.

1.11.4. Specify window, curtain wall, and door surroundings shall be plumb, true and level and free of voids, honeycombing and defects. Window and curtain wall sills need to be flush and level to meet tolerances of the exterior fenestrations. Specify curtain wall surround tolerances as follows:

1.11.4.1. Maximum variation from unit to adjacent unit: 1/16 inch.

1.11.4.2. Maximum variation from plane of wall: 1/8 inch in 10 feet: ¼ inch in 40 feet; non-cumulative.

1.11.4.3. Maximum variation from plumb: 1/8 inch in 10 feet: ¼ inch in 40 feet; non-cumulative.

1.11.4.4. Maximum variation from level coursing: 1/8 inch in 10 feet: ¼ inch in 40 feet; non-cumulative.

1.11.4.5. Maximum variation of joint thickness: 1/8” in 3 feet.

1.11.4.6. Maximum variation from cross sectional thickness of walls: ¼ inch.

2. Concrete Mixes:

2.1. Specify the Contractor shall provide the concrete mix designs. The mix designs shall be designed and signed by a professional engineer employed by a qualified independent laboratory; said laboratory to be other than the Owner’s testing laboratory. The A/E’s structural engineer shall approve concrete mix designs after consideration of the entire Pre-Construction test results.

2.2. Require the Contractor to submit proposed concrete mix design data in accordance with ACI 318 requirements, as a minimum.

2.3. Concrete shall be Ready-Mixed concrete, mixed and delivered in accordance with ASTM C94.

2.4. **Fly ash or other cement substitutes in concrete mixes are not allowed**.

2.5. Curing compounds are not allowed.

2.6. The equivalent alkalis for the cement shall be not greater than 0.60% per ASTM C150 optional chemical requirements.

2.7. Specify the following for each concrete application and/or mix design:

2.7.1. Compressive strength.

2.7.2. Slump (before and after High Range Water Reducer (HRWR) is added on site).

2.7.3. Air entrainment for exposed locations.

2.7.4. Water cement ratio.

2.7.5. Reactivity potential.

2.7.6. Aggregate size and shrinkage (where appropriate).

3. Concrete Placement:

   3.1. Concrete deliveries shall be scheduled to ensure that the concrete in each load is placed within 90 minutes after water was added for non-air entrained concrete and 60 minutes after water was added for air entrained concrete.

   3.2. If the concrete of a concrete delivery truck was rejected for any reason, the truck shall not be allowed on-site for the next 12 hours.

   3.3. Concrete shall not free fall more than 4′ during placement (MnDOT 2401.3).

   3.4. All surfaces (including sub-grade and reinforcement) that will be in contact with newly placed concrete shall be above the minimum temperature of 35 degrees F and not more than 10 degrees F higher than the minimum concrete placement temperature of ACI 306R, Table 3.1, line 1.

   3.5. Specify concrete vibration and/or other consolidation requirements.

   3.6. For concrete curing, specify that the most stringent requirement from both the IBC 1905.11 and the ACI 318-5.11.1 shall be used. The concrete shall be maintained above 50 degrees F and in a moist condition for at least the first seven days after placement.

4. Precast Concrete (designed by supplier):

   4.1. Specify design requirements.

   4.2. Require that the manufacturer of precast concrete submit:

      4.2.1. Structural calculations and drawings bearing the seal of the design engineer, licensed in the state of Minnesota.

      4.2.2. The A/E shall review drawings and calculations for conformance to the Contract Documents.

5. Tests:

   5.1. Testing of proposed mixes is required. Review suppliers testing procedure and schedule prior to the start of testing to ensure testing complies with ACI requirements and sufficient time is allowed to complete testing prior to start of concrete construction.

   5.2. Test requirements, including type, applicable standard and frequency shall comply with Minnesota State Building Code requirements and Owner's minimum testing requirements in Section IV of 01 45 23 – Required Testing and Inspection Services, Cast-in-Place Concrete (03 30 00).

Division 04 – Masonry

04 20 00 Masonry & Stone

1. Design:

    1.1. Current Codes and Standards:

        1.1.1. Minnesota State Building Code.

        1.1.2. MSJC Building Code and Specifications for Masonry Structures (TMS 402/ACI 530/ASCE 5) (TMS 602/ACI 530.1/ASCE 6), as amended by State Building Code.

        1.1.3. Standard Method for Determining Fire Resistance of Concrete and Masonry Construction Assemblies (ACI 216.1/TMS 0216), as amended by State Building Code.

        1.1.4. ASHRAE Standard 90.1 (I-P Edition) Energy Standard for Buildings, Except Low-Rise Residential Buildings (ANSI Approved; IESNA Co-sponsored), as amended by State Building Code

        1.1.5. ASHRAE Standard 189.1 Standard for the Design of High-Performance Green Buildings

        1.1.6. ASHRAE Standard 160 Criteria for Moisture-Control Design Analysis in Buildings (ANSI/ASHRAE approved), as amended by State Building Code.

        1.1.7. In addition to requirements listed in this section, reference the current Minnesota State Exterior Masonry Design Standards Manual located at: http://www.finance.minnstate.edu/facilities/design-construction/resources.html

    1.2. Concrete Masonry Units (CMU) or concrete backup partitions are required at all exterior masonry or stone walls.

    1.3. Exterior cladding shall be clay brick, but exterior stone may be used as a decorative element or may be used in limited quantities if approved by variance.

    1.4. Specify increase masonry tolerances at curtain wall surroundings to accommodate the installation of the curtain wall and the sill pan flashing. Specify curtain wall surround tolerances as follows:

        1.4.1. Maximum variation from unit to adjacent unit: 1/16 inch.

        1.4.2. Maximum variation from plane of wall: 1/8 inch in 10 feet: ¼ inch in 40 feet; non-cumulative.

        1.4.3. Maximum variation from plumb: 1/8 inch in 10 feet: ¼ inch in 40 feet; non-cumulative.

        1.4.4. Maximum variation from level coursing: 1/8 inch in 10 feet: ¼ inch in 40 feet; non-cumulative.

        1.4.5. Maximum variation of joint thickness: 1/8” in 3 feet.

        1.4.6. Maximum variation from cross sectional thickness of walls: ¼ inch.

1.5. **CMU is not allowed below grade.**

1.6. Specify lintels and brick shelf angle metals in the cavity wall shall be hot dipped galvanized steel. Specify that all field welded or field cut galvanized supports be field coated. A/E to specify repair product and methods for these conditions. Specify all other masonry accessories shall be specified as stainless steel at exterior walls.

1.7. Restoration or repair projects shall include only all stainless steel masonry accessories with either copper or stainless steel sheet metal through-wall flashings.

1.8. Structural Design shall include:

1.8.1. Bending analysis from wind or pressure.

1.8.2. Axial compression analysis from self-weight plus other imposed loads.

1.8.3. Special analysis, reinforcing and details at openings, lintels, joints and other irregularities.

1.8.4. Requirements for ties connecting masonry to supporting structure (e.g., structural steel or concrete frame). Analysis shall include determination of tie loads, tie type and tie capacity verification. Analysis shall consider unsupported length of ties to ensure local buckling is prevented.

1.8.5. A/E shall design and specify the location and the width of such joints. A/E shall consult ASTM C1472 and SWRI for addition information regarding joint width sizing.

1.8.6. Vertical control joints for CMU back-up wythe shall be required to align at the same spacing as the exterior wall veneer, unless columns or other structural items interfere; then align as closely as possible. Vertical control joints for CMU and expansion shall have backer rod and sealant installed prior to application of air barrier transition. Specify sealant compatible with air barrier membrane.

1.8.7. Consider brick expansion and contraction influences on wall sections.

1.8.8. Drawings shall indicate locations of ties and spacing. Drawings shall include through-wall flashings for loose lintels and fixed lintels in which anchors are used through the lintels.

1.9. Reference 07 13 30 – Membrane Waterproofing, 07 26 00 Air/Vapor Barriers, and 08 44 13 Curtain Walls and others as required in related work.

1.10. Exterior brick shall meet ASTM C216, Grade SW, Type FBS or FBX. The selected brick shall be shown to have passed ASTM C67, freeze-thaw for pre-qualification testing prior to bidding with submittals of that testing performed within the past 18 months. Brick Manufacturer's must supply current test results for ASTM C67, Efflorescence.

1.11. Exterior repair or restoration of clay brick is not required to pass pre-qualification tests, but certification of clay brick to confirm compliance with specified ASTM requirements shall be submitted. Exterior repair or restoration of clay brick shall match existing in color, texture, and size.

1.12. The A/E Design Firm structural engineer shall recommend and specify building expansion joints and expansion joints between all new and existing structures and specify the anticipated design movement dimension and orientation. The A/E shall design the

air/moisture barrier, waterproofing, roofing, through wall flashing, cladding continuity to accommodate such movement.

1.13. Specify that brick ties shall start a maximum of 8" horizontally and 9” vertically from terminations such as brick ledges, lintels, expansion joints, through-wall flashings, window and door openings, corners, or other interruptions. A/E shall clearly indicate where post installed masonry ties will be installed on the enlarged detail drawings. The A/E shall coordinate the position of such anchors so they do not interfere with reglets, termination bars, stainless steel drip tray flanges and etc. Specify all post installed masonry tie anchors be sealed air and watertight and be coordinated with other trades.

1.14. Design stone anchors so as not to penetrate or interrupt the through-wall flashing at drainage planes whenever possible. Specify that all stone anchors, dowels, welded rods or pins shall be post installed at lintels or shelf angles and sealed where they penetrate the vertical leg of the through-wall flashing.

1.15. Design the masonry layout to accommodate the placement of end dams at head joints in brick and stone. Design the masonry layout and stone size to accommodate Minnesota State required double through-flashing where applicable.

1.16. Identify and detail the air space between the masonry veneer and the cavity insulation at minimum 2” width, depending upon the insulation requirements to meet the current energy code and the results from the hygrothermal modeling analysis.

1.17. Design cavity wall window/curtain wall openings with return brick and sealed to prevent cavity wall air migration into the window surround. Specify that the sealant shall be compatible with that of the primary sealant joint of the curtain wall.

1.18. Specify rope weeps at 16" on-center, using doubled-back 10 mm (3/8”) 100% cotton rope wicks. Nylon rope is not acceptable. Rope weeps shall extend past the masonry veneer, run through the head joint to the cavity, run a maximum of 16” horizontally in the cavity, and to and be tied to the brick ties or terminated per specified securement. Interlace successive rope wicks. Place weeps at the corners of all flashing end dams. Trim rope weeps approximately 1/2” length from masonry veneer face.

1.19. Detail and note through-wall flashings beginning a minimum of 12" above the base course of masonry veneer and 12” minimum above roof membrane. Through-wall flashings above doors, mechanical louvers, and above and below windows shall to be seamless (new construction only, not repair of existing construction) and end dammed at all terminations. All flashing edges, termination bars, and fasteners should be cap sealed. Extend flashings a minimum of 6” beyond jambs of openings and a minimum of 4” beyond ends of lintels. Finished through-wall flashing copper membrane shall extend 1/4” from the exterior face of the masonry units. If the through-wall flashing system is composite system with copper membrane lapped onto stainless steel sheet metal insert, then the copper membrane can be trimmed flush with the exterior face leaving only the stainless steel insert exposed. Detail all through-wall flashings to (minimize or avoid contact) or (to be compatible) with sealants. Provide end dams at all flashing discontinuations.

1.20. Install double layer of through-wall flashing above roofs and parapet walls. Terminate the through wall flashing just beyond the coping.

1.21. Installation:

1.21.1. All structural masonry and exterior masonry shall be laid running bond, except for minimal decorative features.

1.21.2. Specify the surface preparation of the back-up wall to receive the air barrier.

1.21.3. Specify that all CMU at the jambs and sills of window openings be free of chips and be flush, level and true.

1.21.4. Specify that all mortar joints within the CMU back-up wall at window returns be filled and tooled flush without voids, chips or protrusions to accommodate the installation of the curtain wall primary sealant joint.

1.21.5. Rowlock masonry is not permitted at any exterior application.

1.21.6. Soldier coursing of exterior masonry is allowed as a decorative feature, no more than two courses, and must be designed with brick ties installed every 16” o.c. horizontally.

1.21.7. All masonry joints shall be full head & bed joints tooled concave. Raked joints are not allowed on exterior masonry.

1.21.8. Mortar droppings or debris shall not be left in the wall cavity.

1.21.9. Replacement units of exterior clay brick shall be full units for in-plane masonry infills and spot brick replacements: toothing into existing exterior veneer and matching existing coursing.

1.21.10. At ground level conditions, the through-wall flashing system shall overlap the vertical waterproofing within the cavity a minimum of 6” for continuous moisture protection.

2. Quality Assurance and Field Quality Control:

2.1. Specify test and inspection requirements, including type, applicable standard and frequency, per the Minnesota State Building Code requirements and Owner’s minimum requirements of Section IV, DIV. 01 40 00.

2.2. Specify requirements per the Minnesota State Building Code and the Owner’s minimum requirements of Section IV of these Design Standards.

2.3. Specify an exterior wall system mock-up to a size appropriate for the extent of the Project.

2.3.1. Specify that the mock-up shall be completed early in the construction phase, prior to installation of the CMU back-up walls.

2.3.2. Reference the mock-up in other specification sections to include their scope of work.

2.3.3. A whole building Project mock-up shall be constructed in a location designated by the Architect. Construct a mock-up of concrete foundation, CMU backer with reinforcing and grout, weather barrier, one masonry expansion joint, brick ties, insulation, through-wall flashing and accessories, weeps, approved face brick blend, and approved mortar color. Include an outside building corner, wall base-to-foundation waterproofing detail, wall-to-roof system detail,

representative window or curtain wall opening details, roof edge details, and all wall system components shown in layers including the back-up wall, but not interior finishes.

2.3.4. Purpose of mock-up is to illustrate construction and workmanship standard for installation of all components. Mock-up shall demonstrate installation and color, face brick color blending, mortar color, mortar joint tooling, weather barrier installation and details, brick tie installation, through-wall flashing with sheet metal and end dams, joint sealant and backer rod installation, cavity drainage material, vents, and continuous rope weeps for approval by Architect/Engineer and Owner. Architect's acceptances of visual qualities of the mock-up are required before start of masonry work.

2.3.5. Specify the foot print size, width and height, including returns. Mock-up shall have small inside and outside corner/return to observe the air barrier transition membrane, waterproofing lapping and through-wall flashing lapping requirements. These corners typically only return 16-24 inches and do not require being full height. Height required is typically 18 inches above the lintel.

2.3.6. Provide separate mock-up panels for each type of exposed unit masonry wall system.

2.3.7. Mock-up shall be constructed as part of the Pre-installation meeting for masonry, air barrier, and through-wall flashings. The concrete foundation, CMU back-up wythe, waterproofing and air barrier shall be placed and cured prior to this meeting. Contractor shall provide written notice that they are completely prepared for the meeting and have all specified mock-up materials and products on site.

2.3.8. Submittals for all exterior wall materials and adjacent systems must be approved prior to the scheduled mock-up construction.

2.3.9. Indicate each specified mock-up must be constructed by field personnel who will be installing materials during actual Work.

2.3.10. Install masonry veneer (brick and/or stone) from the same production run for this particular project.

2.3.11. Coordinate observation by Owner's Consultants during the installation of the waterproofing, air barrier, through-wall flashing and masonry. The contractor must schedule the mock-up material delivery and construction so mock-up construction and full-time observation occur continuously and efficiently.

2.3.12. A smaller restoration or addition project mock-up may range from a simple strap of brick for color range or color blend to a variation of the mock-up described above that includes key features of the project.

2.3.13. All re-observation and re-testing and associated costs due to non-conformance with the Project requirements required for the mock-up, shall be the responsibility of the Contractor.

Division 05 – Structural Steel

05 12 23 – Structural Steel Framing

1. Design:

    1.1. Shall comply with:

        1.1.1. Minnesota State Building Code.

        1.1.2. The following AISC publications, as applicable:

            1.1.2.1. AISC Load and Resistance Factor Design Specification for Structural Steel Buildings.

            1.1.2.2. AISC Specification for Structural Steel Buildings – Allowable Stress Design.

            1.1.2.3. AISC Specification for the Design of Steel Hollow Structural Sections.

2. The fabricator and erector shall have a minimum of 5 years' experience in performing the Work of this section. The fabricator and erector shall submit resumes showing compliance with the Work experience requirement to the A/E for written approval prior to starting the Work.

    2.1. Prior to the start of Work, the fabricator shall submit certifications to the A/E and structural engineer for written approval, that they are registered and approved by the building official, in accordance with IBC Chapter 17. The fabricator shall participate regularly in the third party quality control program of AISC and be registered and approved by the building official in accordance with IBC Chapter 17. The fabricator shall also be acceptable to the structural engineer.

    2.2. As an alternate to 2.1 above, the Contractor shall pay for full-time inspection during the fabrication of the Project steel. This inspection shall be conducted by the Owner's inspection company (at the fabrication plant). In addition, the fabrication plant shall also be acceptable and approved in writing by the structural engineer, A/E, and building official. Do not proceed with steel fabrication work until the A/E has provided final written approval.

3. The Contractor shall provide certification that welders to be employed in this Work have satisfactorily passed AWS qualification tests. Fabricator(s) and erector(s) shall submit current welding certifications, for fabrication plant and field welding, to the A/E for written approval prior to the start of welding. If re-certification of welders is required, retesting shall be the Contractor's responsibility.

4. Connection Design:

    4.1. Shall be performed by the A/E Design Firm or by the connection design engineer retained by the Contractor.

    4.2. Where connection design is by Contractor:

        4.2.1. Specify design criteria and standards.

        4.2.2. Stipulate a certification statement that shall be applied to all shop drawings depicting connection details designed by such engineer. This certification

statement shall be placed adjacent to the connection engineer's seal and signature. Such statement shall substantially be as follows:

"I, John F. Doe, hereby certify that the connection design shown on this document was prepared by me or under my direct personal supervision and that I am a duly licensed Professional Engineer under the laws of the State of Minnesota and I accept responsibility for the adequacy of the connections shown on this document to meet criteria stipulated in the Contract Documents."

4.2.3. Provide connection design forces:

4.2.3.1. Shear, axial force and moment.

4.2.3.2. Transfer forces where forces are transferred through continuous members (e.g., such as columns).

4.2.4. Bolts which require pre-tensioning shall be tightened to develop minimum tension specified by AISC "Specification for Structural Joints using ASTM A325 or A490 Bolts" using direct-tension indicator tightening method.

4.2.5. For guardrails requiring maximum of 4" clearance, use only vertical bars between top and bottom horizontal rails.

4.2.6. Specify increase steel tolerance for spandrel beams at lintels at window surroundings to accommodate the installation of the curtain wall and sill pan flashing.

4.2.7. Design lintels, shelf angles and other steel members to eliminate thermal conductance from the cold exterior to the interior from any exterior exposure.

5. Painting:

5.1. If existing steel is exposed at exterior and is specified painted and not galvanized, then prepare the steel for painting with a high performance coating. Verify that any existing rusted paint does not contain lead or remove and abate lead paint according to MPCA requirements.

5.2. Specify blockout or paint requirements for faying surfaces of slip-critical connections.

5.3. Where structural steel is finish painted, specify requirements for special handling and field touchup. Exterior steel shall be painted with high performance coating.

5.4. Where structural steel will be spray fire-proofed, specify requirements to not paint selected materials.

5.5. Specify Hot Dipped Galvanizing for the following steel:

5.5.1. Steel embedded in concrete (exterior or interior).

5.5.2. Lintels in exterior masonry walls.

5.5.3. Brick or masonry support shelf angles and plates in exterior masonry walls.

5.5.4. Curtain wall anchorage clips.

5.5.5. Sleeper curbs for roof mounted equipment.

6. Specify that all field welded or field cut galvanized steel supports be field coated. A/E to specify repair product and methods for these conditions.
7. Tests:
   7.1. Specify test and inspection requirements, including type, applicable standard and frequency, per the Minnesota State Building Code requirements and the Owner's minimum requirements from Section IV., 01 45 23 – Required Testing and Inspection Services. Include the following:
      5.1.1. Bolts and bolting.
      5.1.2. Shop and field welding.
8. Shop Drawings:
   8.1. The A/E shall permit the Contractor's detailer to use the A/E's structural steel framing Drawings and elevation files as the base for erection drawings. The Contractor shall be required to remove all reference (logo, names, etc) to the A/E from the file and assign a new drawing number with the detailers/fabricator name, logo, etc. The purpose of this procedure is to eliminate introduction of error by the Contractor when re-drafting the structural steel drawings.

05 31 00 – Steel Decking

1. Metal Deck Fabrication:
   1.1. The fabricator and erector shall each have a minimum of 5 years of experience in performing the Work of this Section. The fabricator and erector shall submit resumes showing compliance with the Work experience requirement to the A/E for written approval prior to starting the Work.
   1.2. The Contractor shall provide certification that welders to be employed in this Work have satisfactorily passed AWS qualification tests. Fabricator(s) and erector(s) shall submit current welding certifications, for fabrication plant and field welding, to the A/E for written approval prior to the start of welding. If re-certification of welders is required, retesting shall be the Contractor's responsibility.
   1.3. The fabrication plant shall comply with the Quality Control provisions as established by the Steel Deck Institute. Submit documentation that verifies compliance to the A/E for their written approval prior to start of deck work. Fabrication shall also be approved by the building official and the A/E's structural engineer in writing prior to start of deck work.
2. Roof deck and floor deck design shall comply with appropriate requirements of the Standard Deck Institute
3. On Drawings, provide fastener type(s) and spacing for connection of roof and floor deck to structural steel and at side laps.

05 50 00 – Metal Fabrications (and All Other Metal Sections)

1. Same requirements as Section 05 12 23-Structural Steel.
2. The A/E shall comply with IBC 2103.11.7 to specify at least minimum corrosion resistance for veneer support, anchors, ties (excluding brick ties), etc.

Division 06 – Wood, Plastics, and Composites

1. General:

    1.1. Fire treated plywood is not allowed, except as required by code for interior backing for mounting.

    1.2. Fire retardant chemicals used for treatment shall be free of halogens, sulphates, ammonium phosphates and formaldehyde and compatible with materials in contact.

    1.3. Plywood backing boards shall be minimum ¾" fire treated plywood.

    1.4. Oriented Strand Board (OSB) is not allowed for any use.

    1.5. <u>Wood blocking shall not be used around or adjacent to exterior openings or within exterior cavity walls.</u>

    1.6. Dressed seasoned dimensioned lumber, S4S, air-dried with maximum 19% moisture content (S-DRY) shall be used for rough carpentry.

    1.7. Pressure preservative treated materials shall be used at the exterior of buildings.

    1.8. Lumber Grades: Southern Pine or Western Lumber species, in compliance with PS-20-70 of American Softwood Lumber Standard.

        1.8.1. Beams: No. 2.

        1.8.2. Joists and rafters: No. 2.

        1.8.3. Studs, 10'-0" and shorter: Standard Stud.

        1.8.4. Studs, longer than 10'-0": No. 2.

        1.8.5. Furring, blocking and bracing: Utility.

    1.9. All wood and lumber brought to the Project site for structural use shall have grade stamps affixed.

    1.10. Where framing (2" through 4" thick) will not be concealed by other Work, Southern Pine or Douglas Fir appearance grade shall be used.

    1.11. All plywood shall be exterior grade in accordance with PS-1-83 or American Plywood Association (APA).

    1.12. Untreated lumber shall be used for roofing and parapets.

    1.13. Fire stops and fire separations shall be used in wall and roof areas as required by applicable code requirements.

    1.14. Specify only screws or bolts for use with treated wood. All fasteners shall be unaffected by treatment chemicals and corrosion resistant, such as galvanized or stainless steel.

    1.15. Specify and approve a nailing schedule.

    1.16. Plywood backing boards shall be used for mounting controls, panelboards, equipment, switches, etc. as required by Mechanical, Electrical and Communication trades.

1.17. All shelving material shall be a minimum of ¾" thick softwood veneer plywood with hardwood edge bands on exposed edges.

1.18. For finished carpentry, use running members in maximum lengths obtainable.

1.19. Joints and connections shall be concealed wherever possible.

1.20. Glue and pin shall be used with tendon and mortis joints. Intermediate joints between supports shall not be permitted

1.21. Countertops in high use public areas, laboratories, or high moisture applications shall be minimum ¾" thick solid polymer material with bull nose edge.

1.22. Countertops which incorporate sinks shall be complete with backsplashes and end-splashes and shall be ready for bottom-mounted sinks/bowls.

1.23. All solid polymer components shall be of minimum joints. Joints shall be inconspicuous in appearance and without voids. 2" wide reinforcing strip of solid polymer material shall be used under each joint.

1.24. All solid polymer component edges shall be smooth, uniform finish.

1.25. Conform to the requirements of the B3 Guidelines, Section I.2. Specify Low-emitting Materials.

Division 07 – Thermal and Moisture Protection

1. General:

1.1. All waterproofing materials and procedures shall be as per Section V., Division 07 – Thermal and Moisture Protection, of these Design Standards. Only approved equals shall be allowed which comply with the minimum performance and other requirements set forth in the specification section.

1.2. Provide a waterproof membrane at the transition from foundation wall to cavity masonry backup wall. Extend waterproofing at least 12" above the finished floor and 12" below the transition surface.

1.3. Provide a waterproof membrane for all below grade occupied spaces. Extend waterproofing down to top of footing, across top of footing and lap onto vertical surface a minimum of 6". Waterproofing shall lap horizontally 3' beyond transition to existing foundations.

1.4. Penetrations through a foundation wall below grade shall have 10" minimum clearance on all sides.

1.5. Mechanical room floors, shower room floors and walls, restrooms, janitor closets and other wet spaces above occupied spaces shall be waterproofed with pedestrian traffic coating.

1.6. Exterior walls shall be insulated and air/vapor/moisture barriers installed to reduce the thermal transmittance and energy losses. The State Energy Code and in accordance with B3 Guidelines and Minnesota SB2030 energy standards requires a 70% reduction as of 2015 of the energy use of a representative building built in 2003 under 1998 codes. This reduction becomes 80% in 2020, 90% in 2025, and 100% (net zero) in 2030.

1.7. Exterior walls shall be detailed and configured to prevent condensation caused by cold surfaces in contact with interior air. Avoid steel members (such as lintels) thermal bridging, which conduct cold to the interior from an exterior exposure.

1.8. Batt insulation installed above suspended ceilings at the top floor is not recommended to avoid condensation.

1.9. Perimeter insulation shall be provided for slab on grade floors and below grade floors to reduce the U value to the same as the exterior wall insulation. Exterior wall insulation and foundation wall insulation shall be designed to avoid uninsulated gaps at the wall/floor juncture(s).

1.10. All partition walls enclosing offices, classrooms, and other spaces requiring acoustic separation shall be continuous floor-to-deck and be filled with acoustical insulation and shall be caulked or sealed.

1.11. General acoustical design requirements shall be NC 35 (noise criteria level) for offices and classrooms and NC 20 for ITV (interactive television) and specialized functions at full cooling or full heating conditions. Other spaces shall at a minimum meet the ASHRAE acoustical requirements.

1.12. Minnesota State compliant exterior wall (CMU Back-Up + Air Barrier + Insulation + Cavity Space + Masonry Cladding) the "Air Barrier" (single product/system) also serves as the vapor barrier (located inboard of the insulation) and the moisture barrier (weather resistive barrier located behind the rain screen masonry cladding). Specify and detail the air barrier to be either vapor permeable or impermeable based on the A/E's analysis that original construction moisture dissipates and subsequent moisture from weather or occupancy does not accumulate in any one element of the wall system.

1.12.1. Air/moisture barriers are required on the interior of the insulation warm side. Detail so that condensation will not occur at relative humidity levels anticipated by ASHRAE standards as determined by hygrothermal modeling analysis or caused by building functions and uses.

1.12.2. Specify and detail the continuity of the air and vapor barriers in the exterior envelope at barrier laps, openings and penetrations, corners, building and substrate joints, and transitions of substrates and building envelope system changes.

1.13. Standard Minnesota State Roof System is a gravel-surfaced four ply built-up roof. The roof shall be durable and maintainable, designed for 40 years of service life for both low-sloped roofs (less than 2" per foot) and steep-sloped roofs (greater than 5" per foot slope). Refer to – Minnesota State Roof Design Standards Manual – Third Edition (2017) for roofing, guidelines, requirements and sample details.

1.14. Proven Roof System Types and Materials (For this climate): Use systems with at least 20 years of satisfactory performance history. Use materials with at least 10 years of satisfactory performance history.

2. Construction Inspection Standards:

2.1. All roofing shall be inspected full time 100% during construction. Roof related sheet metal shall be inspected periodically during construction based on complexity.

2.2. Submittals and condition survey are required prior to the Roofing Pre-Construction meeting.

2.3. A Roofing Pre-Construction meeting shall be held before the delivery of materials and reroof tear-off.

2.4. Roofs adjacent to construction shall be protected.

2.5. Removal from the site of wet, damaged, or rejected materials shall be enforced.

2.6. The Owner shall be notified immediately as to all nonconforming Work.

2.7. Cavity wall construction shall be continuously flashed with through-wall flashing above all shelf angles, opening lintels and heads, below all window and curtain wall sills, above adjoining roofs, at ground level conditions and at any other obstructions to the downward flow of water within the cavity walls. Cavity walls shall be detailed to step flash down slopes and step flash with dual layers down sloping roofs.

2.8. Thru-wall flashing materials shall be as specified.

2.9. Flashings and sheet metal: Specify gauge and material (galvanized, stainless steel, pre-painted, pre-finished steel; or anodized aluminum).

2.10. Specify that no fasteners penetrate through horizontal surfaces of parapet flashings or equipment curbs.

2.11. All through-wall flashings above adjoining roofs shall be detailed as double through-wall flashings that overlap 6” minimum, the roof base flashing system for continuous moisture protection.

2.12. Grade conditions, the through-wall flashing system shall overlap the waterproofing system a minimum of 6” for continuous moisture protection.

2.13. All waterproofing, air barrier, and through-wall flashings substrates shall be free of coatings, form release agents, sealers, curing agents, treatments, and the like, unless written prior approval of the products used is obtained from the specified waterproofing, air barrier or thru-wall flashing manufacturers.

2.14. Fibrous spray-applied fireproofing is prohibited due to concerns for indoor air quality. Cementitious sprayed-on fireproofing is preferred.

2.15. Joint sealant requirements shall be as per Section IV., Division 07 – 07 90 00, Joint Sealants.

2.16. Conform to the requirements of the B3 Guidelines (B3), Section I.2, Specify; Low-emitting Materials to reduce indoor chemical pollution.

2.17. Horizontal Plaza assemblies which are waterproofed shall provide for both surface and subsurface drainage discharged either off the plaza, into interior drains or a combination thereof. All subsurface drainage shall occur at the waterproofing membrane level and be sloped 1/8” per foot minimum. Upturned legs of waterproofing shall be applied to backup walls, to a point 12” above the draining surface. Where brick masonry exists on adjacent walls, through-wall flashing shall weep out a minimum of one brick course above the plaza deck. The base course of

the building wall shall be treated with masonry or precast as a durable wall to withstand snow removal abuse.

2.18. All penetrations through a structure deck shall be a minimum of 10” away from a wall.

07 21 00 –Thermal Insulation

1. Specify insulation by type and manufacturer, stating performance characteristics of density, aged average R-value per inch, flame spread, and fire rating.
2. Specify procedures/precautions for installation of vapor barriers (at each location). Completely detail the vapor barrier to prevent condensation from occurring at relative humidity levels anticipated by ASHRAE or caused by program.
3. Below grade insulation shall be extruded polystyrene only.
4. Isolate flammable plastic insulation materials as required by Chapter 26 of IBC Codes for exterior walls and cavities.

07 27 00 –Air Barrier

1. Specify the building envelope shall contain an air barrier consisting of a material or a combination of materials to resist the passage of air into or out of the conditioned or semi conditioned space.
2. All sections for work that interface with the air/moisture barrier system must be integrated to establish and maintain the integrity and continuity of the whole building air barrier strategy. Lack of an integrated specification to assist in contractor coordination may lead to inadequate substrate installation, incompatibilities in product selection, or inadequacies in the installation, all of which affect the final performance of the air barrier.
3. Specify air barrier assemblies and accessories that shall accommodate movements of building materials by providing expansion and control joints as required.
4. The air barrier assembly shall be capable of withstanding combined design wind, fan and stack pressures, both positive and negative on the envelope without damage or displacement, and shall transfer the load to the structure.

   4.1. Materials of the air barrier assembly shall not displace adjacent materials in the assembly under full load.

   4.2. The air barrier assembly shall be joined in an airtight and flexible manner to the air barrier materials of adjacent assemblies, allowing for the relative movement of assemblies due to thermal and moisture variations, creep, and anticipated seismic movement.

   4.3. Specify air barriers that are durable to withstand the construction process.
5. Specify if the air barrier, cavity insulation and exterior cladding, as a system, shall require to conform to NFPA 285 as determined by building code.

   5.1. If required, specify materials and their execution to meet this requirement. Since NFPA 285 is an assembly test, cross reference and specify materials in other relevant specifications section to meet this standard.

6. Specify the air barrier to be either vapor permeable or impermeable based on the A/E's analyses that original construction moisture dissipates and subsequent moisture from weather or occupancy does not accumulate in any one element of the wall system.

    6.1. If the air barrier is deemed to be air permeable, specify the required vapor permeance as determined in accordance with ASTM E96.

        6.1.1. If both types of air barriers, permeable and impermeable, are to be used on the same project at different locations, clearly identify these different materials on the drawings and use nomenclature in the specifications consistent with that on the drawings to eliminate confusion.

7. A/E shall detail all transitions. Specify that the contractor shall refer to the drawings for all transitions and specify that submittals, manufacturer compatibility letters and shop drawings be supplied to ensure permanent tie-in with compatible materials at, but not limited to, the following locations:

    7.1.1. Foundation waterproofing, including penetrations, ties and anchors.

    7.1.2. Walls, windows, curtain walls, storefronts, louvers and doors.

    7.1.3. Different assemblies and fixed openings within those assemblies.

    7.1.4. Adjacent building existing buildings for additions or remodeling projects

    7.1.5. Soffits

    7.1.6. Construction, control, and expansion joints.

    7.1.7. All penetrations and utility connections through the air barrier

    7.1.8. Seismic and expansion joints.

    7.1.9. All other potential air leakage pathways in the building envelope.

8. Specify that the air barrier manufacturer and installer be present for the mock-up. Refer to the masonry section for mock-up requirements.

9. Specify that the submittals shall include the manufacturer's minimum adhesion value for each type of air barrier on each substrate.

10. If other critical building envelope components adhere/seal directly to the air barrier/transition membrane and rely on this adhesion to provide long term performance:

    10.1. Specify the minimum adhesion rate of the air barrier/ transition membranes to each critical substrate.

    10.2. Specifying ASTM D4541 adhesion testing to confirm that the air barrier is adhered to meet the minimum adhesion rate.

    10.3. Specify contractor required adhesion and compatibility testing be performed. Results of testing and manufacturer approval/compatibility letters shall be submitted by the contractor.

11. Specify that the Contractor is responsible for construction sequencing to allow the proper installation of a continuous air barrier in such a manner that other trades will not damage the membrane.

12. Specify that if penetrations and/or anchors are installed through the air barrier, a manufacture approved permanent repair or sealing application shall be performed in an air/watertight manner with manufacturer approved and compatible material and methods.
13. Specify that if flashing membranes come in contact with an air barrier that the material, adhesives, mastics, and etc. are compatible.

If the air barrier is to serve as part of the redundant moisture management system behind metal wall panels, typically at penthouses, air barrier flashing membranes shall be compatible, terminated 12-inches above the drainage plane with a stainless steel termination bar and cap sealed watertight with manufacturer approved mastic/sealant. The substrate to receive the air barrier flashing shall be cleaned, primed and prepared and material installed in accordance with the air barrier manufacturer by a air barrier-manufacturer approved contractor.

07 51 00 – Membrane Roofing

All roofing materials and procedures shall be as specified in this Section.
General: Refer to the Minnesota State "Roof Design Standards Manual- 3rd Edition, New Construction" for roofing standards and additional information, available at website: http://www.finance.mnscu.edu/facilities/design-construction/resources.html.

07 60 00 – Flashing and Sheet Metal

Specify flashing and sheet metal materials and procedures required by specific Project conditions. Use the following Example:

1. Specify gauge: Specify whether galvanized, stainless steel, pre-painted, pre-finished steel; or anodized aluminum.
2. Require isolation of dissimilar metals.
3. Specify that no fasteners penetrate through horizontal surfaces of parapet flashings or equipment curbs.
4. Through-wall flashing materials shall be as specified. No substitutions allowed. Specify the following for concealed flashing materials:

    4.1 Through-wall flashing at brick ledge shall be as provided under Section 07 13 00, but only when installed above approved waterproofing system.

    4.2 Waterproofing protection flashing shall be prefabricated, preformed, fully welded, stainless steel flashing fabricated from Type 304, 20 gauge, sheet steel, furnished and installed by the masonry Subcontractor.

    4.3 Through-wall flashing above grade, and brick ledge, where waterproofing is not applied to the brick ledge, shall be with a continuous sheet of stainless steel or copper flashing (See Minnesota State Exterior Masonry Design Standards). Install with 6" laps sealed with mastic on both contact surfaces.

    4.4 Flashing adhesive/mastic shall be asbestos free.

    4.5 Fasteners for through-wall flashing shall be stainless steel bolt or nail pin with a brass expansion sleeve for the veneer anchors and a metal alloy body for the termination bar.

4.6 Brick tie anchors that penetrate through-wall flashing shall be stainless steel Type 304 or 316, Hohmann & Barnard, HB-213 adjustable veneer anchors or Wire Bond, 2401 RJ-711 Adjustable Veneer Anchor with 2402 pintel (stainless steel).

4.7 Termination bar shall be 16 GA. x 1″, Type 304 stainless steel bar set in full bed of mastic and anchored with ¼″ x 1 ½″ long stainless steel bolt or nail pin with a brass expansion sleeve anchors or approved equal, at 6”on center but starting no more than 2 ″ from ends.

07 81 00 - Applied Fireproofing

1. Provide details of all concealed and exposed fireproofing conditions on the contract document construction drawings. The details shall include identification of the assembly, necessary dimensions, the UL assembly design and test numbers, the approved fire and time rating, and identification of all fireproofing products and accessories.
2. Products, execution and fireproofing thickness shall conform to the applicable code requirements for the fire-resistance required. Fireproofing assemblies shall comply with Underwriter Laboratories tests and product approvals in accordance with ASTM E 84-91a, surface burning; ASTM E -119, fire tests; ASTM E 605-77, thickness/density; ASTM E 736-86, cohesion/adhesion; ASTM E 759-86, deflection effects; ASTM E 761- **86, compressive strength; ASTM E 859-82, air erosion; and ASTM E 937-83, corrosion** of steel.
3. Sprayed fireproofing shall be factory-blended, Portland cement-based medium density cementitious material only, 100 % asbestos-free. New and replacement sprayed fireproofing shall be integrally colored blue or blue-green to identify it as material that does not contain asbestos.
4. Acceptable Products:

   4.1. CAFCO 400 by Isolatek International

   4.2. MONOKOTE Z-106/H by Grace Construction Products
5. Fireproofing work shall be performed by a firm acceptable to the sprayed fireproofing material manufacturer. A single manufacturer shall supply all fireproofing materials and accessories for each application. Materials and accessories shall be compatible.
6. Application equipment and procedures shall conform to the material manufacturer’s application instructions.
7. All fireproofing materials shall remain in place and intact when subjected to anticipated exposure to elements that may dislodge, crack, delaminate or erode the fireproofing

07 90 00 – Joint Sealants

1. Installer shall be a firm with five years of experience specializing in installing sealants.
2. Specify minimum and maximum depth and width for each sealant application.
3. Comply with recommendations of ASTM C1193 for use of joint sealants.

   3.1 At movement joints on exterior and back-up walls, specify elastomeric joint sealants to meet ASTM C920, Type M, Grade NS, Class 25, Use M.
4. Verify compatibility and adhesion of joint sealants in contact with all systems.

4.1 Silicone joint sealants are recommended by window manufacturers. Check compatibility with air barrier system manufacturer and adjust air barrier transition or termination materials accordingly.

5. Backer rod at exterior wall locations shall be non-oily, non-gassing, non-absorbent, non-staining polyolefin foam with a bi-cellular structure and/or acceptable material as recommended or accepted by the sealant manufacturer.

   5.1 Backer rod for exterior masonry joints shall comply with ASTM C1330, Type B.

6. Specify compressible joint filler for masonry joints as closed cell neoprene pad, ASTM D1056, Class RE41, with compressibility greater than 50%.

7. Specify that all concrete and masonry exterior joints scheduled to receive sealant are primed after other preparations are completed. The primer shall be as recommended by the manufacturer.

8. Specify that if a staining type primer is to be used, apply material in a manner that will prevent exposed stain residue.

9. Specify that all sealants or primers shall not be applied when the air or substrate temperatures are 40 degrees F or below.

10. Forward as a written submittal and comply with joint sealant manufacturer's written installation instructions

Division 08 – Openings

1. General:

1.1. The A/E, in consultation with the C/U Project Manager, shall finalize the approved manufacturers of hollow metal door/frame combinations and hollow metal frame/wood door combinations.

1.2. Commercial grade hardware shall be used.

1. 08 11 00 – Hollow Metal (Steel) Doors and Frames:

1.1. Specify only standard size hollow metal doors.

1.2. Hollow metal doors shall be fully-flush or seamless style.

1.3. Minimum Sound Transmission Coefficient (STC) of 26.

1.4. Specify early separate delivery of hollow metal door frames.

1.5. Specify that submittal shop drawings shall be started immediately following the contract Notice to Proceed to achieve early frame delivery. Shop drawings shall be submitted to the A/E for approval in sufficient detail to assure a comprehensive quality control check. Shop drawing door and frame numbers shall be numbered the same as on the A/E Drawings and Door Schedule.

1.6. Specify minimums of 18 gauge interior doors, 16 gauge interior frames, 14 gauge hot dipped galvanized or stainless steel exterior doors and frames. Doors shall be reinforced and prepared to receive hardware.

1.7. Frames shall be factory pre-assembled with mitered fully welded joints (weld on onside surface) ground smooth and delivered to the job site with spreaders. Knockdown and two-piece metal frames are not allowed. If knockdown and two-piece frames are unavoidable, Specifications shall require quality standards for securing and finishing these frames.

1.8. Specify frame anchors as appropriate for the wall types.

1.9. All fire-rated doors and frames shall bear the appropriate UL label. Specify the appropriate UL label.

1.10. Specify shop priming. All primers shall be applied uniformly: inside, outside, and under removable stops and trim.

1.11. Specify transport, handling, and job site storage protection requirements for doors and frames (spreaders, rapping, vertical storage, pallets, etc.).

1.12. Specify all frames in masonry walls shall be grouted full with Portland cement grout. Gypsum grout is not permitted.

1.13. Specify flush and seamless end channel closure pieces at door heads.

1.14. At the exterior wall, detail air barrier continuity with the exterior frame.

1.15. Through-wall flashing must be detailed at the exterior door head. See Section IV, 04 20 00 Unit Masonry.

2. 08 14 00 – Wood Doors

2.1. All wood doors shall be solid core, 5 ply, guaranteed against manufacturing defects for the life of the building.

2.2. Shop drawings shall be submitted in sufficient detail to assure a comprehensive quality control check. Shop drawing door numbers shall be numbered the same as on the A/E Drawings and Door Schedule.

2.3. Define requirements for delivery, storage, and handling to assure that manufacturer's criteria are met. Specify doors shall not be delivered until building is enclosed, warm, and dry, and the painting Subcontractors are on the job and ready to apply finish immediately after delivery.

2.4. Specify wood door adhesives shall be 100% waterproof.

2.5. Specify all wood doors shall be mortised from templates furnished by the hardware supplier and coordinated with the hollow metal supplier.

2.6. Specify all edges of wood doors shall be sealed.

2.7. Specify fire rated doors and assemblies which comply with codes.

2.8. Wood doors shall be protected with kick plates, typically stainless steel.

2.9. Coordinate electronic door hardware at doors requiring access control devices such as card readers or keypads with C/U Project Manager, electrical engineer or security consultant.

3. 08 31 00 – Access Doors and Panels

3.1. Provide maintenance access through doors or access panels to service all equipment including, but not limited to: filters, strainers, control actuators, isolation and shut-off valves, damper actuators, control valves, sound attenuators, boilers and chillers tube pull, knock-out panels, and mechanical room double doors.

3.2. Access doors in suspended gypsum board ceilings shall be flush mount, minimum 2’-6” x 2’-6”.

3.3. Access door panels shall be 14 gauge steel with 16 gauge steel frame and continuous hinges.

4. 08 33 00 – Coiling Doors and Grills

4.1. Overhead Doors:

4.1.1. Sectional overhead doors shall be used for both exterior and interior.

4.1.2. Sectional overhead doors, tracks and accessories shall be heavy duty rated.

4.1.3. Provide fire protection compliant with NFPA Chapter. 13. Provide sprinkler heads under the door when in the up position.

4.1.4. Coiling doors may be used where there are limitations with headroom and backroom for sectional overhead doors.

4.1.5. Doors shall be mounted on the interior face of the wall.

4.1.6. Doors shall be motor operated with an option of chain hoist.

4.1.7. Exterior doors shall be galvanized steel with foam injected polyurethane insulation.

4.1.8. Doors shall withstand the design wind loads in a fully closed position.

4.1.9. Clear, insulated glass shall be used for vision panels at eye level.

4.1.10. Include automatic door safety devices to prevent personnel or property damage.

4.1.11. Exterior doors shall be fully weather stripped.

4.1.12. Finish shall be powder coated on both sides of the slats or other door components.

4.1.13. Galvanized steel, concrete-filled pipe bollards shall be used to protect the edges of the overhead door opening(s).

5. 08 41 13 – Aluminum-Framed Entrances:

5.1. In addition to the requirements listed in this section, reference Section V, Division 08 – Openings: 08 41 13 – Aluminum-Framed Entrances: Guidelines and Minimum Requirements.

5.2. All aluminum entrance doors shall be monumental quality.

5.3. Storefront frames shall be used for door frames only. When the Project requires sidelights or transoms adjacent to entrances, glazed aluminum curtain wall framing shall be used with door frame inserts/sub-frames.

5.4. Verify with C/U Project Manager requirement for safety laminated glass at door panels, vestibule sidelights or windows.

5.5. At the exterior wall, detail air barrier continuity with the exterior frame.

5.6. Through-wall flashing must be detailed at the exterior door head. See Section IV, 04 20 00 Masonry & Stone.

6. 08 44 13 - Glazed Aluminum Curtain Wall
08 51 13 - Window General Standards

6.1. In addition to requirements listed in this section, reference Section V; Division 08 - Openings; 08 44 13 - Glazed Aluminum Curtain Walls: Guidelines and Minimum Requirements.

6.2. In addition to requirements listed in this section, reference Section V; Division 08 - Openings; 08 51 13 - Aluminum Windows: Guidelines and Minimum Requirements.

6.3. A/E shall coordinate with the Mechanical Engineer to meet B3 energy requirements and State Energy Code requirements for overall whole building performance, including eliminating any unnecessary thermal bridging.

6.4. Locate the thermal break of the curtain wall frame in relationship to the thermal break of surrounding backup wall.

6.5. All building façade work, including cavity wall sealant joints, masonry cleaning, and all roofing work, shall be completed prior to commencing the Curtain Wall or Window Pre-Construction Conference.

6.6. Expansion joint above head of curtain wall or window frames must be properly sized based on calculations identifying extent of structural frame movement, lateral and thermal movement associated with the curtain wall or window frames, and movement capabilities of the exterior/interior perimeter sealant joints

6.7. Head of curtain wall or window frames shall terminate below the bottom of roof structure (joists and beams) and shall not be allowed to be part of the roof parapet wall construction.

6.8. Rough opening dimensions are plum, level, and square and match the final shop drawings.

6.9. The bottom of exterior curtain wall or window openings shall be a minimum of 12" above the top of finished grade, exterior slabs on grade, or other horizontal ground surfaces. Coordinate exterior foundation waterproofing with curtain wall sills for a continuous seal.

6.10. Bottom of exterior curtain wall or window opening shall be a minimum of 30” above the roof deck for high/low roof conditions, roof monitors and clerestories and shall include double through-wall flashings that overlap the roof base flashing system. Door sills shall be no less than 24” above the roof deck for roof access doors.

6.11. Wall openings shall be thermally broken and as-built wall conditions shall not short circuit thermal break location of installed curtain wall or window.

6.12. Curtain wall or window assembly shall be installed vertical, not sloped.

6.13. Verify cavity wall openings are sealed to prevent cavity wall air migration into the curtain wall or window surround.

6.14. At the exterior wall, detail air/moisture barrier continuity with the curtain wall or window frame as described in the Minnesota State Exterior Masonry Design Standards and Facilities Design Standards. Verify compatibility of specified sealants, membranes, coatings, materials involved at the juncture between the air/moisture barrier and the curtain wall assembly's primary sealant joint or the window assembly's interior perimeter sealant joint.

6.15. Limit the size of fixed window units to a maximum window opening of 5 feet wide by 6 feet tall. Split mullion framing is not acceptable. For designs requiring larger window openings, consider using glazed aluminum curtain wall framing.

6.16. Operable windows shall not be used except when required for egress by building code or in Residence Hall projects.

6.17. Window frame receptor starter frames shall not be used except where head deflection of the opening is an issue in a window replacement project.

6.18. Sun Screens mounted to curtain wall frames require consultation with Minnesota State system office and are not allowed without approved design variance.

08 70 00 – Hardware

6.19. Provide a clear definition of extent and scope of finished hardware items.

6.20. Provide hardware section to the C/U Project Manager during the Design Development phase for review and approval.

6.21. Alarmed exit devices shall be approved for use by the C/U Project Manager. Investigate and recommend magnetic locking devices wired to the fire alarm system. Coordinate the design with the Electrical Engineer.

6.22. Specified hardware shall be suitable and adaptable to details and surrounding conditions.

6.23. Require UL listed hardware for fire-rated door assemblies.

6.24. Hardware on doors serving hazardous or restricted locations shall comply with the building code.

6.25. Specify that the Hardware Schedule shall be submitted to the A/E for approval prior to ordering. The Schedule shall include each hardware item, base metal, finish, and type number.

6.26. Specify hardware suppliers shall have local representation.

6.27. Specify submittal samples shall be furnished.

6.28. Specify that the hardware supplier shall furnish other Contractors, Subcontractors, and the Owner with copies of the final approved Hardware Schedule.

6.29. Necessary templates and schedules shall be submitted as soon as possible to hollow metal and wood door fabricators to proceed in accordance with their fabrication schedule(s).

6.30. Upon approval by the A/E of the Hardware Schedule, a Keying Schedule shall be submitted to the A/E for review and approval by the C/U Project Manager.

6.31. Manufacturer's written installation and adjustment instructions shall be followed.

6.32. Installation of hardware shall be by experienced personnel.

6.33. Hardware shall be fitted before the final coat of paint or other finishes are applied.

6.34. Hardware shall be permanently installed after finishing operations are complete and dry.

6.35. Hardware shall be properly adjusted and left in operating condition at the time of Substantial Completion. Coordinate with electrical Specifications for any special alarms and/or releases.

6.36. Provide construction cylinder cores, keys, and core puller for use during construction.

6.37. Power Door Operators:

6.37.1. The A/E shall provide a complete hardware schedule for the Project. Keying shall be coordinated during design with the C/U Project Manager.

6.37.2. Power-operated doors shall be activated using one switch on each side of each door, for traffic in each direction. Switches shall be mounted in an accessible location in accordance with applicable codes and regulations.

6.37.3. As a minimum, all new and remodeling projects shall provide one power-operated entrance door at all accessible entrances. Contact the C/U Project Manager for individual campus requirements for the Project.

6.37.4. Automatic electro-mechanical operators shall be head mounted and concealed with a hinged cover for easy access to the operator.

6.37.5. Power doors shall include an operator master control that is microprocessor based utilizing an encoder to sense door position.

6.37.6. For protection in case of electrical power failure, power door operators shall revert to free manual operation of the door.

6.37.7. A power door operator ON/OFF switch shall be located on the inside of the head and when in the OFF position, shall serve a second function of holding the door open.

6.37.8. Power operator's closing speed shall be field adjustable to not exceed one foot per second closing speed.

6.37.9. The operator shall include an electronic sensing device that will reverse the door from closing when a maximum force of 15 pounds is exerted to prevent the door from closing.

7. 08 80 00 – Glazing

7.1. Safety glazing shall be used as required by applicable building codes. Laminated safety glass is preferred for safety glazing wherever possible.

7.1.1. Safety glazing using tempered safety glass may be used only when necessary due to Low E coatings compatibility, glass weight or other applicable building code and/or design considerations. <u>All tempered glass shall be heat soak tested by the manufacturer a minimum of two hours</u> to minimize the potential of spontaneous breakage due to nickel sulfide inclusions.

7.1.2. An acceptable option is to combined both fully tempered safety glass and heat strengthened laminated safety glass. The insulating units are made up of 1/4" thick fully tempered heat soak tested glass for the exterior lite and 1/4"+ thick heat strengthened laminated safety glass for the interior lite.

This combination allows for a greater range of Low E coatings applied on the No. 2 surface of the tempered glass, while the inner lite of heat strengthened laminated safety glass has a better chance of remaining intact in the curtain wall frame if broken. This combination also results in an overall insulating glass thickness of slightly thicker than 1" and it it is less costly than laminated/laminated safety glass.

7.1.3. The Architect shall verify with local campus facilities management the use of security laminated glass in selected applications for security purposes.

7.1.4. Permanently marked with a certification label of Safety Glazing Certification Council or other certifying agency acceptable to the building official. The designation marking shall be of a type that once applied cannot be removed without destroying the glass.

7.1.5. Wire glass is not permitted.

7.2. Glass material shall be specified in accordance with performance criteria: daylight transmittance, daylight reflectance, U-value – winter night, U-value – summer day, shading coefficient, and relative heat gain.

7.3. Glass manufacturer's warranty:

7.3.1. Manufacturers' Warranty for Vertical Glazing: Provide written manufacturers' warranties for replacement of deteriorated glass, associated glazing product accessories and units, including coated, heat-strengthened and insulating glass units, due to normal conditions of use and not to handling, installation, protection and maintenance practices contrary to the glass manufacturers' published instructions. Defects shall include edge seal separation, delamination, cracks, blemishes or material obstructing vision through the glass. Should any defect develop during warranty period, such defects shall, upon request, be repaired or replaced at no additional cost to the Owner. Costs of such Work shall be borne by the defective product manufacturer. Provide written warranties for a ten (10) year warranty period from the date of final Substantial Completion.

7.3.2. Manufacturers' Warranty for Laminated Glass and Tempered Safety Glass: Provide written manufacturers' warranties for replacement of deteriorated laminated glass and tempered safety glass, associated glazing product accessories and units, due to normal conditions of use and not to handling, installation, protection and maintenance practices contrary to the glass manufacturers' published instructions. Defects shall include edge seal separation, delamination, cracks, blemishes or material obstructing vision through the glass. Defects covered by the warranty for heat-soaked tempered glass shall include spontaneous breakage of the tempered glass due to inclusions, particularly nickel sulfide. Should any defect develop during warranty period, the Contractor shall replace the glass, pay for the cost of replacement labor, including all incidental costs as a result of breakage. Costs of such Work shall be borne by the defective product manufacturer. Provide written warranties for a ten (10) year warranty period from the date of final Substantial Completion.

7.3.3. If there are separate manufacturers for each of the different glass types, then a separate warranty shall be provided by each manufacturer.

7.4. Exterior glass shall be insulating glass except at vestibule doors and/or sidelights within the vestibule.

7.5. Spandrel glass shall be insulating glass with a ceramic frit coating.

7.6. Insulating glass units shall be dual-sealed with primary and secondary seals.

7.7. Do not install glazing, sealants or other materials relying on adhesion when ambient and substrate temperatures are below 40°F and when the glazing channel substrates are wet from rain, frost, snow, condensation or other causes.

7.8. Furnish each type of product from a single manufacturer. Provide secondary materials only as recommended by manufacturer of primary materials.

7.8.1.1.1.1.1. Provide glazing systems capable of withstanding thermal movement and wind and impact loads (where applicable) as required by the Minnesota State Building Code, without failure, including loss or glass breakage attributable to defective manufacturing, fabrication, and installation; failure of sealant or gaskets to remain airtight and watertight; deterioration of glazing materials; or other defects in manufacturing or construction.

7.9. Provide glass thicknesses complying with ASTM E1300.

7.9.1. Design for wind loads as provided by the Structural Engineer of Record and meeting the Minnesota Building Code, whichever is more stringent.

7.10. Float glass is shall meet ASTM C1036, Type I, Quality-Q3, Class I (clear) requirements.

7.11. Laminated glass shall meet ASTM C1172 and comply with the testing requirements in 16 CFR 1201, Category II. Materials shall have no tendency to bubble, discolor, loose physical and mechanical properties after fabrication and installation.

7.12. Heat-treated float glass shall meet ASTM C1048, Type I (transparent glass, flat), Quality-q3 (glazing select).

7.13. All fire-protection-rated glazing shall be listed and labeled by a testing agency recognized by the IFC and Minnesota State Building Code for the design fire-protection ratings, based on testing in accordance with NFPA for door assemblies and NFPA 257 for window assemblies.

Division 09 – Finishes

1. Genera:

    1.1. For each type of finish work, specify minimum and maximum requirements of substrate and ambient conditions for installation including, but not limited to, temperature and moisture requirements.

    1.2. Specify ventilation and isolation requirements to avoid complaints regarding noxious fumes and out gassing from volatile organic compounds.

    1.3. Specify “attic/stock” extra quantities of all finish products including, but not limited to: ceiling tile, wall and floor tile, carpet, vinyl composition tile, sheet tile, wall base, paints and wall coverings.

    1.4. Metal studs shall be used for interior non-load bearing partition walls only.

    1.5. Metal studs shall be minimum 25-gage thick rolled steel, galvanized, channel shaped, punched for utility access.

    1.6. Metal studs at framed doors and windows in partition walls shall be minimum 20-gage. At each door opening of 3’-0” or more wide, provide double studs back to back.

    1.7. Runners shall be of same material and finish as studs.

    1.8. Stud framing shall be braced for rigid framing.

    1.9. Double studs shall be used at each gypsum board control joint.

    1.10. Stud splicing is not allowed.

    1.11. One bead of acoustical sealant shall be placed between runner and substrate to achieve acoustical seal.

    1.12. Additional blocking, brackets, steel channel supports, etc. shall be used for securing and support of wall mounted fixtures, such as plumbing fixtures, toilet partitions, wall cabinets, miscellaneous hardware, etc.

    1.13. All gypsum boards shall be minimum 5/8” thick with tapered edges. Paperless gypsum board shall be specified for exterior walls and high humidity and wet areas.

    1.14. Gypsum construction shall be isolated with control joints when:

        1.14.1. Partitions or ceilings of dissimilar construction meet and remain in same plane.

        1.14.2. Wings of “L”-, “U”-, and “T”- shaped ceiling areas.

        1.14.3. Expansion or control joints occur in base wall construction and/or building structure.

    1.15. Control joints shall be used in the face of gypsum partitions and ceilings when size of surface exceeds the following:

        1.15.1. Partitions: 30’ maximum in either direction.

        1.15.2. Interior ceilings (with perimeter relief): 50’ maximum in either direction.

        1.15.3. Interior ceilings (without perimeter relief): 30’ maximum in either direction.

1.15.4. Exterior ceilings: 30' maximum in either direction.

1.16. Interior finishes shall be appropriate for the design function of the building and spaces. Gypsum board finish shall be Level 4 finish per GA-214.

1.17. Conform to the requirements of the B3 Guidelines, Section I.2, specify Low-emitting Materials.

1.18. Wall coverings are not allowed on perimeter walls.

1.19. Grouts for restroom tile systems shall be compatible with Pedestrian Traffic Coatings (interior waterproofing) in Division 07 18 13. (Intermediate coat is to be eliminated for ceramic floor tile application). Set the tiles in a thin-set grout mortar and use an epoxy grout for the floor tile joints. On wall tile use a multipurpose latex grout mix for the vertical tile joints.

1.20. The A/E shall provide a complete paint schedule and prepare labeled material samples of all finishes for the C/U Project Manager's review and approval.

1.21. Terrazo Flooring (09 66 00) if specified, include the following minimum requirements:

1.21.1. PREPARATION OF THE CONCRETE FLOOR:

1.21.1.1. Moisture Vapor Transmission Test: ASTM F1869. Perform by independent testing laboratory to determine suitability of concrete subfloor to receive floor covering with regard to moisture content and curing compounds. Ensure concrete is within floor manufacturer's recommended limits prior to installation.

1.21.1.2. ASTM F1869 Qualitative Anhydrous Calcium Chloride Test: Do not install flooring on substrates with moisture vapor permeance in excess of 3 pounds water vapor per 1000 square feet per 24 hour period or the maximum permeance allowed by the floor covering manufacturer. Do not proceed with floor covering application until condition is corrected.

1.21.1.3. Perform pH and adhesion tests to concrete substrate in accordance with floor manufacturer's recommendations. Ensure concrete is within National Terrazzo and Moisture Association (NTMA) and floor manufacturer's recommended limits prior to terrazzo installation.

1.21.1.4. Mechanically abrade (shot-blast) concrete subfloor to remove inappropriate curing agents and to open pores of concrete surfaces to allow penetration of bonding agent. Completely remove cleaning residue. Acid washing and grinding are not acceptable.

1.21.1.5. Shot or bead blast substrate to provide surfaces within tolerances required by NTMA for epoxy terrazzo.

1.21.1.6. Repair substrate cracks in a manner to prevent telegraphing of defect through to finished terrazzo surface in accordance with manufacturer's written instructions.

1.21.1.7. Fill voids and establish slopes with concrete patching material.

1.21.1.8. Clean area to receive terrazzo of loose chips and foreign matter.

1.21.1.9. At existing cracks and at control joints, apply self-adhering crack suppression membrane, 6 inches wide, centered over cracks and joints.

1.21.1.10. Prime entire area with flooring manufacturer's primer/sealer.

Division 10 – Specialties

1. General:

1.1. The A/E Design Firm shall prepare a complete sign schedule for the Project. Both interior and exterior signs shall be coordinated with and approved by the C/U Project Manager.

1.2. All signage shall comply with ADA and code requirements.

1.3. Louvers:

1.3.1. All louvers and vents (sizes, shapes, colors, etc.) at exterior walls shall be coordinated for aesthetically pleasant appearance of the buildings.

1.3.2. High performance blade louvers shall be used where water penetration is extremely critical.

1.3.3. Louvers shall withstand the applicable design wind loads.

1.3.4. All louvers shall be finished after assembly in the manufacturer's plant.

1.3.5. Bird screen and sill pan flashing shall be provided and installed with louvers at exterior walls.

1.3.6. At all exterior wall louvers, detail through-wall flashing at the head of the opening and sill pan flashing at the bottom of the opening. See Section IV., 04 20 00 Unit Masonry

1.3.7. Weather stripping shall be used at openings to reduce air infiltration.

1.3.7.1. Air/moisture barriers shall be installed into openings for continuity to the opening system including louvers.

1.4. Chair rails (minimum 4" high profile) shall be considered for class rooms and assembly areas.

1.5. 2"x2", minimum 4'-0" high, heavy duty corner guards shall be installed to protect exposed interior wall corners in high traffic areas.

1.6. The A/E shall coordinate the locations of visual display surfaces with the C/U Project Manager.

1.7. All directories, display boards, tack boards, marker boards and chalkboards shall be factory-built units ready for assembly and installation.

1.8. All marker boards and chalkboards shall include map rails and trays.

1.9. All signs shall comply with Americans with Disabilities Act Accessibility Guidelines requirements.

1.10. All fire-extinguisher cabinets shall be built-in recessed at locations as per codes. Include all fire extinguishers for cabinets and other locations as per codes.

1.11. Fire rated extinguisher cabinets shall be installed in fire rated walls.

1.12. Extinguisher cabinets or other accessories shall comply with Americans with Disabilities Act Accessibility Guidelines requirements.

1.13. Extinguisher cabinets or accessories shall include NFPA compliant signage.

1.14. Portable fire extinguishers shall be provided within 30 foot of travel distance of commercial-type cooking equipment. Kitchen areas that use deep fat fryers shall have Class K fire extinguishers as per Minnesota State Fire Code, Chapter 9, 904.11.5. A sign shall be conspicuously placed near the extinguisher that states that the fire protection system shall be activated prior to using the fire extinguisher. The signs shall state "IN CASE OF APPLIANCE FIRE, USE THIS EXTINGUISHER ONLY AFTER FIXED FIRE SUPPRESSION SYSTEM HAS BEEN ACTUATED" or other similar wording.

1.15. All toilet partitions, screens, doors, compartments and pilasters shall be non-corrosive, waterproof and non-absorbent material.

1.16. Toilet partitions shall be minimum 55" high and mounted at 14" above finish floor. Wall brackets shall be continuous.

1.17. All toilet stall doors shall have 1 coat hook and bumper.

1.18. All toilet accessories shall be stainless steel.

1.19. Washroom accessories shall meet barrier-free washroom guidelines as established by ADA accessibility guidelines.

1.20. All accessories fasteners shall be tamperproof, security type.

1.21. The A/E shall determine from the C/U Project Manager which toilet accessories may be furnished by the C/U for installation by the Contractor.

1.22. The A/E shall provide a complete toilet accessories schedule for the Project.

1.23. The A/E shall review the need for recessed floor mats at all main entrances.

1.24. All movable partitions shall be a series of paired flat panels hinged together in pairs, manually operated, top supported with operable floor seals.

1.25. Movable partitions shall have minimum acoustical rating of minimum STC 50. There shall be vertical interlocking sound seals between panels along with horizontal top seals.

Division 12 – Furnishings

1. All Predesign, design, and construction Projects shall include consideration of the State of Minnesota's Correctional Industries Program, MINNCOR Industries, consistent with Minnesota Statutes Section 16B.181, subdivision 2, paragraph(c), in Predesign planning and product Specifications.

Division 11 – Equipment

1. Equipment shall be recommended by the A/E after consultation with the C/U Project Manager.

Division 14 – Conveying Equipment

14 20 00 – Elevators

1. Elevators:

    1.1. Verify the C/U's product preference, and service records.

    1.2. Elevators capacity shall be sized to accommodate the movement of an emergency medical gurney, equipment, furnishings, etc. and meet IBC and ADA requirements. (*The minimum size elevator that will accommodate a 24" x 84" stretcher is **3500 lb**., with side opening (not center-opening) door.*)

    1.3. The A/E shall select the optimal elevator type for the Project depending upon the elevator travel distance.

    1.4. Elevator cabs shall include an emergency telephone connected to a continuously monitored telephone line, as required by the elevator code official having jurisdiction. Coordinate the installation of the telephone line with the electrical engineer or Telecommunications consultant.

    1.5. Elevator entrances and doors shall be satin finish stainless steel only.

    1.6. The A/E should consider the elevator type that does not require any machine room.

    1.7. Holeless hydraulic elevators should be considered for three story or less buildings.

    1.8. All elevator motors and equipment shall be energy efficient.

    1.9. Elevator hydraulic systems shall use biodegradable vegetable oil.

    1.10. Elevator(s) should be located in a central location within the main entrance lobby of the building and shall be visible from the main entrance.

    1.11. Elevator(s) should be located in close proximity of the geometric center of the building to allow balanced access to all parts of the building.

    1.12. The Engineer shall review the need for emergency electrical power service to elevators and review this with the C/U Project Manager.

    1.13. Elevator shafts and equipment rooms shall include heat and smoke exhaust and ventilation relief systems.

    1.14. Coordinate the need for access controls within the elevator cab or outside the elevator doors for elevator access. Consider installing additional travelling cables to

the elevator controller for connection to card readers that may be added in the future. Coordinate requirements for elevator access control with the electrical engineer or security consultant.

2. Waterproofing of Elevator Pits:

   2.1. All elevator pits below grade shall be continuously foundation waterproofed on walls and floors by sandwiching the horizontal waterproofing on a minimum 2" mud slab constructed 24" larger than the pit footing perimeter so the horizontal waterproofing can make a continuous 12" tie-in to the wall waterproofing. Hydraulic cylinder penetrations can be boxed out and packed with bentonite clay as a gasket seal before concrete infilling.

Division 21 - Fire Suppression

1. General:

   1.1. The A/E shall design a complete fire suppression system. The A/E shall coordinate the equipment selection and design with the C/U Project Manager.

   1.2. The basis of design shall consider building configuration, structure and required systems to minimize human injury, loss of facility function and property damage.

   1.3. Continue existing equipment numbering sequence for new equipment in existing construction and additions. Start a new sequence of equipment numbers for new system types and new buildings only.

   1.4. Facility fire suppression system interruptions shall be scheduled with the C/U one week in advance. Interruptions shall be planned to cause the least interference with normal institutional schedules and business routines. Interruption duration shall not exceed one day.

2. Current Codes and Standards:

   2.1. The latest adopted edition of each code shall be applied to the design. In cases where there is a conflict between codes, the most conservative design standard shall be adopted. Prior to starting design, the designer shall contact state and local officials to determine which codes (including, but not limited to the following list) have been adopted and any amendments that have been issued and are in effect:

      2.1.1. Minnesota State Building Code and International Building Code.

      2.1.2. MN Department of Labor & Industry, MN Plumbing Code, Chapter 4715.

      2.1.3. MN Department of Labor & Industry , MN Energy Code.

      2.1.4. MN Department of Public Safety, MN State Fire Code and Related Statutes.

      2.1.5. MN Department of Labor & Industry, OSHA, Chapter 182, 5205, 5206, 5210, 5215.

      2.1.6. MN Department of Labor & Industry, International Mechanical Code, MN Amendments to International Mechanical Code.

   2.2. Designs shall incorporate the use of the following standards:

2.2.1. ASHRAE Standard 90.1 – Energy Standard for Buildings Except Low-Rise Residential Buildings

2.2.2. ASHRAE Standard 62 – Ventilation for Acceptable Indoor Air Quality

2.3. Contact the Minnesota Department of Labor & Industry, Building Codes and Standards Division for requirements to obtain building code approval information for plan review and inspections for fire suppression systems within Minnesota State facilities.

3. Fire Protection:

3.1. General: Prior to starting design work, provide documentation of consultation with the Fire Protection Authority having jurisdiction over the building in question. Provide documentation of any change of use/change of occupancy and final classification of occupancy by the Fire Protection Authority. Provide wet type sprinkler systems unless other type(s) are required by code.

3.2. Invite the local fire marshal to be present at the Substantial Completion inspection walk-through.

3.3. In areas which have finished ceilings, flush concealed pendent type sprinkler heads shall be used. Consult with the C/U Project Manager for other sprinkler head type. Sprinkler heads shall be located on the Architectural reflected ceiling plan in spaces that are architecturally sensitive.

3.4. Design Analysis: Fire protection design analysis shall be provided for all designs and shall address the fire protection requirements documented herein. Coordinate with other disciplines to provide a complete documented design analysis addressing the following minimum fire protection provisions:

3.4.1. Building Code Analysis (type of construction, height and area, separation protection, etc.).

3.4.2. Classification of occupancy and hazardous areas.

3.4.3. Specific compliance with NFPA.

3.4.4. Requirements for fire-rated walls, fire-rated doors, fire dampers with ratings and smoke barriers.

3.4.5. NFPA 101, Life Safety Code.

3.4.6. Automatic suppression systems and protected areas.

3.4.7. Water supply and pressure requirements.

3.4.8. Smoke control systems.

3.4.9. Fire detection system (type of system, location of detectors, zones).

3.4.10. Fire alarm system (type of system, location of equipment, zones).

3.4.11. Standpipe systems and fire extinguishers.

3.4.12. Interior finish ratings.

3.4.13. Connection to and description of fire alarm control panel and reporting system.

3.4.14. Fire Department access.

3.5. Plans and Calculations: Working plans and calculations shall be prepared and submitted for approval to the local authority have jurisdiction by a registered Professional Fire Protection Engineer, in accordance with the applicable NFPA code. New sprinkler system protection areas 1,500 square feet or greater shall be designed using hydraulic calculations in accordance with NFPA 13. Calculations shall show the design will provide adequate water supply based on recent water flow test data. Plans shall show locations for standpipes, test heads, fire department connection valves, and water flow indicators on the Drawings. The Fire Protection Engineer shall provide notes on the Drawings for any special conditions, siamese connections, and fire pumps.

3.6. Water Flow Testing: The A/E shall obtain and provide documentation of recent witnessed water flow tests at the nearest municipal water fire hydrants to determine available water supply for buildings with water based fire protection systems. Coordinate with the municipality and the local Fire Protection Authority having jurisdiction to obtain test flow data.

4. Water Supply:

4.1. Water Demand for Sprinkled Facilities: Provide complete documentation of water demand required for sprinkler protection including occupancy, discharge density, design area and other building construction features. Water demand, design density, design area and water demand for hose streams shall be designed using the Area/Density Method of NFPA 13.

4.2. Water Supply Pressure Requirements: Provide complete documentation of water supply pressure requirements based on the most demanding pressure of the total system.

4.3. Total Water Demand: Provide complete documentation of the total water demand for occupancies with automatic sprinkler systems. The total water demand for the building shall be the sum of domestic building use plus the sprinkler system demand and the hose stream demand. The fire protection system shall be designed so that the automatic sprinkler system is provided the required sprinkler system water demand at all times at the pressure necessary to produce the required sprinkler density over the most hydraulically remote area of sprinkler operation.

4.4. System Connections: Provide separate fire water main and building domestic use water main connections to the local municipal water system. Otherwise, provide one connection to the local municipal water main, sized for the total water demand for the building (as defined above) and provide a means to automatically isolate the building domestic water demand upon activation of the automatic sprinkler system. The system shall require manual reset to open the isolation valve on the building domestic use side.

4.5. Standpipes: When required, provide and design standpipe systems in accordance with NFPA 14, Installation of Standpipe, Private Hydrant, and Hose Streams.

4.6. Glycol shall not be used in fire protection systems without approval by the C/U Project Manager and the Fire Protection Authority having jurisdiction.

5. Fire Pumps:

   5.1. Provide fire pumps as required by the Fire Protection Authority having jurisdiction. Provide fire pumps in accordance with NFPA 20, Standard for the Installation of Stationary Pumps for Fire Protection. Fire pumps, motors and other related equipment shall be UL listed and approved by FM.

   5.2. Location: Locate fire pumps in a 2-hour rated room, in a location with direct access from the exterior if possible.

   5.3. When a fire pump is required, use electric motor driven if allowed. Use an energy efficient motor. The power supply for an electric fire pump shall comply with the requirements of NFPA 20, Standard for the Installation of Centrifugal Fire Pumps.

   5.4. When a fire pump is required, review the requirements for emergency power capability with the Fire Protection Authority having jurisdiction.

6. Fire Water Distribution:

   6.1. Main Distribution Systems: Shall be designed in accordance with American Water Works Association Manual M31, Distribution System Requirements for Fire Protection and NFPA 24, Installation of Private Fire Service Mains and their Appurtenances; unless otherwise required by the Fire Protection Authority having jurisdiction. If backflow preventers are required, design the installation in accordance with NFPA 13 utilizing a double check valve type backflow preventer. Provide test connections downstream of backflow preventers for flow tests at system demand. Include flow switches in all risers with connection to the building fire detection and alarm system.

   6.2. Valves: Provide either post-indicating or outside-stem-and-yoke type control valves. Provide test and drain connections for water flow testing and monitoring requirements. Include valve position indicator sensors for electronic monitoring connections to an off-site advisory service.

   6.3. Hydrants: Provide UL listed, FM approved, fire hydrants installed adjacent to paved areas accessible to fire department apparatus. Design the installation in accordance with NFPA 24. Provide bollards to protect hydrants located near vehicle traffic.

   6.4. Avoid the use of private water tanks to meet facility flow requirements. If a tank is needed, specify the tank to comply with NFPA 22, latest edition.

   6.5. All piping shall be minimum schedule 40 steel. Flexible pipe may not be used for sprinkler head drops.

7. Chemical Extinguishing Systems:

   7.1. Dry Chemical Extinguishing Systems: Design fixed, dry chemical fire extinguishing systems, in areas required, in accordance with NFPA 17, Dry Chemical Extinguishing Systems.

   7.2. Wet Chemical Extinguishing Systems: Design fixed, wet chemical fire extinguishing systems for protection of cooking surfaces. Include valve position indicator sensors for electronic monitoring connections to an off-site advisory service.

7.3. For all chemical extinguisher systems, include flow sensors or detectors with connection to the building fire detection and alarm system.

Division 22 – Plumbing

1. General:

1.1. The A/E shall provide a complete plumbing system. The A/E shall coordinate the plumbing equipment selection and design with the C/U Project Manager.

1.2. The basis of design shall consider building population, potential visitor's population for event and assembly spaces, and gender ratio for plumbing fixture determination. Fixture units shall be quantified for sanitary drainage, venting and cold/hot water piping systems. For new and remodel construction, the quantity of toilet fixtures may exceed the minimum required by code to meet program needs.

1.3. Plumbing Equipment Schedules: Provide equipment schedules on the design Drawings for plumbing fixtures, flush valves, fixture valves, floor drains, trench drains roof drains, overflow roof drains, tanks, water heaters, fuel oil equipment, water coolers/fountains and other numbered plumbing devices. Schedules shall include manufacturer, model number, service connection size, function and applicable accessories. Provide equipment basis of design cut sheets to C/U Project Manager for review and approval during the Design Development phase. Specify that fixtures and valves of a given type shall be from a single manufacturer. Where the Project is a remodel, match existing fixture and valve types when practical.

1.4. Continue existing equipment numbering sequence for new equipment in existing construction and additions. Start a new sequence of equipment numbers for new system types and new buildings only.

1.5. Schedule facility plumbing system interruptions with the C/U one week in advance. Interruptions shall be planned to cause the least interference with normal institutional schedules and business routines.

1.6. The A/E shall inquire about the long-range plans for the facility and incorporate long-range plans into the design when practical.

1.7. Provide Americans with Disabilities Act (ADA) fixtures as required by the code authority having jurisdiction.

1.8. Provide ASSE-1010 certified water hammer arrestors recommended by ASSE-1010 to prevent water hammer. Vertical capped pipe columns are not acceptable.

1.9. Provide dielectric couplings at connections of dissimilar metals.

1.10. Provide isolation valves, drain valves and vacuum breakers on hot water and cold water, compressed air, natural gas and medical gas systems to isolate rooms or labs without affecting adjacent areas. Provide isolation ball valves for all hot water and cold water branches off service mains. Provide isolation ball valves off of mains or branches to each toilet room group and provide service stops for each plumbing fixture served.

1.11. Provide separate sanitary and storm sewer piping systems.

1.12. For remodel projects where piping is being capped, remove abandoned piping back to active mains to prevent stagnant water in abandoned branch.

1.13. When selecting, sizing and locating equipment, design for future removal and replacement access.

1.14. Provide plumbing chases for new construction rest room groups with more than three fixtures. Chases shall be a minimum of 30” clear width to accommodate piping maintenance. For remodel work, provide access chase whenever possible.

1.15. Plumbing system piping and components shall be clearly labeled.

1.16. Provide equipment tags for each pump, tank, heat transfer unit and control valve and similar components.

1.17. Provide an approved system for indicating the location of concealed valves.

1.18. Label piping at each side of wall penetrations, and at 25 foot intervals, minimum.

1.19. Provide buried indicator tape 18” above underground plumbing pipe outside buildings. Provide trace wire for location of non-metallic underground piping. Provide a minimum of 12” of clean, screened sand all around buried pipes (12” above, below and on both sides).

1.20. Provide plumbing riser diagrams for all plumbing systems.

1.21. Energy Conservation: Plumbing equipment shall comply with applicable energy standards. Equipment and systems that exceed the standards shall be used when total life cycle cost analysis indicates sufficient energy savings. Energy upgrades shall be approved by the C/U Project Manager.

1.22. Reference B3 Guidelines, Guideline S.8 with regard to overall building water measurement and device water measurement.

2. Current Codes and Standards:

2.1. Apply the latest adopted edition of each code to the design. In cases where there is a conflict between codes, the most conservative design standard shall be adopted. Prior to starting design, the designer shall contact state and local code officials to determine which codes (including, but not limited to the following list) have been adopted and any amendments that have been issued and are in effect:

2.1.1. Plumbing systems shall conform with the MN Department of Labor & Industry Plumbing Code, Minnesota Rules, Chapter 4715 & 4716, latest edition, and additional requirements of the Authority having Jurisdiction.

2.1.2. MN Department of Labor & Industry, Minnesota State Building Code.

2.1.3. MN Department of Labor & Industry, MN Energy Code, Minnesota Rules, Chapter 1323.

2.1.4. MN Department of Public Safety, State Fire Marshall, MN State Fire Code and Related Statutes.

2.1.5. MN Department of Labor & Industry, OSHA, Minnesota Rules, Chapter 5205through 5215.

2.1.6. MN Department of Labor & Industry, International Mechanical/Fuel Gas Code, MN Rules, Chapter 1346

2.2. Designs shall incorporate the use of the following standards:

2.2.1. ASHRAE Standard 90.1 – Energy Standard for Buildings Except Low-Rise Residential Buildings

2.2.2. ASHRAE Standard 62 – Ventilation for Acceptable Indoor Air Quality

2.3. Contact the Minnesota Department of Labor and Industry, Building Codes and Standards Division for requirements to obtain building code approval information for plan review and inspections for plumbing systems within Minnesota State facilities. Reference the B3 Guidelines, Section S.8, for water use reduction requirements.

3. Building Storm Sewer:

3.1. Storm drainage design shall include consideration of college's or university's MS4 campus storm water management plan.

3.2. The basis of design shall consider roof plan areas for determining storm drainage pipe size. Storm drainage design shall include roof drains, leaders and conductors and shall to be connected to an interior storm sewer system. Primary roof drain lines shall not discharge on grade.

3.3. Roof drainage systems shall be sized in accordance with rainfall intensity-frequency based on the most recently published 100-year, 1-hour rainfall data for the location. (4" minimum)

3.4. Overflow/backup roof drains shall be an interior system separate from the primary roof drain system. Overflow roof drains shall discharge to a visible location outdoors. Discharge nozzles should be located a maximum of 3 ft. above grade and have splash pans to prevent erosion. Overflow scuppers are acceptable with permission of the Minnesota State Program Manager.

3.5. The base of all storm sewer pipe stacks shall have accessible cleanouts. Coordinate access panels with Architectural Drawings.

3.6. Provide roof drains, leader pipe, overflow drain and overflow pipe sizes in accordance with the Minnesota Plumbing Code.

3.7. Horizontal rain leaders below roofs shall be insulated.

3.8. Coordinate plumbing system roof penetrations including vents, storm drains and overflow drains with roof design consultant and the C/U Project Manager.

3.9. New and replacement roof drains shall be Model 21500 as manufactured by the Josam Company, 525 W. U.S. Hwy 20, Michigan City, IN 46360, or Series RD1200–JD - STR, manufactured by MIFAB, Inc., 3380 Sheridan Dr. #364, Amherst, NY 14226. Roof Drains: Coated cast iron roof drain with bottom threaded or no-hub outlet, metal deck clamp, and cast iron dome that are vandal-proof secured. No substitutes allowed. Mechanical systems designer shall coordinate with the roof design consultant to specify these specific models of roof drain for use.

4. Building Sanitary Sewer, Fixtures & Floor Drains:

    4.1. When possible, provide fixtures conforming to the National Standard Plumbing Code for water conservation.

    4.2. Before placing into service, new sanitary sewer systems shall pass a water exfiltration test or a low pressure air test. Maximum leakage shall be in accordance with local requirements.

    4.3. Provide at least one floor drain in toilet rooms containing at least one toilet/urinal fixture.

    4.4. Consider installing trap primers for seldom used floor drains and sinks (such as in mechanical/electrical equipment rooms, janitors closets, etc.) to prevent backup of sewer gases.

    4.5. Provide trap primers for traps serving fixtures in air plenum spaces.

    4.6. Consult ADA requirements for special design requirements for toilet rooms, showers and fixtures.

    4.7. Provide wall hung fixtures in toilet rooms, unless ADA has other requirements.

    4.8. Use hard wired, low voltage sensor-operated flush valves for new construction. In remodel situations, use battery operated or hard wired flush valves as the installation dictates. All flush valves installed at a campus shall be by the same manufacturer.

    4.9. Provide fixture stops for lavatories, sinks and similar fixtures with ½" threaded or sweat inlet fitting. Compression inlet fittings are not acceptable. Outlets shall be ½" risers.

    4.10. Provide accessible cleanouts at bases of all waste stacks and at all changes of direction. Coordinate access panels with Architectural Drawings

    4.11. Provide minimum 3" waste line for water closets.

    4.12. Provide minimum 2" waste line for shower drains.

    4.13. Provide minimum 3" waste line for floor drains.

    4.14. Provide all urinals with individual 2" waste lines and cleanouts (individual 2" or common 3" on the riser).

    4.15. Provide minimum 4" horizontal main waste sanitary sewers.

5. Vent Systems:

    5.1. Protect the seal of every fixture trap in the plumbing system by an individual vent in accordance with the National Standard Plumbing Code.

    5.2. Piping shall not be placed in exterior walls or within ceiling/roof insulation space. Piping shall be confined to interior walls and to open areas below ceiling/roof insulation. The only exceptions to this are exterior wall hydrants and plumbing vents.

6. Domestic Cold Water:

6.1. Water service pipes shall be sized in accordance with the Plumbing Code.

6.2. Service lines shall enter the building in an accessible location. Provide a building isolation valve, strainer (if required by water department supplying water meter), water meter, meter service valves, meter bypass line (if allowed), separate connection for underground landscape irrigation system with meter if applicable, and additional components as required by the local water district.

6.3. Maintain separation distance per local Authority Having Jurisdiction for underground domestic water lines and underground sanitary sewer lines.

6.4. Drains shall be installed on the fixture side of all service valves located inside a building.

6.5. Piping shall not be placed in exterior walls or within ceiling/roof insulation space. Piping shall be confined to interior walls and to open areas below ceiling/roof insulation. The only exceptions to this are exterior wall hydrants and plumbing vents.

6.6. Cross connections between water supply piping and waste, drain, vent or sewer piping are prohibited.

6.7. When the municipal supply water pressure to a building exceeds the required water pressure by 10 psig, a pressure reducing valve shall be provided. Provide pressure booster system if system pressure is not available.

6.8. Consider increasing water distribution main sizes based on anticipated future installations of fixtures or equipment.

6.9. Provide a Reduced Pressure Zone (RPZ) backflow preventer in the municipal water supply main after the water meter. Single check valves are not acceptable. Provide access to RPZ for testing and maintenance. Provide adequate drainage near each device.

6.10. Provide water softening treatment equipment for potable water supply and make-up feed for chilled water, hot water and steam systems when the system water hardness exceeds 1.0 grain per gallon. Water softening equipment shall include a softener unit and a regeneration brine tank utilizing common salt (NaCl) for regeneration of the softener exchange material.

6.11. Protect the supply outlet connection to each point of use fixture or appliance that is subject to back-siphonage of non-potable liquids, solids or gases in accordance with the Plumbing Code.

6.12. Provide hose bibs on exterior walls as required and in locations as coordinated with the C/U Project Manager.

6.13. Domestic water supply lines 2-1/2” diameter and smaller shall be copper. Piping above 2-1/2” shall be galvanized steel or copper.

6.14. Review with the C/U Project Manager the need for additional water meters to record use for selected equipment, building functions or areas.

7. Domestic Hot Water: Service water heating temperatures shall be in accordance with the Plumbing Code, Applications; except as follows:

    7.1. General Service, showers, sinks, and toilet rooms shall be supplied with 120°F hot water.

    7.2. Laboratory sinks shall be supplied with 120°F hot water.

    7.3. Dish washers shall be supplied with internal boosters to create 180°F hot water.

    7.4. Instantaneous Water Heaters

        7.4.1. Gas-fired or electric instantaneous or semi-instantaneous water heaters may be provided for lavatory banks less than 5 fixtures.

        7.4.2. Ensure that instantaneous water heater turn on flow is less than minimum flow rate of 1 of connected fixtures (i.e. 1 lavatory).

        7.4.3. Set discharge temperature of instantaneous water heater to 120°F.

    7.5. Hot water recirculation: Use circulation pump(s) for hot water circulation loops as needed to provide hot water at each fixture within 10 seconds.

    7.6. Do not install check valves and backflow preventers upstream of water heaters unless required by code. If required, include an expansion tank to accept thermal expansion from the water heater.

    7.7. Expansion of piping shall be estimated and accounted for as required.

    7.8. When practical, do not install large storage gas/oil fired water heaters. Use separate storage tank with low volume high efficiency or copper fin type water heater.

    7.9. Avoid the use of electricity for large-volume water heating. Use natural gas, or high temperature heating water or building steam when available, for heating water.

    7.10. Where converters are used to produce domestic hot water, provide two pumps (one standby) and provide continuous flow through the converter for extended life. Provide lead/lag control for the pumps.

    7.11. Provide temperature and pressure safety relief valves (or combination valves) on hot water heaters, generators, boilers and storage tanks.

    7.12. Consider evacuated tube solar collectors for domestic hot water demand, based on life cycle cost benefit analysis.

    7.12.1. Provide separate pumping system for solar hot water collectors, with control panel.

    7.12.2. Provide separate solar hot water pre-heating tank piped to pumping system, and piped to main storage water heater(s).

    7.13. Provide 3-way valve on piping that directs flow through a finned tube for heat dissipation times when hot water could be produced and tank temperature does not require hot water production.

8. Compressed Air Systems:

    8.1. Provide compressed air for maintenance and cleaning as required by facility or program function.

8.2. Piping shall be designed to allow for the removal of moisture, particulate and foreign material. Provide coalescing oil filters and particulate filter at the discharge of each compressor. Provide refrigerated or desiccant dryers when needed to maintain air quality.

9. Laboratories:

9.1. Prior to starting laboratory facility design, document risk assessments to identify and understand hazards, develop a Chemical Hygiene Plan (CHP), compile Material Safety Data Sheets (MSDS) on all hazardous materials within the laboratory and document environmental requirements for temperature, humidity, air quality, lighting, odor, allergens and noise.

9.2. Coordinate the integration of the building architecture and mechanical systems including the utility distribution (ductwork, plumbing, gas, fire protection, electrical power and signals) with the laboratory layout plan.

9.3. The design of laboratory facilities shall follow the design process outlined in ASHRAE publication, “Laboratory Design Guide” (latest edition).

9.4. Gas/Lab Plumbing:

9.4.1. The selection of pipe and fitting materials for acid waste and vent applications shall be based upon the type, concentration and temperature of the acid waste handled.

9.4.2. Provide solenoid operated safety emergency isolation valves for laboratory gas & vacuum systems. Include isolation valves for: fuel gas, oxygen, nitrogen, carbon dioxide, vacuum and other non-ambient systems. Provide keyed switch at instructors’ station to allow system to operate. Provide mushroom type emergency shut-down switch at space exit.

9.4.3. Provide instructional area gas distribution system isolation valves for laboratory gas and vacuum systems near the main instructional station.

9.4.4. Provide atmospheric vacuum breakers on sink outlets in lab areas; or provide a branch line backflow preventer in a water line supplying an area of labs. When a backflow preventer is used, label the water piping downstream of the device “Non-Potable Water.”

9.4.5. Provide acid waste neutralization systems as required and as directed by the local code official having jurisdiction.

10. Mechanical Rooms:

10.1. Mechanical Rooms above occupied spaces shall provide a minimum 4" high perimeter containment, including all pipe, duct, utilities and personnel access penetrations, and shall be sealed and waterproofed to prevent water damage to spaces below. Waterproof concrete floors with Pedestrian Traffic Coatings per Section V, Division 07 18 13 of these Design Standards. Seal connection points between concrete floor and walls. Coordinate this work with the Architect.

10.2. Provide floor drains within 5’-0” of mechanical equipment which has any type of water connection.

10.3. Provide a floor sink in close proximity of automatic sprinkler system drains, Inspector's test valve outlets or provide a means to drain to the outdoors.

10.4. Provide heavy duty floor drains with clean-outs in mechanical rooms.

10.5. Provide heavy duty trench drains at boilers to accommodate blow down, equipment service and equipment drains. Provide floor drains at chillers, pumps and heat transfer equipment.

11. Medical, Art, Shops and Industrial Training:

11.1. Provide containment systems to prevent oils, solvents, flammable liquids, paint and other hazardous materials from entering public sewer systems and private septic systems.

11.2. Provide plaster/solids traps to remove solids from public sewer systems and private septic systems.

11.3. Medical & Industrial Gas Piping:

11.3.1. Provide solenoid operated safety emergency isolation valves for laboratory gas & vacuum systems. Include isolation valves for: fuel gas, oxygen, nitrogen, carbon dioxide, vacuum and other non-ambient systems. Provide keyed switch at instructor's station to allow system to operate. Provide mushroom type emergency shutdown switch at space exit.

11.3.2. Provide instructional area gas distribution system isolation valves for laboratory gas and vacuum systems at the main instructional station.

11.3.3. Provide a branch line backflow preventer in a water line supplying an area. When a backflow preventer is used, label the water piping downstream of the device "Non-Potable Water."

11.3.4. Provide acid waste neutralization systems as required and as directed by the local code official having jurisdiction.

12. Emergency Equipment:

12.1. Provide emergency showers and emergency eye wash stations as required by space function including Laboratories, Medical, Art, Industrial Shops, Kitchens, and Mechanical Rooms.

12.2. Emergency shower and emergency, eye wash station equipment shall comply with ISEA Z358.1, and be installed as required by OSHA, ANSI standards and per the authority having jurisdiction.

12.3. Emergency showers and eye washes shall be accessible and compliant with ADA requirements.

12.4. Provide accessible isolation valves upstream of emergency shower and eye wash stations.

12.5. Provide floor drains for emergency shower and eye wash stations.

12.6. Water supply shall be potable water, tempered to 70-75°F and shall be supplied at the flow and duration required.

12.7. Control valves should be easy to use and activate within one second and remain open once activated without the use of the user's hands until intentionally closed.

12.8. Provide an un-obstructive path, accessible within 10 seconds (approximately 55 feet).

12.9. Emergency showers and eye wash stations shall be in a well-lit area and identified with a sign.

Division 23 – Heating Ventilation and Air Conditioning (HVAC)

1. General:

1.1. The A/E shall design a complete HVAC system. The A/E shall coordinate the HVAC systems and equipment selection, design and installation with the C/U Project Manager.

1.2. The basis of design shall consider building type and occupancy loads in setting the requirements for HVAC systems and indoor air quality.

1.3. HVAC Equipment Schedules: Provide schedules on the design Drawings for boilers, chillers, pumps, air handlers, fans, filters, air separators, solids separators, tanks, fuel oil equipment, condensing units, coils, heat exchangers, energy recovery devices, variable air volume (VAV) terminal units, unit heaters, cabinet unit heaters, make-up air handlers, hoods and other numbered devices. Schedules shall include manufacturer, model number, service connection size, flow rates, energy requirements, function and applicable accessories. Provide equipment basis of design cut sheets to the C/U Project Manager for review and where the approval during the Design Development phase. Specify that devices of a given type shall be from a single manufacturer. Where the Project is a remodel, match existing equipment types when practical.

1.4. Continue existing equipment numbering sequence for new equipment in existing construction and additions. Start a new sequence of equipment numbers for new system types and new buildings only.

1.5. Provide single line schematic diagrams for all chilled water and boiler systems.

1.6. Provide airflow diagrams on the Drawings during the Design Development phase for large HVAC systems or complex systems such as laboratories.

1.7. Provide vents on all high points and drains on all low points of chilled water and heating water piping systems.

1.8. Provide manual flow balancing devices (i.e. circuit setters) for all coils, radiation elements, pumps, and secondary piping. Add pressure gauges with shut-off cocks for all pumps and chillers. Provide thermometers with wells for heating and cooling coils, hot water boilers, and converters.

1.9. Schedule facility distribution system interruptions with the C/U two weeks in advance. Interruptions shall be planned to cause the least interference with normal institutional schedules and business routines.

1.10. 1.10 Energy Conservation: Study and select available energy sources to provide building heating, cooling, and process needs. Demonstrate through documented life cycle costs analysis the most appropriate fuel and power sources. The study

period for all life cycle cost analyses shall be 20 years. Mechanical equipment shall comply with applicable energy standards. Equipment and systems that exceed the standards shall be used when total life cycle cost analysis indicates sufficient energy savings. Energy upgrades shall be approved by the C/U Project Manager.

1.11. Reference B3 Guideline, Section P.5 Operations Commissioning related to device water measurement, energy device and system level measurement and indoor environmental quality measurement.

2. Current Codes and Standards:

2.1. Apply the latest adopted edition of each code to the design. In cases where there is a conflict between codes, the most conservative design standard shall be adopted. Prior to starting design, the designer shall contact state and local officials to determine which codes (including, but not limited to the following list) have been adopted and any amendments that have been issued and are in effect:

2.1.1. Plumbing systems shall conform to MN Department of Labor and Industry Plumbing Code MN Rules, Chapter 4715 & 4716 latest edition and additional requirements of the authority having jurisdiction.

2.1.2. MN Department of Labor and Industry, MN State Building Code.

2.1.3. MN Department of Labor and Industry, MN Energy Code, MN Rules, Chapter 1323.

2.1.4. MN Department of Public Safety, State Fire Marshall Division, MN State Fire Code and Related Statutes.

2.1.5. MN Department of Labor & Industry, OSHA, Chapter 182, MN Rules Chapter 5205through 5215.

2.1.6. International Building Code.

2.1.7. MN Department of Labor & Industry, International Mechanical/Fuel Gas Code. MN Rules, Chapter 1346.

2.1.8. National Fire Protection Association, NFAP Standard 30

2.1.9. Minnesota Pollution Control Agency (MPCA) requirements for Underground Storage Tanks (UST)

2.2. Designs shall incorporate the use of the following standards:

2.2.1. ASHRAE Standard 90.1 – Energy Standard for Buildings Except Low-Rise Residential Buildings.

2.2.2. B3 Guidelines, Section E.1, requires a 70% reduction as of 2015 of the energy use of a representative building built in 2003 under 1998 codes. This reduction becomes 80% in 2020, 90% in 2025, and 100% (net zero) in 2030.

2.2.3. ASHRAE Standard 62 – Ventilation for Acceptable Indoor Air Quality.

2.2.4. B3 Guidelines, Section I.4. Ventilation Design

3. Energy Conservation:

3.1. General: Typically, mechanical systems shall be designed to minimize the need for energy consumption. The designer shall use premium efficiency motors when available. Fans, pumps, chillers, boilers, furnaces and other energy consuming equipment shall be selected based on energy efficiency, maintainability and total life cycle cost.

3.1.1. Equipment Final Adjustments:

3.1.1.1. Fans shall be balanced and RPM adjustments made to minimize fan horsepower (HP). The use of main balance dampers to reduce fan total flow by more than 2% shall not be used. Impellers on pumps larger than 7-1/2 HP shall be trimmed to meet the design flow rate (unless VFD's are used). The use of main balance valves to reduce pump total flow by more than 5% shall not be used. When variable frequency drives (VFD) are used, the VFD shall not be used as the main balance device without C/U Project Manager consent. (The intent is for the VFD to be used as an energy savings device, not a balancing device for a poorly designed system).

3.1.2. Variable Air Volume (VAV) Systems:

3.1.2.1. Air systems used for spaces with varying heating & cooling loads shall use Variable Air Volume (VAV) distribution systems with terminal reheat. Variable Frequency Drives (VFD's) shall be utilized to regulate volumetric flow rates. Fan systems served by VFD's shall have a failsafe such as a second high static pressure transmitter at the unit discharge for unit shutdown or a pressure relief door installed in the supply main, set to relieve duct over-pressure when the VFD fails to full speed, and thereby protecting the duct seams downstream of the fan. An example relief damper is Ruskin Model PRD18 Pressure Relief Door with a 12 gauge frame and door, and polyurethane foam seals around the door perimeter.

3.1.2.2. Hydronic Distribution Systems: Provide variable speed pumping systems for primary hydronic loops served by pump systems larger than five horsepower. Systems less than five horse power shall be evaluated and designed with VFD's if cost effective.

3.1.3. Variable Refrigerant Flow (VRF) Systems

3.1.3.1. Where space is above ceilings is limited, or part load operation is prevalent at the designed building, variable refrigerant flow (VRF) systems may be used.

3.1.3.2. Utilize heat recovery VRF systems where an hour exists in a typical year that 40% of spaces would be in the opposite of the prevailing mode (heating when the system is in cooling).

3.1.3.3. Comply with ASHRAE Std. 15 & Std. 34. Provide calculations to C/U Project manager with CD Submittal. Plenums above ceiling are permitted to be included in volume calculations when permitted by ASHRAE Std. 15.

3.1.3.4. Use only systems that utilize refrigerant R-410A.

3.1.3.5. Refrigerant piping shall be brazed copper ACR tube or aluminum piping with mechanical couplings.

3.1.3.6. Refrigerant piping shall be mounted no less than 7.25 feet above the finished floor, per ASHRAE 15.

3.1.3.7. Locate VRF condensing unit(s) in mechanical rooms where possible, and where ASHRAE 15 allows. If located outdoors, locate unit in a "doghouse" type enclosure and provide heating where necessary.

3.1.3.8. System must have a full load COP of 3.6 or higher in heating mode, and an EER of 11.0 or higher in cooling mode, when measured at AHRI conditions.

3.1.4. Ground-Source Heat Pump (GSHP) Systems:

3.1.4.1. Where project has land available for well field installation, or where indicated in RFP, ground source heat pump systems utilizing geothermal vertical or horizontal heat exchanger bores may be used.

3.1.4.2. For all projects that intend to utilize geothermal well fields, test bores must be done at the proposed well field site, with results included as part of the SD submittal.

3.1.4.3. All pumps distributing geothermal water must be equipped with a VFD.

3.1.4.3.1. Pumps shall be sized at 50% of flow, with 3 equivalent pumps, unless space available does not allow. In this case, 2 redundant pumps, sized at 100% flow, shall be used.

3.1.4.3.2. Pumps shall be sized at 2.5 gpm/ton, unless calculations can be provided to validate another flow rate.

3.1.4.3.3. Pumps shall be selected within 5% of the selected pump's best efficiency point (BEP).

3.1.4.4. Piping shall be sized per ASHRAE 189.1 maximum pipe sizing criteria.

3.1.4.5. Propylene Glycol shall be used were necessary to prevent freezing in water piping.

3.1.4.6. Ducted return shall be utilized for water-to-air heat pumps. Filtered return grilles shall be used in addition to filters at heat pump units.

3.1.4.7. System must have a full load COP of 3.2 or higher in heating mode, and an EER of 18.0 or higher in cooling mode, when measured at AHRI conditions.

3.1.4.8. Thermally enhanced bentonite grout shall be used in well field bores.

3.1.5. Energy Recovery Systems: Energy recovery systems shall be analyzed on a total life cycle cost basis, where not explicitly code required. Systems that return building exhaust air to occupied spaces shall not be used without an approved air cleaning device. The following system types may be applied:

3.1.5.1. Energy Recovery Wheels: Use only systems that utilize a 3-angstrom molecular sieve type wheel for total energy transfer. Energy recovery wheels shall be designed to dynamically adjust rotation speed based on system load and incoming air conditions.

3.1.5.1.1. Minimum energy recovery effectiveness for energy recovery wheels shall be 75% for sensible heat recovery, and 75% for latent energy transfer.

3.1.5.2. Use solid aluminum construction as an energy transfer media for sensible heat transfer wheels.

3.1.5.3. Run around coil loops or plate type air to air heat exchangers shall be used for locker rooms, gymnasiums, sports facility and other spaces with prevalent odor transfer issues. Air to air heat exchangers shall also be used when energy recovery wheel technology is not cost effective.

3.1.5.4. Provide a frost protection method for energy transfer devices to prevent or periodically remove frost build-up on transfer media.

3.1.5.5. Limit cross leakage of energy recovery wheels to 5% when using restroom exhaust for energy recovery purposes.

3.1.6. Energy Efficiency Rebates:

3.1.6.1. The designer shall coordinate the mechanical design with the local utility, and take advantage of cost effective rebates available from public utility companies. Early in the Schematic Design phase the Engineer shall contact the energy provider. Furnish the utility with preliminary concepts and review available energy options with the representatives. Review available energy conservation measures with the C/U Project Manager and work to select cost effective measures that best meet the facilities' long-term needs. Typically rebates are available for: Premium Efficiency Motors, High Efficiency Chillers, oversized Cooling Towers, VFD's, Transformers, Condensing Boilers and energy optimizing designs.

4. Mechanical Rooms:

4.1. Provide a concrete equipment pad, 4" high minimum, for all mechanical equipment.

4.2. Provide floor drains within 5'-0" of mechanical equipment which has any type of water connection. Coordinate the layout of mechanical room drains with the Division 22 Designer.

4.3. Provide adequate floor space to maintain mechanical equipment. Provide sufficient access without requiring removal of permanently installed building elements or other permanently installed equipment to maintain, remove and replace equipment. Use knockout panels as a last resort. Clearly identify on the Drawings tube pull spaces, panels and access/maintenance areas to show compliance with equipment removal/maintenance requirements.

4.4. Minimum headroom clearance in mechanical space walking areas shall be 6'-8".

4.5. Safety Equipment: Coordinate the location of emergency showers and safety equipment with Division 22 designer.

5. Central Energy Plants:

5.1. Heating Plants:

5.1.1. Plant Study: Conduct and document a Heating Plant Study during the early Design Development phase before designing the heating plant. The Engineer shall submit the Heating Plant Study with the Design Development Submittal. The Study shall evaluate plant operating parameters with a primary emphasis on economic factors. The Study shall also address energy conservation and environmental concerns. The Study shall evaluate and determine as a minimum, the following:

5.1.1.1. Plant peak load and operating characteristics.

5.1.1.2. Review plant output and discuss whether steam or hot water. Hot water is generally preferred.

5.1.1.3. Fuels anticipated to be burned.

5.1.1.4. Dependability and redundancy of service required.

5.1.1.5. Predicted life cycle of the plant.

5.1.1.6. First cost, operating cost and life cycle costs.

5.1.1.7. Required pollution control equipment.

5.1.1.8. Plant expansion capabilities.

5.2. Heat Generating Equipment:

5.2.1. Equipment Capacity: The combination, number and size of thermal generating equipment in a plant shall determine the plant capacity. Provide redundancy of at least 100% of the largest individual unit in the system (or greater if determined by the Project scope). A smaller peaking and off-season boiler should be included if increased efficiency at low loads economically justifies the installation. Avoid installation of initial main boilers whose capacities are smaller than those to be added when the plant is expanded. Avoid unnecessarily large numbers of small boilers.

5.2.2. Minimum Load: The plant shall operate efficiently at minimum loads. The following variables may be manipulated to meet minimum load requirements:

5.2.2.1. Number of Boilers: Multiple smaller boilers will lower the minimum plant capacity. This option should not be considered if the plant would require more than four equal capacity boilers.

5.2.2.2. Minimum Load Boiler: Where the difference between a minimum plant demand and minimum boiler load with main boilers is large, a small, packaged boiler unit with its own boiler feed pumps should be used to provide low plant capacities.

5.2.2.3. Steam Boiler Pressure: Design steam boiler plants to operate at less than 15 psig to reduce the need for continuous operator supervision and to reduce the cost of distribution piping, valves and fittings. Design high pressure steam boiler plants (above 15 psig) only when very large heating loads exist and space requirements prevent the installation of large low pressure boilers.

5.2.2.4. Plant Layout: The plant layout should be designed to reduce maintenance time, and allow for easy operation of equipment. Layout considerations shall also include space for tube cleaning, tube replacement and future expansion. Provide enough space to accommodate auxiliaries such as feed pumps, fuel pumps, condensate tank water heaters, de-aerators, condensate receivers and other equipment normally located in the boiler room. Utilize outside wall openings (panels, overhead doors, imbedded lintels) to allow large equipment removal/installation. Clearly identify such areas on Drawings to show compliance.

5.2.2.5. Water Treatment: Provide an automatic boiler feed water chemical treatment system to control scale, corrosion, carryover and caustic embrittlement or cracking for heating plants. Consult a qualified water treatment specialist to design the system.

5.2.2.6. Makeup Water: Heating plant makeup water shall be softened water to a level recommended by the boiler manufacturer. Include a separate meter on the make-up water line.

5.2.2.7. Feed water Pumps: Size boiler feed water pumps with a 1.25 safety factor (for pump wear, blowdown requirements and excess boiler capacity available for short periods). Pumps operating in parallel shall have similar head capacity curves and equal head at shutoff. Ensure continuous pump operation under system conditions by designing for sufficient Net Positive Suction Head above the vapor pressure of the hot condensate.

5.2.2.8. Economizers: Analyze the life cycle cost effectiveness of economizers in the boiler plant and design the plant accordingly. Consider pre-heating boiler feed water with flue gas economizers or with blowdown heat recovery systems for continuous boiler surface blowdown designs. Also consider economizer corrosion control and overall plant heat balance and fuel savings.

5.2.2.9. Underground Storage Tank Systems: Follow MPCA requirements for new or replacement underground fuel storage tanks.

5.2.2.9.1. Contractors who install UST Systems must be certified by MPCA.

5.2.2.9.2. Minimum of 10 days' notice must be given to MPCA prior to start of work.

5.2.2.9.3. Within 30 days of initial use of the UST, notifications must be provided to the MPCA of completion of the installation using the Notification of Installation or Change in Status" form. Form needs to be signed by the Owner and the certified Contractor.

5.2.2.9.4. Contractor is to provide the Owner documentation on the UST design, invoices, specifications, operational manuals, and manufacturer/model/performance claims for tanks, piping, overfill prevention equipment, line leak detectors, leak detection sensors, dispenser and submersible pump containment, etc. Documents must be kept for the life of the tank.

5.3. Chilled Water Plants:

5.3.1. Plant Study: Conduct and document a Chilled Water Plant Study during the early Design Development phase before designing the plant. The Engineer shall submit the Chilled Water Plant Study with the Design Development Submittal. The Study shall evaluate plant operating parameters with a primary emphasis on economic factors and energy conservation. The Study shall evaluate and optimize the entire chiller plant (not just single pieces of equipment) for the application based upon as a minimum, the following:

5.3.1.1. Plant peak load and operating characteristics.

5.3.1.2. Dependability and redundancy of service required.

5.3.1.3. Predicted life cycle of the plant.

5.3.1.4. First cost, operating cost and life cycle costs.

5.3.1.5. Noise and vibration.

5.3.1.6. Refrigerant handling.

5.3.1.7. Plant expansion capabilities.

5.3.2. Chillers and Chilled Water Systems:

5.3.2.1. Typically, use air-cooled chillers or direct expansion cooling units for facilities with a total load less than 200 tons refrigeration. Utilize water-cooled, high efficiency electric or absorption chillers for facilities with total cooling load in excess of 200 tons refrigeration. The Engineer shall review the available cooling options with the C/U Project Manager.

5.3.2.2. Chilled water plants shall meet or exceed ASHRAE 90.1 Standard for minimum efficiency (or better if local code is more stringent). Chilled water plant equipment (chiller, pump motors and cooling

tower) shall qualify for the local electric utility company rebate program and any programs, if available.

5.3.2.3. Chilled water systems shall be capable of producing chilled water supply temperatures that meet the demand load requirements for the spaces served. Consider areas requiring dehumidification when selecting chilled water supply design temperature. Consider designing for high delta T's for the chilled water and condenser water systems to minimize first cost and operating costs.

5.3.2.4. If ice storage is utilized for peak shaving, then the chilled water distribution system shall be equipped with a loop tempering control strategy to maintain distribution temperature above 34°F to avoid coil frosting.

5.3.2.5. Design the system to maintain flow rates within manufacturer specified limits through chiller condenser and evaporator tube bundles.

5.3.2.6. Design variable chilled water flow systems using variable speed driven pumps and two-way control valves. Design systems to maintain chiller manufacturer recommended minimum flow rate through the chiller at part load conditions.

5.3.2.7. For plants with multiple chillers, design primary-secondary (decoupled) systems with one primary pump for each installed chiller connected to an intermediate header (to allow any pump to serve any chiller). Provide an unrestricted, short neutral bridge and secondary distribution pumps with variable speed drives and two-way valves at the coils.

5.3.2.8. Do not install redundant chilled water secondary pumps. Where appropriate, consider partial capacity pumps in parallel and operate in lead/lag control.

5.3.2.9. Design system to purge air through an air separator and to accommodate water volume expansion and contraction with an expansion tank.

5.3.2.10. B3 Guidelines (B3), Section E.4 outlines refrigerant selection requirements and bans CFCs. If LEED certification will be sought for a project, follow prerequisite and/or enhanced refrigerant management guidelines.

5.3.3. Cooling Towers and Condenser Water Systems:

5.3.3.1. Design cooling towers to provide the peak condenser water load of the chillers at the local wet bulb summer design condition (not greater than 78°F WB).

5.3.3.2. Design cooling tower water to optimize chiller plant and reduce overall electrical power consumption. Suggest variable speed driven cooling tower fans for cooling water temperature control.

Consider VFD pump motors when multiple cooling tower cells are installed to maintain full flow through individual tower cells.

5.3.3.3. Design cooling tower water systems to take advantage of free cooling opportunities. Design winter operating cooling towers with freeze protection systems or provide means for freeze protection when towers are not in use during winter. Provide bypass line with isolation valve between tower supply and return water piping.

5.3.3.4. Establish an outdoor noise criteria level and design cooling tower installations to minimize sound levels generated.

5.3.3.5. Provide side stream automatic backwash filters in cooling tower systems.

5.3.3.6. Provide automatic cooling tower blowdown, makeup and water treatment control.

5.3.3.7. Provide basket or Y-type in-line strainers on the suction side of the condenser water pumps.

5.3.3.8. Comply with ASHRAE Standard 188 – 2015: “Legionellosis”: Risk Management for Building Water Systems”. Design the cooling tower system to accommodate the maintenance functions outlined in the standard.

5.3.4. Chiller Plant Controls & HVAC:

5.3.4.1. Specify the chiller energy management system compatible with the C/U's existing energy management control system.

5.3.4.2. Provide Direct Digital Control (DDC) systems in lieu of pneumatic controls. DDC system shall be an open protocol.

5.3.4.3. As a minimum, chiller-monitoring points shall include those recommended in ASHRAE Std. 147- 2013. Coordinate with the C/U’s plant operators for additional monitoring points.

5.3.4.4. Provide chiller room with fresh air ventilation to allow the space temperature to rise no more than 10°F above the maximum annual outdoor dry bulb temperature.

5.3.4.5. Provide unit heaters in the chiller room to maintain the space at 65°F during winter months.

5.3.4.6. Provide the chiller room with refrigerant leak detection systems, emergency shutdown systems, and emergency exhaust ventilation in accordance with ASHRAE Standard 15 and the applicable sections of the International Mechanical Code.

6. Exterior Mechanical Utility Distribution:

6.1. Underground Tunnels Design Considerations (shallow trenches and walking tunnels).

6.1.1. Determine maximum load of the systems and future expansion loads.

6.1.2. Consider ground water table levels and frost depth.

6.1.3. Coordinate installation with other distribution systems, utilities, manholes, streets, walks and other surface features.

6.1.4. Coordinate interference and tie-ins with electrical distribution lines and manholes, fire/water piping, sanitary/storm sewers and manholes and telecommunication/cable systems.

6.1.5. Document and design for thermal expansion of steel and copper pipe systems. Model all systems where thermal pipe expansion is a factor and provide for control of expansion. Piping systems design shall comply with ASME B31.1.

6.1.6. Coordinate location of expansion loops or requirements for expansion joints. Utilize expansion loops or changes in pipe direction in piping systems in lieu of expansion joints to reduce maintenance requirements. Where expansion joints are used, provide re-packable slip type over bellows type and locate all expansion joints in an accessible location to allow for maintenance.

6.1.7. Coordinate location of pipe anchors, valves and supports with structural discipline.

6.1.8. Slope all tunnel sections toward low spots and provide sump pump pits and pump or gravity flow to storm sewers.

6.1.9. Provide means for future pipe and equipment removal/installation by removal of a section(s) of the tunnel roof or other means approved by the C/U Project Manager and clearly identify locations on the Drawings to show compliance.

6.1.10. Where required and practical, design structural pipe support racks for additional equipment/piping support and planned expansion projects.

6.1.11. Route electrical and communication cables in cable trays above steam/water piping systems.

6.1.12. Structural supports in tunnels shall be of sufficient structural capacity to carry a minimum of twice the load existing at the time of design. A licensed structural engineer shall design and approve structural supports.

6.1.13. Tunnel structural supports shall be corrosion resistant. Locate structural steel supports out of drainage trenches or provide structural steel base supports(concrete equipment pads of sufficient height) to prevent steel exposure to standing water.

6.1.14. Provide maintenance access to and service clearance around all expansion joints, valves and equipment.

6.1.15. Provide isolation valves at branch takeoffs and access to valves to increase system reliability.

6.1.16. Provide means for freeze protection or drain valves and vents for drainage of water piping when required.

6.1.17. Provide rigid jacketed pipe insulation system to protect insulation from crushing.

6.2. Underground Tunnel Design Considerations (walking tunnels only):

6.2.1. Lighting levels shall be equivalent to equipment rooms. Arrange fixtures in locations that do not pose a threat of head injury hazard.

6.2.2. Provide four-way convenience receptacle outlets spaced no further than 100 feet apart.

6.2.3. Consider providing welding outlets in tunnels where known future expansion or repairs will occur.

6.2.4. Provide fresh air ventilation throughout tunnel with manual damper control.

6.2.5. Provide secured access at all entry/exit points by padlock or keylock. Provide panic hardware on full size doors and through-the-door louvers for ventilation.

7. Mechanical Roofing Issues and Coordination:

7.1. Avoid routing conduit, piping and ductwork on building roofs. Minimize roof penetrations.

7.2. Mechanical penetrations in roof drain sump areas are prohibited.

7.3. Rooftop penthouses are allowed, provided there is access from within the building for equipment maintenance and a minimum 3 ft. CMU knee wall is required at perimeter walls, if a full masonry cavity wall construction is not used.

7.4. Installing mechanical equipment on the roof is discouraged. Explore alternative designs to locate equipment inside the building whenever possible. If equipment must to be located on the roof, verify structural capacity of the roof structure and provide sleeper curb structure with minimum 36” clearance from roof surface to bottom of support structure.

7.5. Provide a separate roof drain under each roof mounted cooling tower (in addition to roof drains and overflow drains required for storm water drainage).

7.6. Provide roof access scuttle or an access door, accessible from a non-public, secure area, for access to all roof areas where rooftop equipment will require servicing.

7.7. Provide fall protection or guard rails at the roof edge for any equipment requiring maintenance is located within 15 ft. of the roof edge.

8. Heating, Ventilation & Air Conditioning:

8.1. General:

8.1.1. Outside air design temperatures shall be as prescribed in Minnesota State Building Code, latest edition. The designer shall also consider local facility experience when determining final design temperature criteria. Equipment selections shall account for actual site elevation as determined by a site

survey or other reliable source. Air flows shown on Drawings shall be in actual conditions.

8.1.2. Indoor design temperatures shall be a maximum of 72°F and 20% RH for heating occupied spaces per Minnesota State Energy Code.

8.1.3. Indoor design temperatures in cooled spaces shall be a minimum of 75° F and 50% RH for cooling occupied spaces per Minnesota State Energy Code. Coordinate with B3 Guidelines, Section I.5.

8.1.4. Refer to the MNIT Building Infrastructure Best Practices for State Owned Buildings for temperature and humidity requirements for IT rooms.

8.1.5. Air conditioning shall be included in all occupied building.

8.1.6. Thermostat zones shall avoid combining spaces with different interior/exterior or directional exposures.

8.1.7. Humidification systems shall be included only when needed for material loss prevention and approved by the C/U Project Manager. When humidification systems are approved, systems shall be provided which do not use corrosion inhibiting chemicals commonly found in central steam systems.

8.1.8. The HVAC system design shall consider issues related to indoor air quality, including location of air intakes and exhausts, humidity controls, filtration and special circumstances related to the treatment and handling of hazardous substances for buildings.

8.1.8.1. Refer to B3 Guidelines, Section I.1 for additional criteria for eliminating environmental tobacco smoke from entering the building.

8.1.9. Air intakes at or below grade are not allowed. Air intakes shall be located a minimum of 25 feet from contaminated or odorous exhaust sources to avoid intake of fumes from exhaust stacks or vehicle exhaust. The bottom of outdoor air intakes shall be a minimum of 3 feet above roof or ground level.

8.1.10. Bird screens shall be provided on the exterior face of the intake louvers.

8.1.11. Infiltration shall not be acceptable for exhaust fan makeup air.

8.1.12. Provide reheat coils to avoid sub-cooling spaces. Reheat systems shall be provided for air conditioning systems. Reheat systems shall comply with applicable energy and mechanical codes.

8.1.13. Design shall show capability of cooling coil discharge air temperatures required to provide proper humidity control (in the range of 50° F – 55 ° F). Provide reheat systems (per Minnesota Energy Code) as needed to comply with the space comfort conditions.

8.1.14. Interview C/U facility personnel to determine ventilation requirements of each space, including material safety data information for special use spaces such as laboratories, printing, etc. Review site specific needs with local C/U maintenance staff. Systems that require maintenance skills not available at a particular site shall be used only with C/U Project Manager approval.

8.1.15. Consider other alternatives to using glycol in hydronic systems, especially on new system designs. Whenever possible design with sufficient insulation, controls and safeties to prevent damage to facility components resulting from temperature extremes. Utilize face & bypass and heat recovery systems as applicable.

8.1.16. Design quiet, efficient mechanical systems without reliance on internal duct lining for sound deadening. **Interior duct lining is prohibited.** Include all necessary sound and vibration eliminators before ducts and pipes leave mechanical room. Provide ample space in mechanical room between air handling equipment and the walls where ducts exit, to allow noise abatements to be installed and serviced.

8.1.17. Equipment schedules shall include design ventilation air requirements for each system; clearly indicate the minimum outside air required, number of occupants and ventilation rate per person. Process make-up air systems such as shop, kitchen hood and lab hood systems shall indicate interlocking equipment.

8.1.18. If unitary HVAC equipment is selected, B3 Guidelines, Section E.4 outlines refrigerant selection requirements and bans CFCs.

8.2. Air Handler Construction:

8.2.1. Air handling units larger than 2,000 CFM shall be double wall construction with 3 lbs/ft^3 density insulation. Exposed internal fiberglass insulation inside the air handling unit shall not be allowed on any size air handling units.

8.2.2. Air handling units shall be located to provide adequate access and ability to easily replace equipment without requiring removal of permanently installed building elements or other permanently installed equipment.

8.2.3. The designer shall design air handlers to insure complete mixing of the incoming air paths. Provide a blender designed to eliminate stratification and provide thorough mixing of return and outside air streams on air handling unit systems other than those supplying 100% outside air at all times.

8.2.4. Select equipment with door swing against air pressure (swing “out” on return air side and swing “in” on supply side).

8.2.5. Select equipment that is as quiet as is practical. Provide sound attenuation section at the discharge of equipment serving noise critical spaces.

8.2.6. Select fans that allow for up to 20% additional flow for future expansion. Do not select fans at the edge of the fan curve, or in fan surge zones.

8.3. Indoor Air Quality (IAQ):

8.3.1. Dust Collectors: Dust collectors shall be used in facilities that produce particulate material in quantity, that produce an unsafe environment for the space user. When dust collectors are used, air shall be cleaned and exhausted to atmosphere. Recirculating systems may be used with the

consent of the C/U Project Manager. Provide a make-up air system for each dust collector system.

8.3.2. Air Filtration: Provide air filters for air systems to protect system components and provide filtered air to system users.

8.3.2.1. Pre-filters shall have a minimum air filtration efficiency of 30% (minimum MERV 9 rating) when tested in accordance with ASHRAE Standard 52.1, Atmospheric Dust Spot Method.

8.3.2.2. Secondary Filters shall have a minimum air filtration efficiency of 90% (minimum MERV 13 rating) when tested in accordance with ASHRAE Standard 52.1, Atmospheric Dust Spot Method.

8.3.2.3. Air filters shall be mounted inside the air handling unit using compression clips and gasket frames.

8.3.2.4. For systems rated at 2,000 CFM or greater the air flow pressure drop across each bank of filters shall be monitored by the temperature control system and shall signal an alarm when it is time to change the filters. The pressure drop values used to signal an alarm shall be obtained from the filter manufacturer.

8.3.2.5. For outside air only systems and energy recovery wheel outside air filters, use a moisture resistant pre-filter. Use permanent washable media or filters.

8.3.2.6. If permanent air handling units are to be used during construction, follow SMACNA air quality control measures and provide MERV 8 filtration, which will be removed prior to occupancy. Coordinate with B3 Guidelines, Section P.4 to establish indoor air quality procedures during construction and warranty period according to Construction Air Quality Management Plan and Warranty Period Air Quality Management Plan.

8.3.3. Ventilation air shall provide required ventilation rates spelled out in ASHRAE Standard ASHRAE Std. 62.1-2013, Air intakes shall be located so as not to introduce class 2,3,4 air (i.e. near cooling towers, exhausts, vehicle emissions, garbage dumpsters, etc.), as classified by ASHRAE Std. 62.1.

8.3.4. Cooling coil drain pans shall be constructed of stainless steel with a cross broken, minimum ¼" per foot sloped bottom (drain outlet at lowest point). Pan shall be trapped and connected to the required building waste system using an air-gap, indirect waste connection. Trap shall be of sufficient depth to provide continuous condensate pan drainage. Provide trap with an accessible fill point for manual trap priming.

8.3.5. Each air handling unit shall be designed with access sections located between air handling components (where possible). Access sections shall include hinged doors sized to permit access by maintenance personnel for inspection and cleaning.

8.3.6. Reference B3 Guidelines, Section P.4. Design & Construction Commissioning.

8.4. Ducted Air Systems:

8.4.1. Air distribution systems shall provide adequate air quantities for cooling non-occupied rooms for future use as occupied space, even though cooling may not initially be provided. Air shall be introduced in the occupied zone at RC values, which do not exceed current ASHRAE limits found in ASHRAE Systems, Sound and Vibration Control.

8.4.2. When possible, the size of the distribution system shall be sufficient to adequately cool the space (as if cooled air were being introduced) even though cooling may not be currently intended for the space.

8.4.3. Return air system shall be ducted.

8.4.4. Supply and return diffuser locations shall be designed to prevent "short circuiting" of the supply air flow.

8.4.5. Ducted systems shall be constructed of sheet metal and sealed to minimize air leakage. Maximum length of flex duct shall be five feet and shall be insulated type.

8.4.6. All ductwork installed outdoors shall consist of double wall construction with insulation between the two walls. The exterior surface shall be sealed and made waterproof. Ductwork, piping, conduits, and air handling units are discouraged from running across building roofs in order to minimize roof penetrations, but there are existing conditions that cannot be avoided.

8.4.7. Provide manual volume balancing dampers on each branch duct line, located to allow easy access and shall be labeled to indicate final balancing position. Include damper locations on Drawings.

8.4.8. Variable air volume boxes shall be of double wall construction with insulation between the two walls.

8.4.9. Specify that flex duct lengths shall not exceed 5 ft. on connections to registers/grilles.

8.4.10. Access panels shall be provided on each side of all duct mounted equipment.

8.4.11. The use of displacement ventilation distribution systems shall be considered when practical. If used, the designer shall comply with the recommendations outlined in the ASHRAE Fundamentals handbook. Displacement ventilation is desirable for systems in new construction which require a high percentage of outside air or removal of indoor air pollutants. The designer shall be careful to insure that displacement diffusers do not create unnecessary drafts. Obtain C/U Project Manager approval prior to designing displacement ventilation distribution systems.

8.4.12. Where constant volume dual duct systems are specified, two VAV controllers set for constant volume service shall not be used. Specify true constant volume controls on a single constant volume supply box (twin VAV boxes will not be approved).

8.4.13. Provide adequate maintenance clearance around ventilation equipment allowing for access to motors, filters, controls, bearings, coils, and other

system components. Provide access panels on each side of all duct mounted equipment. Provide access panels in VAV boxes upstream from reheat coils.

8.4.14. Specify during construction that the ductwork openings for all ducted air systems, shall be temporarily sealed off with reinforced plastic film and tape every day as the Work progresses to maintain clean interior duct and air systems equipment surfaces.

8.4.15. Upon substantial completion and prior to occupancy, the inside of all air handling units, return fans, and ductwork shall be cleaned to remove all surface dust and debris.

8.4.16. After substantial completion of construction and prior to occupancy, provide purging ventilation to the construction area by supplying and exhausting 100% of the design maximum air flow for that area, operating continuously for a minimum of seven days with a maximum relative humidity of 60%.

8.5. Special Consideration For The Following Building Space & Types:

8.5.1. Instructional Areas:

8.5.1.1. Mechanical systems in new construction; Mechanical and electrical components, including pipes, ducts and conduit penetrating through walls, ceilings, and floors shall be resiliently caulked at the penetration point and fire caulked at rated walls/floors.

8.5.1.2. Classrooms shall have HVAC systems with temperature and humidity control that is sufficient to function year-round without the need for through-window ventilation.

8.5.1.3. Mechanical system design and installation shall provide space for classroom technology components that may require space above finished ceilings. Examples include projection screen troughs, cable trays, projector mounts and conduit.

8.5.1.4. There shall be no air diffusers or intakes within 10 feet of projection screens.

8.5.1.5. When possible, HVAC systems shall be designed so there is minimal need to access the systems via the classrooms for maintenance purposes. Locate VAV boxes serving classrooms outside of the classroom areas.

8.5.1.6. The HVAC system that serves classrooms shall operate independently of other system(s) that serve other functions within the same building.

8.5.1.7. Systems that serve classrooms shall be interconnected to a campus central monitoring system. Room occupants shall ~~not~~ be able to adjust environmental controls via a tight bandwidth.

8.5.1.8. Mechanical Systems in Existing Construction: Systems shall be improved as much as reasonably possible and in accordance with

the Project scope (that is, full building rehab vs. single room renovation). Existing lined ductwork shall be removed and replaced with new ductwork as much as possible.

8.5.2. Acoustical Considerations for Instructional Areas:

8.5.2.1. Design mechanical systems to meet acoustical requirements for classrooms in new construction as follows:

8.5.2.1.1. General Classrooms: NC 35 or less.

8.5.2.1.2. Auditorium/Lecture Hall: NC 25 or less.

8.5.2.1.3. Interactive Television Classrooms, Studios or Control Rooms: NC 20 or less.

8.5.2.1.4. HVAC: Diffusers shall have a rating of 10dB lower than the room NC rating at rated flow.

8.5.2.2. Architectural design can greatly affect reverberation time and background noise. A critical goal in the design of any instructional space is to keep noise outside of the building from being audible inside the classroom. Noise from passing vehicles, as well as internal building (HVAC) and hallway noise, can significantly detract from the learning experience and must be addressed in design. Mechanical systems shall be designed to not be a significant contributing factor to the space sound power level.

8.5.2.3. Mechanical equipment mounted adjacent to or above a classroom shall be isolated from vibration. Consider that transmitted noise shall be kept at a low frequency when designing mechanical components near classrooms.

8.5.3. Areas with Significant Exhaust:

8.5.3.1. Provide sufficient outside air to make-up the exhaust air volume and to maintain positive space pressure. When exhaust system is designed for fume or odor control, design adjacent systems to minimize cross contamination and increase supply air to meet exhaust needs.

8.5.4. Storage Space:

8.5.4.1. Storage spaces in new construction larger than 50 square feet shall be designed for future use as office or instructional space. Provide air supply and return to each space and separate zone temperature controls.

8.5.5. Computer Lab, Computer Rooms, Communication, Phone and Internet Head End Rooms (and other spaces containing temperature sensitive equipment):

8.5.5.1. Provide cooling systems capable of cooling the space 24 hours/day, year-round without the necessity of operating a central cooling plant. Use direct expansion (DX) cooling and/or outside air economizers to meet the requirements. Provide

filtration and acoustical isolation for each cooling device. Provide humidity control to maintain space at 50% RH (+/- 10%).

8.5.6. Building Entrances:

8.5.6.1. Public Spaces: Provide cabinet unit heaters or convectors at building entrances in public spaces. Size equipment to exceed the anticipated infiltration load by a minimum of 20%. When significant foot traffic is anticipated, use systems that wash the entrance vestibule floor with warm air. Controls shall be stand alone, no interface to the building automation is necessary unless directed by the C/U Project Manager.

8.5.6.2. Service Entrances: Provide unit heaters to cover the anticipated infiltration heating load. Controls shall be stand alone, no interface to the building automation is necessary unless directed by the C/U Project Manager.

8.5.6.3. Overhead Doors: Provide unit heaters to account for anticipated heat loss when doors are opened. Controls shall be stand alone, no interface to the building automation is necessary unless directed by the C/U Project Manager.

9. Energy Management/Control Systems:

9.1. Provide detailed automatic controls diagrams on construction Drawings, indicating control component locations, function and schematic configuration. Provide a detailed sequence of operation for each building mechanical system. For systems larger than 5,000 CFM supply air or 3,000 CFM minimum outside air, provide a continuous outside air flow monitoring system fully integrated into the control network including CO_2 demand control. Hard balancing is acceptable to set the minimum required outside airflow; however, outside airflow monitoring is preferred (consult with C/U Project Manager for specific application). Provide minimum outdoor air quantities and positive pressure control for each supply system serving areas with fume hoods and exhaust systems. For additional system requirements see Division 25 – Integrated Automation.

10. **23 05 93 - Testing, Adjusting, and Balancing for HVAC**

10.1. All ventilation systems shall be balanced and shall be in accordance with ANSI/ASHRAE Standards. Balancing shall be performed by an independent balancing Subcontractor hired by the Contractor and also will be inspected by the Owner's Commissioning Agent.

10.2. The balancing company shall measure the minimum fresh air at both peak summer and peak winter modes.

10.3. Specify hydronic balancing at peak cooling and peak heating conditions.

10.4. Require a length of straight duct inside the building to permit accurate measurement of the outside airflow.

10.5. The balancing damper locations shall be specified in the Contract Documents and not left to the discretion of the Contractor.

10.6. Dampers in diffusers and registers shall not be used for balancing airflow.

10.7. Specify balancing at 100% maximum outside CFM and at minimum outside CFM.

10.8. Specify water flow balanced to no less than 90% of required flow.

10.9. Specify that pump discharge pressure shall be adjusted to the lowest setting possible to achieve balance at the most remote hydronic terminal.

10.10. Specify that balancing shall confirm that total fan airflow equals the total airflow of all terminal units.

11. **23 08 00 - Commissioning (Cx)**

11.1. Requirements: These Design Standards cover the requirement to commission Mechanical, Electrical and Indoor Air Quality Elements and Systems. Mechanical systems shall include HVAC systems & associated controls, Laboratory room level controls and containment systems, energy & renewable energy systems, and overall air & hydronic system testing, adjusting, and balancing. The Electrical systems shall include lighting and daylighting controls, power systems and distribution systems and electronic safety and security systems.

11.1.1. If the project contains electrical and electronic safety & security systems; additional Cx and testing scope coordination may be required. Review specification Cx and testing requirements.

11.1.2. If the project is pursuing LEED certification, consult the LEED Fundamental or Enhanced Cx guideline requirements. The guidelines may require Cx of the Domestic hot water systems, refrigeration systems, water & energy measurement systems, the building envelope, and irrigation systems.

11.1.3. Consider consulting the LEED and B3 Guidelines for additional recommend systems and associated tasks.

11.1.4. All Commissioning deliverables shall meet ASHRAE Guideline 0 – 2013, The Commissioning Process.

11.2. Commissioning Plan: Refer to paragraph 11.4 below for requirements of the Commissioning Plan.

11.3. Commissioned Systems: The following is a sample list of systems (and all integral equipment controls) which shall be evaluated by the A/E, C/U Project Manager and the Minnesota State Program Manager as to which system(s) to include in the Commissioning Plan (there may be other systems not listed here that would benefit from a Commissioning Plan). Unless noted otherwise, 100 percent of all systems shall be commissioned.

11.3.1. Chiller system (including controls, chillers, cooling towers, piping, pumps and variable speed drives).

11.3.2. Boiler system (including controls, boilers, piping, pumps and variable speed drives).

11.3.3. Heat exchangers.

11.3.4. Piping, cleaning and flushing.

11.3.5. Chemical treatment.

11.3.6. Ductwork.

11.3.7. Air handling units and energy recovery systems.

11.3.8. Packaged DX units (heat pumps or AC).

11.3.9. Split systems.

11.3.10. Evaporative coolers.

11.3.11. Evaporative condensers.

11.3.12. Terminal units (VAV's, VAV's with reheat, fan coil units, and radiant heaters). (25% minimum sampling)

11.3.13. Testing, Adjusting and Balancing (TAB) verification ((25% minimum sampling).

11.3.14. Unit heaters.

11.3.15. Building Automation System (system checkout and calibration).

11.3.16. Lighting and Lighting Controls

11.3.17. Domestic Hot Water Systems

11.3.18. Renewable Energy Systems

11.3.19. Plumbing Systems

11.3.20. Envelope Integrity

11.3.21. Vibration/Acoustic/Noise

11.3.22. Laboratory Ventilation Containment Systems

11.3.23. Fire & Life Safety Systems

11.3.24. Electrical Power & Distribution Systems

11.4. Commissioning of Systems:

11.4.1. Requirements: These Design Standards cover the development of a Commissioning Plan. In general, Commissioning shall be required on all new large scale HVAC and Electrical designs and major HVAC and Electrical renovations or upgrades where there is substantial replacement of existing energy consuming systems.

11.4.2. At the C/U Project Manager's discretion, Commissioning may start at any point of time during the Project; B3 Guideline P.4 Cx requires the Commissioning Authority be brought onboard during the project's Pre-Design Phase. Reference the B3 Guidelines, Sections P.4 and P.5 for required and recommended commissioning activities. Abbreviations and Definitions: The following are common abbreviations used in this document:

BOD	Basis of Design
CA	Commissioning Authority
CC	Controls Contractor
Cx	Commissioning
Cx Plan	Commissioning Plan document
DID	Design Intent Document (or OPR)
EC	Electrical Contractor (or Subcontractor)
FT	Functional performance Test
MC	Mechanical Contractor (or Subcontractor)
O&M	Operation & Maintenance Manuals/Data
PC	Pre- functional Checklist
TAB	Test and Balance Contractor (or Subcontractor)

11.4.3. Purpose of the Commissioning Plan (written by CA):

11.4.3.1. Provide direction for the development of the following Cx Specifications during the design phase (if CA is hired during design phase):

11.4.3.1.1. Mechanical and Electrical Systems Commissioning.

11.4.3.1.2. Mechanical and Electrical Testing Requirements.

11.4.3.1.3. Pre-functional Checklist Examples.

11.4.3.1.4. Functional Test Procedure Examples.

11.4.3.1.5. Commissioning Requirements.

11.4.3.2. Provide direction for the commissioning process during construction, such as scheduling, participation of various parties of this particular Project, actual lines of reporting and approvals, coordination, etc.

11.4.3.3. The Commissioning Plan does not provide a detailed explanation of required testing procedures. The detailed testing requirements and procedures are found in the Specifications. Additionally, the Commissioning Plan does not provide extensive narrative on all commissioning concepts.

11.4.4. Commissioning Scope:

11.4.4.1. Commissioning is a systematic process of ensuring that building systems perform interactively according to the design intent and the Owner's operational needs. This is achieved normally by beginning in the design phase, documenting the design intent document and continuing through construction, acceptance and the warranty period with actual verification of performance.

11.4.4.2. Commissioning during the construction of the Project is intended to achieve the following specific objectives in accordance with the Contract Documents:

11.4.4.2.1. Ensure that applicable equipment and systems are installed properly and receive adequate operational checkout by installing contractors.

11.4.4.2.2. Verify and document proper performance of equipment and systems.

11.4.4.2.3. Ensure that Operations & Maintenance documentation left on site is complete.

11.4.4.2.4. Ensure that the C/U's operating personnel are trained in the maintenance and operation of commissioned systems.

11.4.4.3. The Operations Commissioning scope is to define practices that detail the operation of a building until its next use. This scope picks up where the design and construction commissioning plan generally stops. An Operations Commissioning Plan generally includes the following:

11.4.4.3.1. Problem Response plan – provides clear assignment of responsibility to individuals and defines lines of communications. Coordinate with campus management systems.

11.4.4.3.2. Maintenance Plan – identifies cleaning and replacement schedules. Recalibration and follow-up testing are noted.

11.4.4.3.3. Energy Efficient Operations Plan – documents important reference information for operation building systems.

11.4.5. Construction and Commissioning Team:

11.4.5.1. The Commissioning Plan shall include a table identifying the entire construction and commissioning team, listing company names, primary contact names and contact information (voice/office/cell/fax/email/address). This table shall include C/U, General Contractor, Commissioning Authority, A/E, OR, Mechanical Engineer, Electrical Engineer, Mechanical Subcontractor, Electrical Subcontractor, TAB Subcontractor, Controls Subcontractor and others.

11.4.6. Roles and Responsibilities:

11.4.6.1. Team Members; The members of the commissioning team consist of the CA, C/U Project Manager, C/U chief plant/operating engineer, OR, GC, A/E, the Mechanical Subcontractor, Electrical Subcontractor, TAB Subcontractor, Controls Subcontractor, and any other installing Subcontractors or suppliers of equipment.

11.4.6.2. General Descriptions of Roles: General descriptions of the commissioning roles are as follows:

CA: Coordinates the Cx process, writes Cx specifications, conducts design reviews, and reviews the DID/BOD, if hired during the design phase. During the construction phase the CA develops the Cx plan, reviews submittals impacting the Cx scope, writes the Pre-functional checklists, and writes the Functional Test Procedures.

GC: Facilitates the Cx process, ensures that Subcontractors perform their responsibilities and integrates Cx into the construction process and schedule.

Subcontractors: Demonstrate proper system performance by manipulating systems during onsite Functional Test Procedures. Supports the commissioning process and resolves all identified deficiencies.

A/E: Performs construction observations, approves O&M manuals approves the final TAB report following CA review and comment, and assists in resolving problems. Writes Cx Specifications, if CA is not hired during design.

C/U Project Manager: Facilitates and supports the Cx process, approves test plans, and gives final approval of the Cx work.

C/U Chief Plant/Operating Engineer: Observes performance tests.

OR: Verifies performance tests are completed. Assists in scheduling tests.

Mfr: The equipment manufacturers and vendors provide documentation to facilitate the commissioning work and perform contracted startup.

11.4.7. Initial Submittals and Documentation:

11.4.7.1. Standard Submittals: The CA shall be included in the submittal process. The GC shall provide copies of each submittal for the use, comment and review of the CA. This data request typically coincides with the normal A/E submittal process. At minimum, this equipment data includes installation and start-up procedures, O&M data, dimensional data, performance data and control drawings and sequences of operations. The CA reviews equipment and systems, submissions relative to those specified in the Contract Documents, and submits comments to the A/E for review and consideration. CA recommendations shall be provided to the A/E and C/U Project Manager as directed.

11.4.7.2. Pre-functional Checklists (PC): The PC's are developed by the CA and completed by all associated subcontractors and vendors during the normal course of installation and startup. When developing the PC's, the CA shall include sections verifying equipment installation, startup, and integration; in preparation for onsite Functional Performance Tests. Before scheduling onsite Functional Performance Tests, the GC shall submit completed copies of the PC's to the CA and C/U Project Manager.

11.4.7.3. Functional Performance Tests (FT's): The FT's are pass/fail test procedures developed by the CA. The test procedures shall at a minimum include a section reviewing all associated BAS input/output values, sequences of operation, and equipment safeties and alarms per the approved Contract Documents. The FT's are completed by the CA; with the support of the installing contractors, and vendors. During onsite Functional Performance Testing the subcontractors and vendors are required to manipulate all equipment and systems; and demonstrate operation per the FT procedures.

11.4.7.4. Special Submittals, Notifications and Clarifications: The Subcontractors, GC or A/E shall notify the CA of any new design intent or operating parameter changes, added control strategies and sequences of operation, or other change orders that may affect commissioned systems. The Controls Subcontractor provides the CA a full points list with details requested by the CA Thirty (30) days prior to performing Owner-contracted tests, the Subcontractors shall provide the CA full details of the procedures. As the phases of the TAB are completed, the draft TAB report shall be provided to the CA with full explanations of approach,

methods, results, data table legends, etc. The final TAB report shall be provided to the CA upon completion.

11.4.7.5. The CA may request additional design narrative from the A/E and from the Controls Subcontractor depending on how complete the documentation was which was provided with the Contract Documents. The CA may submit written RFIs to Subcontractors through the A/E and GC, or address them directly for clarifications, as needed.

11.4.7.6. Deficiencies and Retesting: The CA documents the results of the Functional Performance Tests. Corrections of minor deficiencies identified may be made during the tests at the discretion of the CA. The CA shall record the results of the tests on the procedure or test forms. Deficiencies or non-conformance issues are noted and reported to the OR, the A/E and the C/U Project Manager. Sub-Contractors shall then correct deficiencies and notify the A/E, GC, OR, CA and the C/U Project Manager and provide a written statement of how the issue was resolved. The CA shall schedule retesting through the GC and the OR. Decisions regarding deficiencies and corrections are made at as low a level as possible, preferably between the CA and the Subcontractors. For areas in dispute, final authority resides with the A/E and the C/U Project Manager. The CA recommends acceptance of each test to the A/E, GC, OR and the C/U Project Manager. The C/U Project Manager gives final approval on each Functional Test. Refer to the Specifications for further details.

11.4.7.7. Commissioning Report: At a minimum, the Final Commissioning Report shall include the following sections:

11.4.7.7.1. Report Summary

11.4.7.7.2. Design Indent Document

11.4.7.7.3. Pre-functional Checklists (PC's)

11.4.7.7.4. Functional Performance Test procedures

11.4.7.7.5. Testing Report/Deficiency Log

11.4.7.7.6. Training Record

11.4.7.7.7. O&M's

11.4.7.7.8. Systems Manual

11.4.8. Operation and Maintenance (O&M) Manuals and Warranties:

11.4.8.1. Owner Training & orientation shall be completed by the GC, associated subcontractors, and vendors. The GC shall submit the proposed training agenda and associated trainer qualifications to the CA and C/U Project manager for review and approval, prior to scheduling onsite training.

11.4.8.2. Mechanical and Electrical Design Engineer: The design engineers shall provide an overview of the major systems and equipment in the facility, including for each system: the design intent, rationale of why the system was chosen, an overview of its operation and interactions with other systems, any special areas to be aware of, issues regarding future expansion and remodeling, etc.

11.4.8.3. Warranty Period: The C/U Project Manager and the A/E shall determine if warranty verification at the 10 month mark and seasonal testing is required in the scope of the Commissioning Plan. B3 Guideline P.4 Cx requires that the CA conduct a Deferred/seasonal testing inspection and a 10-month O&M review.

11.4.9. Operations Commissioning:

11.4.9.1. The CxA and the Owner shall develop a Problem Response Plan. Include clear assignment of responsibility, contact information, sample decision trees, and document lines of communication. Define a process by which problems or documented and passed on to the appropriate party for attention. Incorporate a planned response to anticipated feedback or triggers indicating potential performance problems.

11.4.9.2. The CxA and the Owner shall develop a Maintenance Plan. A preventive maintenance plan shall include regularly schedule checks to verify ongoing performance and to prevent failures of the facility and its systems. Establish procedures that will identify unintended water intrusions and provide drying and removal within 48 hours of the event. Identify corrective actions required to prevent mold. Clearly schedule filter changes, cleaning, and other necessary replacements.

11.4.9.3. The CxA and the Owner shall develop an Energy Efficient Operations Plan. This plan will include ways to evaluate the systems as needed to support performance of the guidelines.

Division 25 - Integrated Automation

[This Division is currently under review.]

1. General

2.1. The A/E shall design a complete Integrated Automation system using a BACnet or LonWorks compatible direct digital control (DDC) system as the backbone. The A/E shall coordinate the Integrated Automation System and equipment solution design and installation with the C/U Project Manager.

2.2. The A/E shall inquire about the long-range plans for the facility and incorporate long-range plans into the design when practical.

2.3. The Integrated Automation system shall meet the requirements of Minnesota Statues and federal and local codes and regulations.

2.4. All Owner-furnished equipment shall be installed per the National Electrical Code and applicable industrial standards.

2.5. Integrated Automation system interfaces shall be coordinated with other equipment and control systems.

2.6. The design shall incorporate energy savings practices.

2.7. All Integrated Automation system equipment and materials shall be labeled by Underwriters Laboratories or other certifying agency.

2.8. Architectural Drawings shall be reviewed to identify ADA areas, and operator interface areas for the Integrated Automation system Human-Machine Interfaces (HMI), which shall be designed for compliance with ADA requirements.

2.9. Reference State of Minnesota Sustainable Building Guidelines (B3), Section P.5 with regard to device water measurement, energy device and system level measurement, and indoor environmental quality measurement.

2. Codes and Standards: Design and installation of Integrated Automation systems shall conform to the latest editions of the following Codes and Standards unless otherwise stated in Minnesota Statutes.

2.1. Minnesota Department of Administration, Minnesota State Building Code.

2.2. Minnesota Department of Public Safety.

2.3. International Mechanical Code, Minnesota Amendments to International Mechanical Code.

2.4. National Fire Protection Association (NFPA).

2.5. NFPA 70 – National Electrical Code.

2.6. ANSI/ASHRAE Standard 135-2001.

2.7. NEMA (National Electrical Manufacturers Association).

3. General System Requirements:

3.1. The Integrated Automation system shall, as a minimum, integrate the following building systems to provide centralized control and monitoring:

3.1.1. HVAC temperature controls.

3.1.2. Power and lighting.

3.1.3. Fire and Life Safety.

3.1.4. Security – Access control and intrusion alarms.

3.1.5. Security -Digital video (if applicable).

3.2. The Integrated Automation system shall be modular and expandable. The system shall be fault-tolerant design so a single component failure will not interrupt normal operation. Include a 10% minimum expansion capacity in I/O terminations and cards, plus a minimum 20% spare cabinet space.

3.3. Provide a secure source of 120 volts ac, single phase, 60 Hz power to various system cabinets as required. All necessary power conversion devices to supply other required internal system voltages shall be provided with the Integrated Automation system. All control power transformers and similar control accessories shall be mounted within enclosed cabinets. Externally mounted devices are not acceptable.

3.4. I/O modules shall be provided for the following signals, as a minimum:

3.4.1. Analog inputs: 4-20 mA dc, either system-powered or external-powered.

3.4.2. Analog inputs: 0-10 V dc, external-powered.

3.4.3. Thermocouple inputs, grounded and ungrounded: for Types E, J and K.

3.4.4. RTD inputs, 3-wire, grounded and ungrounded: 100 ohm platinum (American or European) and 10 ohm copper.

3.4.5. Analog outputs: 4-20 mA dc (0-600 ohms load, minimum).

3.4.6. Discrete inputs: either system-powered or external 120 V ac power.

3.4.7. Pulse inputs: 0-8,000 Hz maximum range.

3.4.8. Discrete outputs, external-powered, both latched and momentary.

3.5. A high-speed direct digital communications network shall be used as the primary means of data transmission. The capability of the network shall provide sufficient operating speed and signal characteristics to provide all functions required for control and monitoring.

4. Network Devices:

4.1. The network shall be high-speed Local Area Network (LAN), field bus. The network shall have the capability of detecting and accommodating single or multiple failures of workstations, control panels or network media. The network shall include provisions for automatic reconfiguration to minimize the effects of single or multiple failures. Communication at this level of the architecture shall be a TCP/IP-based protocol, specifically the BACnet®-IP protocol developed by ASHRAE

4.2. Servers: Servers shall be provided as necessary to interface serial devices to the high-speed LAN network.

4.3. Routers, Bridges, Switches, Hubs and Modems: Multi-port repeaters shall be used in a star, bus or mixed configuration. Each repeater shall retransmit to every node on the network and provide isolation between nodes. The hub shall not require external terminators.

4.4. Workstations:

4.4.1. Operator Workstations: Operator workstations shall be general purpose, commercially available desktop PCs configured with sufficient memory, storage capacity, and processor speed to perform all required functions. The desktop PCs and laptop PC manufacturer shall be selected by the C/U for standardization purposes. Verify selection with the C/U Project Manager during the Construction Documents phase.

4.4.2. Portable Operator Workstation: A general purpose, commercially available laptop PC shall be provided for command entry, alarm management, information management, and database management functions. The laptop PC shall be configured to match the desktop PCs to the greatest practical extent and to permit direct connection to stand-alone DDC system panels on a temporary basis. The laptop PC and desktop PCs manufacturer shall be selected by the C/U for standardization purposes. Verify selection with the C/U Project Manager during the Construction Documents phase.

4.5. Gateways: The use of gateways to interface separate control systems and local area networks (LANs) with different communications protocols shall be minimized. The preferred communication protocol is BACnet, which will permit a high level of natural integration of systems for new construction applications. For renovated buildings with existing systems, gateways shall be judiciously applied with the objective of future native integration of all systems.

5. Control and Monitoring Network:

5.1. Supervisory Control: The network shall allow supervisory control of various systems from a centralized operator interface by use of a standard communications protocol like BACnet. The network shall also permit remote access from another building or a home through telephone, broadband or wireless communication channel. Remote access through the internet shall include security measures to ensure communication channel integrity.

5.2. Integration Panels: Network panels shall be provided for housing microprocessor-based control processors, including application-specific controllers; input/output (I/O) modules; communication controller modules; and power supply modules. Processor capability shall be provided for custom application controllers, network controllers, and system integrators, as a minimum. Controllers shall be provided with sufficient memory to support control processes, energy management applications, alarm management, trend data for defined points, custom processes, operator input/output, dial-up communications, manual override monitoring, and other functions required for complete system operation.

5.3. The application-specific controllers include variable air volume (VAV) controllers, which control single-duct, dual-duct, fan-powered and supply exhaust VAVs; unitary controllers, which control unit ventilators, heat pump units, packaged rooftop units, and fan coil units; lab and central plant (LCP) controllers, which control single boiler or chiller plants with pump logic, cooling towers, zone pressurization of labs, and generic system interlocking through hardware; and air handling unit (AHU) controllers.

5.4. Interoperability: Network devices from different manufacturers shall conform to the BACnet standard protocol to allow a high level of “plug and play” connectivity.

6. Software: Provide network software to form a complete supervisory control and data acquisition operating system. Programming for each controller and panel shall reside in that controller or panel. A copy of the programming for each controller shall be stored on the operator workstation for backup. Controllers and panels shall act as stand-alone devices once programmed. All inputs, outputs, software and other points shall be accessible on the entire

network as global points. Points shall be shared between controllers, panels, operator workstations and other network devices without special programming.

Division 26 - Electrical

1. General

1.1. SB 2030 projects shall include sub-meter plug loads in a way that will capture a project's total plug load energy use separately from other loads. Reference B3 Guidelines and SB2030 metering requirements for additional requirements.

1.2. The A/E shall design a complete electrical system. The A/E shall coordinate the electrical systems, equipment and design with the C/U Project Manager.

1.3. The electrical system voltages, layout, loads and emergency/standby generation requirements shall be based on the facility requirements. Coordinate with the C/U Project Manager during the Schematic Design phase to verify these conditions and requirements.

1.4. Electrical outages shall be scheduled with the C/U Project Manager one month before the outage. Outages shall be planned to cause the least interference with normal institutional schedules and routines.

1.5. The A/E shall inquire about the long-range plans for the facility and incorporate long-range plans into the design when practical.

1.6. The electrical system shall meet the requirements of Minnesota Statutes and federal and local codes and regulations. All equipment shall be listed and labeled for its intended use.

1.7. Provide regulatory compliant access to all electrical devices requiring maintenance.

1.8. The A/E shall study electrical systems to determine infrastructure, life safety, security, and overall capacity requirements and modifications.

1.9. Provide a complete electrical system. All Owner furnished equipment shall be installed per the National Electrical Code and industrial standards and shall be coordinated by the A/E. All equipment shall be listed and labeled for its intended use.

1.10. The A/E shall coordinate all electrical systems with the architectural, structural, civil, and mechanical designs.

1.11. The architectural, mechanical and electrical designs shall be integrated to provide adequate space to install and maintain all electrical equipment. No electrical equipment subject to failure shall be installed in any location that would require excavation or building modification to replace such equipment.

1.12. Working clearances around electrical equipment shall meet the requirements of the National Electrical Code and National Electrical Safety Code as a minimum.

1.13. Remediate the negative effects of harmonic currents. Oversize neutral conductors to accommodate harmonic currents caused by equipment with power supplies such as elevator digital controls, variable speed drives, computers, and lighting system electronic ballasts.

1.14. The electrical systems design shall take into consideration the installation of harmonic loads (computers, variable frequency drives, etc.). The electrical design shall reduce

the effects of harmonics to the electrical system meeting installation requirements as defined by IEEE 519. Steps to reduce the effect of high harmonics include using separate circuits or restricting the number of receptacles per circuit, oversizing panelboard neutral buses and feeder neutral conductors, and installing isolation transformers, k-rated transformers, harmonic filters, or other such equipment.

1.15. The electrical design shall incorporate energy savings practices. Reference B3 Guidelines, Section P.5 with regard to energy device and system level measurement, whole building energy measurement and sub-metering. Energy efficient design shall be carried throughout electrical distribution system to end use devices such as switched receptacles and lighting controls as required to meet energy efficiency standards.

1.16. Electrical materials and equipment shall meet ANSI/NEMA or Underwriters Laboratories requirements.

1.17. Review the Architectural Drawings to identify ADA areas and design the electrical system to meet ADA requirements.

2. Design and installation shall conform to the latest editions of the following Codes and Standards associations unless otherwise stated in Minnesota Statutes.

2.1. National Fire Protection Association (NFPA).

2.2. NFPA 70 - National Electrical Code.

2.3. NFPA 70E Electrical Safety in the Workplace.

2.4. NFPA 72 National Fire Alarm Code.

2.5. NFPA 780 Installation of Lightning Protection Systems.

2.6. NFPA 101 Life Safety Code.

2.7. NFPA 110 Standard for Emergency and Standby Power Systems.

2.8. NFPA 780 Standard for Installation of Lightning Protection Systems.

2.9. Minnesota State Building Code.

2.10. Minnesota State Fire Code.

2.11. National Electrical Code (NEC).

2.12. Underwriter Laboratories.

2.13. Illuminating Engineers Society of North America (IES) Lighting Handbook.

2.14. NEMA: National Electrical Manufacturers Association.

2.15. ANSI: American National Standards Institute.

2.16. IEEE: Institute of Electrical and Electronics Engineers.

2.17. ICEA: Insulated Cable Engineering Association.

3. Power System Studies: Prepare and submit to the Owner, in the Construction Document phase submittal, a Power Distribution Studies including the following:

3.1. Short circuit study verification for all 15 kV, 5 kV, and 480-volt equipment including 480-volt and 120/208-volt panelboards and step down transformers.

3.2. Provide documentation for all installed cable lengths signed off by an electrical contractor.

3.3. Comparison table of equipment ratings vs. available short circuit current.

3.4. Provide equipment data sheets for all protective equipment including relays, breakers, fuses, current transformers, voltage transformers, etc.

3.5. Protective Coordination Study showing coordination of 15 kV, 5 kV, and 480-volt and 120/208 volt equipment including panelboards.

3.6. Time-Current Curves for protective devices (relays, fuses) showing adjustment ranges (bands) where applicable. Verify adjustment ranges against physically installed protection devices. Provide photographs to verify adjustable setting devices. Provide manufacturers time current data sheets for all protective devices to include total clearing times.

3.7. Studies shall provide appropriate relay and breaker settings for all switchgear and interchangeable trip, adjustable circuit breakers.

3.8. Coordination shall be based on IEEE standard practices

3.9. Illustrate clearly by use of time-current characteristic curves (generated by study software) on standard size 5-cycle log-log paper.

3.10. System Harmonic Current Study shall meet IEEE 519 requirements.

3.11. Provide a complete arc flash study for all new building additions and limited studies for renovations projects to comply with NFPA 70E and OSHA regulations for the installation of all electrical equipment. Coordinate with the C/U Project Manager during Design Development Construction Document phase electrical design work.

3.12. Bind completed Short Circuit, Protective Coordination and Arc-Flash Study information in 3-ring binder format, tabbed and indexed for easy reference. Submit to the Owner as part of the Construction Document phase submittal. These documents to also be included with Operations & Maintenance Manuals.

4. Electrical Distribution:

4.1. The preferred site distribution installation consists of a looped-primary circuit service from multiple sources. Medium voltage pad-mounted distribution switches or metal clad switchgear shall be located in or near the main distribution centers or campus buildings.

4.2. Looped-primary equipment at each building shall typically consist of looped non-fused switch cubicles, fused transformer primary disconnect switches, dry-type

transformers, secondary meters, and secondary distribution enclosures, installed indoors in a dedicated electrical room.

4.3. Pad-mounted electrical equipment location(s) shall be coordinated with the C/U Project Manager. Pad-mounted equipment shall be provided with padlocks. Provide concrete equipment pads for all pad-mounted equipment. Concrete equipment pads shall extend a minimum of 4 inches beyond the equipment footprint and 6 inches above grade. Pad mounted equipment shall have a sub base that extends a minimum of 3 feet below grade for cable access, termination and future maintenance.

4.4. Identify underground obstacles or obstructions on Electrical Drawings.

4.5. Underground Electrical Site Distribution

4.5.1. Conduits shall be installed 36 inches below grade centered in 12 inches of sand. Provide a metallic/magnetic warning tape 24 inches above all underground conduits, including site lighting conduits.

4.5.2. Conduits shall be HDPE or PVC Schedule 40 or PVC Schedule 80. Install galvanized rigid steel elbows with long radius bends at 90 and 45 degree elbows.

4.5.3. Duct banks installed under roadways or areas of heavy traffic shall be concrete steel reinforced.

4.5.4. Conduits shall be sloped away from buildings and toward manholes or pull boxes.

4.5.5. Install manholes so the cables are not damaged during installation. Wrap cables in manhole with fire tape as required.

4.5.6. Install a minimum of two 4 inch spare conduits for future use, with pull cord, in duct banks. Coordinate the number of conduits in duct banks with the C/U Project Manager.

4.6. Direct-buried cable is not allowed.

4.7. Underground splicing of cables is not allowed.

4.8. Communication systems shall not occupy the same trench as electrical power cables. Communication systems underground conduits shall be separated from power systems as required by IEEE.

5. Electrical Room and Closets:

5.1. Provide adequate ventilation or cooling for electrical rooms and equipment. As a minimum, provide ducted fresh air supply and exhaust for all electrical rooms. Ventilation system shall provide adequate cooling for the electrical equipment installed in the room. Coordinate ventilation and cooling requirements with the Architect and Mechanical Engineer.

5.2. Electrical and communications equipment shall be installed in separate rooms or closets unless approved by the C/U Project Manager. Coordinate locations of electrical and communications equipment to avoid EMI interference.

5.3. Electrical panels shall not be installed near any plumbing fixtures, sinks, tubs, or other sources of water.

5.4. All medium-voltage rooms shall contain a ground bus installed completely around the perimeter of the room.

5.5. All electrical and communication rooms or closets shall contain a ground bus installed at a minimum of 8'-0" AFF. Minimum size to be ¼" x 3" x 24" with pre-drilled holes for two hole, ground type cable connections.

6. Installation Criteria:

6.1. Provide an industrial rated non-fused maintenance safety disconnect switch near every motor or every piece of electrical machinery for maintenance and safety; unless a motor starter meeting NEC requirements is located within sight of the electrical equipment. The disconnect switch shall be rated for the horsepower and amperage of the device and shall also contain auxiliary contacts to interrupt control circuit when in the "OFF" position. Control conductors shall also be provided between motor controller and safety disconnect switch.

6.2. The use of electrical raceway conduit systems under or in concrete floor slab-on-grade is discouraged due to potential damage during concrete work. When used, the A/E shall specify all requirements and conditions necessary to obtain a good quality conduit system.

6.3. The 480/277-volt circuits shall not be installed in the same raceway with 208/120-volt circuits.

6.4. Lighting and receptacles shall be on separate branch circuits.

6.4.1. All branch circuits shall contain dedicated neutrals.

6.5. Install metal conduits in all areas. Minimum conduit size is ½ inch. Install exposed receptacles in cast metal boxes. Locate receptacles in the web of columns or in locations where the receptacle is protected from damage. Exposed sheet metal boxes are not allowed.

6.6. Do not install raceway in stairwells that is not required for equipment located in the stairwell.

6.7. Enclosures shall have screws or screw clamps and shall have provision for locking with utility-type seals. Adjust height of electrical enclosures installed on modular masonry walls to avoid cutting more than one masonry unit.

7. Utility Coordination:

7.1. The Engineer shall coordinate with the local power Utility for service expansions or new services required. Determine any easements or special conditions required by the Utility for the installation. If easements are required, coordinate these with the C/U Project Manager and the Minnesota State Program Manager at the start of the Design Development phase.

7.2. Coordinate metering requirements and point of service entrance connection with the Utility and the C/U Project Manager.

7.3. Determine any Utility costs and include in the bid price if approved by the C/U Project Manager.

7.4. Coordinate the construction schedule with Utility.

7.5. The Engineer shall coordinate with the Utility for all available electrical rebate programs. Contact the Utility and provide information to the C/U Project Manager and the Department of Administration's Energy Management Services describing rebate program and potential energy savings. Provide assistance and forward Contractor's invoices to C/U Project Manager for rebate application(s). Also see Section II. – 10.4 of these Design Standards for additional information.

8. Major Electrical Equipment:

8.1. Transformers:

8.1.1. All indoor transformers shall be dry-type, copper wound, cast coil, and adequately vented for proper cooling. Oil-filled transformers shall not be installed indoors. If oil filled transformers are installed outdoors, they must contain biodegradable transformer oil or be installed with a spill containment system sized to hold transformer oil plus the volume of water from a 25 year, 24 hour event.

8.1.2. Specify K-rated step down transformers.

8.1.3. Transformers located near offices, classrooms, dormitories, and similar occupied spaces shall be designed to limit the amount of noise and vibration that can be detected by occupants.

8.2. Panelboards:

8.2.1. Panelboards shall be fully rated for the available fault current, and furnished with main circuit breakers, full sized bolt-on branch breakers, 200 percent rated neutral buses, and bonded equipment grounding buses. Panelboards shall be surface mounted with surface mounted conduits in dedicated electrical rooms. Panelboards shall be recessed where installed outside of dedicated electrical rooms. Installation of panelboards outside of electrical rooms shall be minimized. Panelboards shall be located near the loads they serve. Twenty-five (25) percent of each panelboard shall be provided with spare breakers.

8.2.2. Provide arc flash analysis and labeling for all new panelboards in accordance with Minnesota State Fire Code, Chapter 6, Section 605 - Electrical Equipment.

8.2.3. Panelboards shall have a typed panel circuit schedule mounted in the panelboard, for all installed circuits.

8.2.4. Panelboard buses shall be copper (aluminum buses are not allowed).

8.2.5. Provide main circuit breakers for all panelboards which are not located in the same room as their feeder disconnect or breaker.

8.2.6. Provide lock and clip-on fire alarm panel circuit breakers, security, or other essential load circuit breakers.

8.3. Variable Frequency Drives (VFD's):

8.3.1. VFD's shall be compatible with motors to alleviate shaft current arcing or specify motors with shaft grounding kits.

8.3.2. Harmonic filters shall be considered for long cable runs from VFD to motor.

8.3.3. Consider using XLP type cables between VFD and motor on long cable runs.

8.3.4. Provide line reactors and harmonic filters on the primary side of the VFD where required to meet IEEE 519 requirements.

8.3.5. Provide VFDs with bypass functionality for maintenance when needed for system reliability and operation.

8.3.6. VFD's shall include integral disconnect switches.

8.3.7. The Engineer shall verify acceptable VFD manufacturers with the C/U Project Manager to coordinate with existing VFD equipment.

8.4. Surge Suppression:

8.4.1. Design surge arresters and Surge Protection (SPD) into all Projects that involve primary or secondary electrical service equipment.

8.4.2. Provide surge arresters in the primary side of all medium-voltage transformers, and in 5-kV and 15-kV loop switches. Fused transformer primary switches (5 kV and 15 kV) do not require a separate surge arrester as long as surge arresters are provided in the medium-voltage transformer.

8.4.3. A single SPD device shall be installed on the load side of a building's main service disconnect, typically at the service entrance switchboard or main distribution panel. If required, surge arrestors installed on sub-panels shall be coordinated with primary surge arrestors.

8.4.4. Surge arresters and SPD devices shall be metal oxide varistor (MOV) type. Include replacement of existing surge arresters and SPD devices in the Project if they are not MOV type.

8.4.5. SPD devices shall be connected through a multi-pole circuit breaker.

9. Service Entrance Equipment:

9.1. The service entrance panel shall have a main circuit breaker or fused disconnect switch.

9.2. The main service panel shall have a digital panel meter that displays three-phase and single-phase volts, amperes, kVA, and kWh.

9.3. Coordinate with the C/U Project Manager to identify other electrical power submeter requirements such as separate building areas, zones or functions. Coordinate with the C/U Project Manager if digital meter should be connected to the building LAN for logging of meter data. Coordinate LAN connection with electrical engineer or Telecommunications consultant.

10. Power Systems:

    10.1. Verify the operating voltages at each facility.

    10.2. The building service entrance cable and service entrance equipment shall be sized for 150 percent future load.

    10.3. Feeders, transformers, and panels shall be sized for 125 percent future load. Provide 25 percent spare circuit breakers in panels where possible.

    10.4. The preferred system voltages to be used within buildings include 208/120 Wye and 480/277 Wye. For large motor loads and large lighting loads, use 480/277-volt systems wherever possible. Coordinate required system voltages with local conditions.

    10.5. For building services where the code requires, provide ground fault protection on the main service disconnect. Also provide ground fault protection on the next level feeder breakers.

    10.6. The Engineer shall provide all set points for the distribution system's protective relays and electronic trip circuit breakers.

    10.7. The use of multi-wire branch circuits with a common neutral feeding loads is not permitted.

    10.8. Lighting and receptacles shall be installed on separate circuits.

11. Raceway and Cable Tray:

    11.1. All power control, signal and communication wiring, including telecommunications and data cabling which may be installed by the Owner, shall be installed in raceway or cable tray systems.

    11.2. Conduit shall be run continuous and concealed, unless in unfinished room or in remodeling projects involving existing wall construction that does not allow for recessed conduit and boxes.

    11.3. Conduit and cable tray shall be accessible for cable installation and shall provide for cable turn radiuses.

    11.4. Conduit and cable tray shall be independently supported as required by NEC. Do not support conduit from ductwork.

    11.5. Include pull ropes in all spare conduits, including underground conduits.

    11.6. Provide bonding jumper between cable tray and conduit at each transition.

    11.7. Specify raceway fire-stopping requirements as required by building codes and authorities having jurisdiction.

    11.8. Specify cable tray fire stopping with expandable and removable pillow materials at all fire-rated partition penetrations.

    11.9. Conduits for communications and low voltage cabling shall meet the installation requirements of the EIA/TIA and BICSI including the more stringent requirements for the degree of bends between pull boxes and required bend radius requirements. Coordinate with the Telecommunications consultant.

12. Wiring Devices:

    12.1. All general receptacle and lighting circuits shall be fed from 20-ampere circuits, fed by 20-ampere circuit breakers. Receptacles shall be specification grade or better. Coordinate with the C/U Project Manager for specific locations of receptacles and device configurations for Owner equipment.

    12.2. Provide automatic shut off for at least 50% of 125 volt, 15- and 20-Ampere receptacles when the building is not in use, including those installed in modular partitions in Open Office, Computer Classroom and Private office spaces per latest version of ASHRAE 90.1 Energy Code.

    12.3. Provide all branch circuits required by the National Electrical Code (NEC) as a minimum. Horizontally offset receptacles on opposite sides of common walls.

    12.4. Provide all circuits serving computer loads, lighting, and receptacles with a dedicated neutral conductor and separate ground conductor. Sharing neutrals is not allowed.

    12.5. General purpose receptacles shall be installed in accordance with the National Electrical Code. Receptacles in office areas shall be limited to five duplex receptacles per circuit. Where a circuit is designed for shop equipment, maintenance equipment, appliances, etc., as few as one or two receptacles per circuit may be appropriate.

    12.6. Refer to the MNIT Building Infrastructure Best Practices for State Owned Buildings.

    12.7. Provide Ground Fault Current Interrupting (GFCI) receptacles as required by the National Electrical Code as a minimum.

    12.8. Restrooms shall have a GFCI receptacle located adjacent to each pair of sink basins. Above-sink fixtures shall not have receptacles.

    12.9. Exterior receptacles shall be GFCI and shall have weatherproof while-in-use type covers, rated NEMA 3R.

    12.10. For power-operated door requirements, see Division 08 – Openings in Section IV, of these Design Standards.

    12.11. Each residence hall room shall have one 20 amp circuit per occupant minimum in each dorm room. Verify other circuit requirements for residence halls with the C/U Project Manager during the Schematic Design phase of the Project.

    12.12. Each elevator shall include a shunt-trip breaker for interconnection with the fire detection and alarm system.

13. Grounding and Bonding:

    13.1. Grounding and bonding shall meet the requirements of the National Electrical Code.

    13.2. Install an insulated green grounding conductor in all conduits. Each end shall be terminated on a UL listed device.

    13.3. Grounding for telecommunication equipment and rooms shall meet ANSI/TIA 607 B minimum requirements.

    13.4. Grounding conductors shall be copper, 600-volt cable.

13.5. Where electrical systems feed computers or sensitive electronic equipment, including personal computers and other sensitive Owner equipment, verify the requirements for isolated ground devices with the C/U Project Manager. The Engineer shall consult and coordinate requirements with the supplier(s) of electronic equipment.

13.6. Refer to the MNIT Building Infrastructure Best Practices for State Owner Buildings for electrical grounding requirements for IT equipment and spaces.

14. Lighting and Control:

14.1. In general, the lighting design shall conform to the most current requirements of the B3 Guidelines and shall be based on the guidelines of the Illumination Engineers Society of North America (IES) lighting handbook. The lighting design shall also conform to the most current requirements of ASHRAE 90.1.

14.2. Coordinate lighting and control with Division 25 - Integrated Automation of these Design Standards.

14.3. Lighting design shall be functional, energy efficient and limit lighting pollution. The Engineer shall coordinate with the C/U Project Manager to identify existing fixture types and select preferences for new fixture types.

14.4. Incandescent lighting is not allowed.

14.5. Operable lighting control shall include switches, occupancy sensors, multilevel and daylighting dimming controls, and zone programmed lighting control panels. Lighting control from circuit breakers only is not allowed.

14.6. Occupancy sensors shall be used to reduce lighting usage. Occupancy sensors shall have an adjustable time delay no shorter than 5 minutes and no longer than 30 minutes of the space becoming unoccupied. Occupancy sensors shall be installed in restrooms, classrooms, conference rooms, open office spaces, individual offices, and corridors as coordinated with the C/U Project Manager and as required by ASHRAE 90.1. For offices and conference rooms exceeding 250 square feet, provide daylighting dimmer control per ASHRAE 90.. Restrooms with occupancy sensors shall have one light fixture on a non-interruptible circuit. All occupancy sensor cabling and signal conductors shall be installed in raceways or cable tray systems.

14.7. Interior Lighting:

14.7.1. Interior lighting shall use LED or fluorescent fixtures.

14.7.2. Light fixtures shall not be supported from the suspended ceiling grid. Fixtures shall be supported from the building structure.

14.7.3. During design, the Engineer shall consider maintenance operations and access to change lamps and ballasts in fixtures in all ceiling spaces 15 feet or more above the floor directly under each fixture. Revise location(s) and/or fixture types to provide a means of lowering the fixtures or provide a safe access such a catwalk to get to the fixture

14.7.4. The building lighting system shall be designed following required guideline I.6 – Quality Lighting from the State of Minnesota Sustainable Building

Design Guidelines (B3), requiring flexible lighting controls to accommodate various uses of a given space

14.7.5. Provide ceiling or wall-mounted fixtures for rooms and interior areas. Fixtures shall be LED or fluorescent type with a prismatic lens or parabolic louver troffer or indirect fluorescent fixtures. Lighting control shall be from wall-mounted switches, except for selected lights such as night lights which shall be controlled by constant-on, locked circuit breaker only. Control switches for general room lighting shall be located at room entrances. Rooms with more than one door shall have three- or four-way switches.

14.7.6. Adjustable task lighting shall be incorporated into the lighting design, except in multi-occupant classrooms, following recommended guideline I.11 – Personal Control of IEQ Conditions and Impacts from the B3 Guidelines.

14.7.7. Light fixtures, exit signs, egress light fixtures, etc., shall be heavy duty commercial grade.

14.7.8. LED light bulbs shall be Energy Star rated.

14.7.9. Fluorescent lighting shall be energy efficient, consisting of T-8 or T-5 lamps and electronic ballasts. Lamps shall be high-efficiency, reduced wattage, color corrected as required for the application. Consider the use of programmed start ballasts.

14.7.10. Stairwells shall have light levels of 10 – 20 foot candles (FC) and must be controlled so that the lighting power can be reduced by at least 50% within 30 minutes of the stairwell becoming unoccupied per ASHRAE 90.1. All lighting in stairwells shall be installed at stairwell landing for maintenance and safety. No lighting shall be installed along stair treads unless lamps are installed at less than 4 feet above stair tread

14.7.11. The Engineer shall submit manufacturer's product data and catalog cut sheets for all proposed interior fixtures to the C/U Project Manager for review and approval during the Design Development phase.

14.8. Emergency and Egress Lighting:

14.8.1. Emergency and egress lighting systems shall provide for the safe passage of people out of and beyond the building to a safe separation distance as determined by the authority having jurisdiction. Systems shall be designed to meet NFPA, Minnesota Statutes, Minnesota State Fire Code and local codes.

14.8.2. Emergency lighting shall be powered by circuits from a building's emergency system and/or emergency battery lighting units.

14.8.3. Emergency egress lighting and exit signs shall be provided as required by NFPA 101. The emergency power shall be obtained from emergency backup generator, lighting inverter, battery packs or as approved by the C/U Project Manager. Residential grade fixtures or fixtures not intended for emergency lighting or exit fixtures are unacceptable and shall not be used. Exit signs shall have LED-type lamps with emergency battery packs.

14.9. Exterior Lighting:

14.9.1. MN Statute 16B.328 Outdoor Lighting Fixtures Model Ordinance**:** An outdoor lighting fixture may be installed or replaced only if meeting the requirements outlined in subdivision 3 or one of the listed conditions applies.

14.9.2. Exterior lighting shall be evaluated for energy efficiency, design characteristics, safety, and maintainability.

14.9.3. Site lighting in parking lots, and heavily traveled areas shall be a minimum 3 FC with a minimum 4:1 uniformity ratio. In parking lots, ideally there is 10 FC at task level, about 30 inches from the ground or about where you would be unlocking a car door.

14.9.4. Lighting for parking ramps shall be a minimum of 20FC at entrance, stairwells and exit lobbies. General parking area shall be an average of 6 FC with a minimum 4:1 uniformity ratio. Bumper walls, roofs and surface areas shall average 2 FC. Parking automatic shutoff requirements so that lighting power can be reduced by at least 30% when there is no activity detected for no longer than 30 minutes.

14.9.5. Exterior lighting at entrances shall be a minimum of 10 FC.

14.9.6. Sidewalks and other pedestrian areas a uniform minimum of (0.5) FC (1FC preferable).

14.9.7. Exterior lighting IES Handbook recommendations, including full cutoff fixtures and shields, shall be used to minimize light trespass. Lighting shall be provided for walks, parking areas, entrance gates, perimeter roads, and the exterior of the buildings. Fixtures shall be visually compatible with the C/U Project Manager's standards and existing fixtures in the area. The Engineer shall submit manufacturer's product data and catalog cut sheets for all proposed exterior fixtures to the C/U Project Manager for review and approval during the Design Development phase. Install light poles in parking lot areas on 1-m high concrete pedestals. Lighting shall be LED. Provide full cutoff fixtures where required to reduce lighting pollution.

14.9.8. Provide wall-mounted lighting fixtures with LED lamps at personnel doors and overhead doors.

14.9.9. Controllability of Lighting Systems:

14.9.9.1. Exterior Lighting shall be controlled by an astronomical time switch or photo-sensor capable of turning the lights on at dusk and turning the lights off either when the lighting is not required during nighttime hours or at dawn. Astronomical time switches shall be capable of retaining programming and the time setting during loss of power for a period of at least 10 hours.

14.9.10. Light fixtures installed outdoors shall be rated for cold weather applications. Batteries shall not be installed outdoors in unheated enclosures.

14.9.11. Show trenching details for underground wiring on the drawings.

14.9.12. Coordinate with C/U Project Manager to identify all viable utility rebate opportunities. Specify equipment that meets or exceeds the efficiency standards and qualifications for utility rebate programs. Upgraded equipment specifications that have incremental costs covered by project budget are to be pursued.

15. Cable:

15.1. All high-current equipment conductors shall be copper.

15.2. Medium-voltage cable shall be copper conductor, 133 percent insulated, copper tape shield, type MV90, with a semiconducting shield, EPR or XLP insulation, PVC outer jacket, and rated for system voltage.

15.3. Medium-voltage cable shall be a minimum 1/0 AWG.

15.4. Cable terminations shall be appropriate for the equipment served.

15.5. 600V cable: All conductors shall be copper (aluminum is not allowed) and not smaller than #14 AWG. Branch circuit conductors #10, #12 and #14 shall be solid; Conductors #8 and larger shall be stranded. Control conductors shall be stranded copper.

15.6. All conductors shall be installed in metallic conduit. Wire types XHHW, or THHN/THWN shall be used. Electrical Nonmetallic Tubing (smurf tube) is not allowed. Metal-clad cable may be allowed for light fixture connections not in excess of 60” per fixture.

15.7. Typically existing cable shall not be spliced.

16. Motors and Motor Control:

16.1. Provide solid-state soft starters or adjustable speed drives for large motors to limit the motor inrush current. Specify reduced voltage starters or adjustable speed drives for all motors 25 hp and above.

16.2. Locate non-fused disconnect switches by motor and electrical loads as required by the operating system and the National Electrical Code.

16.3. Specify combination type motor starters for all 3 phase motors and motors larger than 1 hp. Included integral step down control voltage transformer.

16.4. Provide a Motor Control Center (MCC) where six or more starters are needed in the same area. New MCCs shall be designed and specified to contain at least 20 percent spare size-one spaces. Minimum size NEMA starter shall be Size 1.

16.5. Motors 2 horsepower and above shall be premium efficiency rated meeting NEMA-MG-1 requirements.

17. Lightning Protection For Buildings and Structures:

17.1. Provide lightning protection in accordance with NFPA 780. Complete a risk assessment to evaluate the design requirements per NFPA guidelines.

18. Emergency Power:

    18.1. The Engineer shall consult with the C/U Project Manager to define the requirements for installation of emergency generator and/or battery packs for emergency power systems. Some C/U are designated as community emergency response centers or provide IT outside services such as computer internet hubs. Consider installation of emergency generators at these facilities or provide wiring infrastructure to hookup a portable emergency generator.

    18.2. Specifications for emergency/standby generators shall be a design specification – not a performance specification. Contact the C/U Project Manager for information on the necessary level of quality and components.

    18.3. If an engine-driven generator with automatic transfer switching equipment is provided as back-up power for the emergency systems, building systems such as fire alarm, security, elevators, exit and egress lighting shall be connected to the generator system in accordance with all applicable codes. Critical mechanical equipment may be connected to the generator system to avoid building freeze-up or flooding of key facility spaces. If one generator is used to supply both emergency and non-emergency, the installation shall be designed to meet codes.

    18.4. For small buildings or facilities with minimal emergency loads, the Engineer should perform a life cycle cost analysis to determine if battery pack sources or a generator set or lighting inverter source would be the most cost effective source for emergency systems. The Engineer shall consult the local power Utilities for input on reduced rates.

    18.5. Engine-driven generators shall be located in a room designed solely for the purpose. Generator sets shall be isolated from other areas as required in the code for the isolation of hazards. Allow sufficient room around the generator set for service and to ensure free flow of cooling air. The generator and building shall be designed to reduce the amount of noise to the surrounding area as required by local codes.

    18.6. Provide an adequate supply of combustion air and cooling air for the emergency generator room. Exhaust generator into an upright stack, well above ground level, not into an area well or underground pit. The location of an exhaust outlet shall not be located where it could affect building occupants. Coordinate air, fuel and exhaust design requirements with the Mechanical Engineer.

    18.7. Review alternative fuel sources for engine-driven generators. Design all fuel systems required. Natural gas is the preferred fuel.

19. Field Quality Control:

    19.1. Qualified technicians and personnel shall perform inspections and tests.

    19.2. Provide factory representative(s) to supervise installation(s) where required to commission equipment.

    19.3. Submittals:

        19.3.1. Provide the specified number of copies of typewritten reports listing circuit or equipment tested, date, equipment used, person or persons performing and witnessing tests, and results of tests.

19.3.2. Submit a letter to the A/E and the C/U Project Manager certifying that testing and commissioning services have been satisfactorily completed.

19.3.3. The Electrical Subcontractor shall record “as-built” variations from design Drawings in accordance with provisions of the Division 1 Specifications requirements.

20. Electrical Testing and Commissioning:

20.1. Quality Assurance:

20.1.1. Test equipment shall have calibration dates within 12 months of use on the Project and be calibrated by equipment manufacturer or authorized calibration facility to assure accuracy of the commissioning process.

20.1.2. Testing firm shall be independent of Project’s Electrical Sub contractor. Independent electrical testing firm shall be NETA certified.

20.2. Test Equipment:

20.2.1. Furnish all required equipment for performing tests.

20.3. Testing General:

20.3.1. Notify the A/E and the C/U Project Manager prior to performing tests to permit observation.

20.3.2. Work involved with testing shall be coordinated with the A/E the OR and the C/U Project Manager and other Subcontractors.

20.3.3. Notify the A/E, OR, and the C/U Project Manager of equipment which is disclosed by test as unsatisfactory and replace equipment or wiring furnished under the Contract which is disclosed by tests as unsatisfactory.

20.3.4. Provide all recommended mechanical and electrical tests specified in latest edition of International Electrical Testing Association (NETA) – Acceptance Testing Specification (ATS). Provide optional tests as requested by the C/U Project Manager.

20.4. Insulation Resistance Tests:

20.4.1. Tested cable shall pass requirements of ICEA bulletin S-66-516, latest version. Failed cable shall be replaced and all cable retested without additional cost to the Owner. Provide all test data from either testing agency or electrical contractor quality control checklists. All data shall be dated and signed by testing personnel.

20.5. Medium Voltage Cable Acceptance Test:

20.5.1. Medium voltage cable shall be insulation-resistance tested after cable is installed and splices are made, and before cables are terminated on equipment and before Tan-Delta or Very Low Frequency AC Withstand (VLF) test is performed. Do not use DC Hi-Potential testing on MV Cables. Protect cables from moisture accumulation and wipe clean prior to testing.

20.5.2. Prior to splicing and terminating, perform high-potential tests on each section of installed cable. Contractor shall be responsible for cable damaged during installation.

20.5.2.1. Duration: As recommended by cable manufacturer.

20.5.2.2. Voltage: As recommended by cable manufacturer.

20.5.2.3. Complete cable Tan-Delta or Very Low Frequency AC Withstand (VLF) acceptance test before fireproofing tape is applied.

20.6. Continuity Tests: Test control, alarm, and temperature control low voltage circuits to verify continuity of wiring and connections.

20.7. Phasing and Rotation Tests:

20.7.1. Perform tests and checks necessary to establish proper phase and rotation relationship of connected equipment.

20.7.2. Check connections to motor-driven equipment for proper motor rotation. Correct connections as required.

20.7.3. Disconnect, prior to checks, any device which could be damaged by application of voltage or incorrect phase sequence.

20.8. Relay Programming:

20.8.1. Program, set, and adjust relays.

20.8.2. Provide services of certified testing firm to test and calibrate relays. Calibration test reports shall be typewritten.

20.9. Controls:

20.9.1. Check out controls of system prior to start-up to assure proper performance.

20.9.2. Check for proper operation of pushbuttons, hand switches, pilot lights, and other control devices.

20.9.3. Check control circuits and programs for proper sequence of operation and interlocking functions.

20.10. Field Acceptance Tests:

20.10.1. Perform field acceptance tests after installation and wiring of equipment is complete.

20.10.2. After wires and cables are in place and connected to devices and equipment, test system for short circuits, improper grounds, and other faults. When fault condition is present, rectify trouble, and perform retest. Provide written documentation of all testing with dates performed and signatures of personnel.

20.10.3. Perform insulation resistance test before energization and voltage test after energization at each lighting and distribution panel. Provide written documentation of voltage readings at each panel with dates performed and signatures of personnel. Adjust taps of transformer as needed to obtain correct voltage.

20.10.4. All service and feeder cables, after being pulled in place and before being connected, shall have a Megger test conducted to determine wire and cable insulation resistance is not less than that recommended by National Electrical Code. Provide written documentation of all testing with dates performed and signatures of personnel. Provide the specified number of copies of all tests to the A/E for review and delivery to the C/U Project Manager. Remove, replace, and retest cables failing insulation test.

20.10.5. All switchboards and switchgear shall be tested as recommended by NETA ATS. Include insulation resistance, metering, current transformer, potential transformer, control wiring and ground tests.

20.10.6. All circuit breakers above 400 amp rating shall be tested using primary current injection testing. Document as found and as left test values. Test at values provided in the coordination study if possible. Verify and document that final as left state matches coordination study setting.

20.10.7. All automatic transfer switches shall be tested to meet NETA ATS requirements. Document all time delay settings and verify connection to Building Management and Control System. Test in conjunction with associated engine generator to verify run signal and cool down settings. Provide written documentation of all settings from manufacturer start-up test report.

20.10.8. All generators shall be tested per NETA ATS requirements. Testing shall also comply with NFPA 110 requirements and include a minimum of 2 hour full load bank test and block load testing. Verify all generator components work properly including battery charger, fueling system and day tank filling, exhaust system, coolant and lube oil heaters.

20.10.9. All occupancy sensors, photo sensor controls and time switches shall be tested and documented via functional testing per ASHRAE 90.1.

20.11. Test motors under load with ammeter readings taken for each phase and record rpm of motors at time. Test motors for correct direction of rotation. Run tests on all motors and verify proper overload devices have been installed. Test and record the following on motors and submit the specified number of copies to the A/E for review and delivery to the C/U Project Manager:

20.11.1. Motor No., Location, HP rating.

20.11.2. Motor circuit protector setting and size.

20.11.3. Fuse size.

20.11.4. Heater size.

20.11.5. Full load amperes.

20.11.6. Running amperes.

20.11.7. Rated voltage.

20.11.8. Terminal operating voltage.

20.11.9. Acceptance For Operation:

20.11.10. The A/E and the C/U Project Manager will accept equipment and systems for operation when construction has been substantially completed. "Acceptance for Operation" shall mean the Owner will assume operational and routine maintenance duties. "Acceptance for Operation" does not relieve the Electrical Subcontractor from responsibilities related to defective materials and workmanship; neither does it constitute final acceptance of materials and equipment.

20.11.11. After the A/E and the Owner have accepted a system for operation, continue to perform the following as requested and scheduled by the C/U Project Manager at no additional cost to the Owner:

20.11.11.1. Troubleshooting and adjustments, until systems operation and performance is acceptable.

20.11.11.2. Provision of technical services when needed until final acceptance.

20.11.11.3. Provide warranty services in accordance with provisions of the Contact Documents.

20.12. Final Cleaning:

20.12.1. Thoroughly clean electrical materials, equipment, and apparatus to be free of dust, dirt, rust, and foreign materials before acceptance at Substantial Completion.

20.12.2. Clean panelboards, switchgear, motor controls, etc. Take special care to remove dirt, mortar, wire scraps, etc., from equipment interiors.

20.12.3. Clean accessible elements of disconnecting and protective devices of equipment, coils of dry-type transformers, etc. with compressed air (less than 15 psi), and vacuum clean enclosures prior to being energized.

20.12.4. Thoroughly clean light fixtures and lamps prior to inspection for Substantial Completion. Clean fixture enclosures, lenses, shielding, etc., by approved methods.

20.13. Demonstration:

20.13.1. In presence of the Owner’s facilities personnel, demonstrate the proper operation of electrical systems per the operational and function requirements of the Contract Documents and as outlined in any sequence of operation.

Division 27 – Communications

1. General:

1.1. Refer to Technology Guidelines - Building Infrastructure Best Practices for State Owned Buildings and incorporate these guidelines into the Communications Systems design for the Project. This document can be found at the Department of Administration web site: http://mn.gov/admin/images/space_management_techguidelines.pdf. The Electrical Engineer or Telecommunications Consultant shall coordinate Communications Systems during the Design Development phase with the C/U Project Manager.

1.2. The Electrical Engineer or Telecommunications Consultant shall verify the use of wireless communication systems with the C/U Project Manager. When wireless communications Access Points (AP) are to be installed the C/U Project Manager shall provide the Electrical Engineer or Telecommunications consultant with a Radio Frequency (RF) survey showing the required locations for AP's. Communications cabling shall be designed to serve all AP locations.

1.3. Communications systems shall match existing equipment when practical. Communications systems shall be provided by suppliers that can provide service to the equipment and approved by the C/U Project Manager.

1.4. Communications wiring shall be homerun style. Conductors, wiring method and method of termination shall be per the Technology Guidelines - Building Infrastructure Best Practices for State Owned Buildings. The telephone Main Point of Presence (MPOP) service entrance and backboard shall be located in the telecommunications room.

1.5. All communications cabling shall be plenum rated. Category 6 rated cabling shall be used. Augmented Category 6 (Category 6a) shall be used where high bandwidth applications are used. Consider Category 6a cabling to all wireless access point locations. Category 5E cabling may only be used when installation in an existing building to match the existing cabling plant.

1.6. Each communications outlet shall include a minimum of two (2) cables per location. Cable requirements for specific locations shall be as follows:

1.6.1. Wall mounted voice locations: (1) cable.

1.6.2. Wireless access point locations: (1) cable.

1.6.3. Instructor podium locations - Review specific communications requirements for locations such as classrooms and labs with C/U Project Manager.

1.7. Projects that include remodeling or additions to an existing building shall include communications equipment that matches the existing installed system.

1.8. MNIT standards indicate a ¾" conduit to each communications outlet, recommend a 1" conduit to allow for use of larger Category 6 or 6a cabling.

Division 28 - Electronic Safety and Security

1. Fire Detection and Alarm:

   1.1. General Design Standards:

      1.1.1. Coordinate fire detection and alarm requirements with the College/University (C/U) Project Manager, the Fire Marshal, and the local inspector.

      1.1.2. The designer shall determine the type of fire alarm system (FACP) suitable to the building usage. The system types shall include a fire alarm system, an emergency communication system or a mass notification system. The system type shall be identified in the fire alarm specification and construction drawings.

      1.1.3. In designing Minnesota State fire alarm systems, nothing in these standards shall be construed to allow anything less than full compliance with the minimum legal requirements of the applicable codes and standards as established in the current edition of the Minnesota State Fire Code. Any discrepancies found should be brought to the immediate attention of the college or university Project Manager and the Architect.

      1.1.4. The fire alarm system shall be designed by a NICET (minimum LEVEL 3 Fire Alarm Systems) certified individual under the direct supervision of a Licensed Electrical Engineer or a licensed fire protection engineer with a minimum of 5 years' experience designing fire alarm systems.

      1.1.5. The fire alarm system shall meet the requirements of NFPA 72, Minnesota codes and local codes. The design shall clearly indicate the locations of all fire alarm initiation and notification equipment on drawings as necessary to meet the requirements. Fire alarm systems shall meet ADA requirements.

      1.1.6. Advise in the specification and construction documents, which editions of applicable codes were referenced for the fire alarm system design. The basis for design shall incorporate the installation of all code required fire alarm peripheral devices, with the location and spacing of each type of device as required by NFPA and other applicable codes and standards.

      1.1.7. The designer shall provide a letter to C/U Project Manager and the Minnesota State Program Manager during the construction document phase, stating that the Fire Marshal and/or Authorities Having Jurisdiction (AHJ) have approved the fire detection and alarm design and that the fire alarm system is in adherence to codes and standards.

      1.1.8. The fire alarm system shall be point-addressable, with addressable/analog alarm initiating devices. All initiating devices shall report to the building fire alarm control panel and any remote annunciator(s) in the building. Clarify in the specification if the fire alarm control panel is stand alone, or if it is part of a network. If part of a network, identify the location of the main campus control panel and/or graphic annunciation terminal in the bidding documents.

1.1.9. Every tamper and flow switch shall be individually addressed, regardless of their proximity to other devices.

1.1.10. Indicate in the bidding documents that the campus assigned room numbers shall be used for the fire alarm programming. These room numbers may differ from the bidding drawing numbers.

1.1.11. When an existing campus fire alarm network is available, provisions shall be made to update the network when new systems are added. The main campus control panel, any graphics terminal shall be reprogrammed to include information, site plans, floor plans, etc., as needed to add the new system to the network.

1.1.12. Graphic maps shall provide individual point annunciation of all initiating devices on graphic floor plans.

1.1.13. Specify that the three -pulse temporal pattern evacuation signal will be broadcast during a general fire alarm evacuation. The three pulse temporal pattern shall be as described in NFPA 72. A separate distinctly different signal from the three - pulse temporal pattern, shall be utilized for both the general evacuation signal and the pre - alert tone for a speaker system.

1.1.14. When the fire alarm system includes speaker appliances, the system design shall designate on the construction drawings, the areas requiring intelligibility and areas not requiring intelligibility within all the occupied spaces in the building. These spaces shall be designated on the construction drawings as intelligible and non – intelligible acoustically designated spaces (ADS). The designer shall designate each occupied interior space of the building as an acoustically designated space (ADS) when designing the speaker layout, as required by NFPA 72. Construction documents shall indicate all the ADS's. The designer shall provide a layout of the ADS to the AHJ if requested.

1.1.15. The system designer will review the expected ambient air conditions for all installed smoke detectors. Smoke detectors that will be installed in air conditions with poor air quality and/or a potential for particle contamination should be specified as sensors with multiple sensing elements. The intent is to minimize false alarms.

1.1.16. Review with the (AHJ) the location of the new fire alarm control panel (FACP) and any required remote fire alarm annunciators, prior to issuing the construction documents.

1.2. Equipment:

1.2.1. The designer shall review all existing fire alarm systems on the campus prior to beginning the design and determining networking capabilities.

1.2.2. The fire alarm control panel shall be designed to control any pre – action sprinkler systems. Specify the FACP to be UL listed for pre-action release.

1.2.3. The fire alarm control panel is for the use of personnel designated by the building owner and the responding fire department. The fire alarm control panel is not required to be mounted at an accessible height. Mounting

height of the fire alarm control panel shall be between 72" –75" inches above the finished floor measured to the top of the FACP.

1.2.4. Specify that all batteries associated with the fire alarm system shall not be older than 3 months old (based on the date code on the battery) at the time of system acceptance. Batteries not installed in the FACP or secondary panels, shall be installed not higher than 3 feet above the finished floor.

1.2.5. Specify that the power supplies shall be sized to furnish the total connected load in a worst-case condition plus 25% spare capacity. Remote transponders, remote power supplies and remote voice amplifiers shall be installed in dry and secure room.

1.2.6. Specify where an electrical generator is available, the FACP and all secondary panels shall be connected to emergency power with back up batteries sized as described in NFPA 72. When no generator is available, provide batteries as the secondary power source.

1.2.7. The designer shall specify that the FACP shall be a red enclosure(s) and red cabinets. Secondary panels may be red or black.

1.2.8. The designer shall determine the method of communication between the building fire alarm system and the UL listed central station. The connection may be POTS, VOIP or wireless. If a digital alarm communicator transmitter (DACT) is specified, the DACT shall be provided with a minimum of two (2) telephone lines for a POTS connection. VOIP communicators mesh radio and GSM cellular are all listed for single transmission and no back up is required. Designer shall verify that no prohibitive software and or hardware is installed on site that would prohibit the transmission of signals from the IPDACT to the central station. If such software/hardware exists the designer shall specify an alternate method of communication. If part of a network, clarify the method to be utilized for off-site fire alarm signal transmission.

1.2.9. The designer shall incorporate 25 % spare capacity in the NAC circuit design for future expansion.

1.3. Initiating Devices:

1.3.1. Manual pull stations shall be dual action. The designer shall follow the requirements for initiation listed in the current adopted Minnesota State Fire Code. If the initiation is automatic, then the designer shall locate manual pull stations only in monitored and/or secure locations in the building. Unless requested by the college or AHJ, manual pull stations at each exit door would not be required with an automatic initiation design.

1.3.2. Perform visual and audible device layout calculations to determine placement of devices. Intensity and coverage requirements shall be as listed in NFPA 72. Audible calculations shall be based on NFPA listed average ambient sound levels for new buildings. Ambient sound pressure levels shall be measured for existing buildings. The ambient sound pressure levels shall be indicated on the bid documents.

1.3.3. Duct smoke detectors shall be installed in accessible locations. Every duct-mounted smoke detector shall have a key activated remote alarm/test station, installed between 48” – 60” above the finished floor, measured to the top of the remote alarm/test station. Each station shall have a permanent red engraved label with the AHU number engraved in white letters.

1.3.4. Specify all fire detectors shall be addressable.

1.3.5. Ionization smoke detectors shall not be acceptable for automatic smoke detection.

1.3.6. All water flow switches, shall be supervised by the fire alarm system. Connect and program each flow switch as a separate zone addressable point.

1.3.7. Designer shall provide supervision of all tamper switches, each post indicator valve (PIV) for the fire protection sprinkler. Provide separate addressable fire alarm monitor points for each sprinkler system supervisory valve tamper switch. Program the custom message to indicate the physical location of the tamper switch, not the sprinkler zone location.

1.3.8. Specify all sprinkler system water shut off valves controlling water supplies or automatic sprinklers shall be locked or secured in the open position at all times. Exception: Valves located in a room or space with access is limited to essential personnel only.

1.4. Notification Devices:

1.4.1. Wall or ceiling mounted devices are acceptable. The designer shall specify that surface mounted notification devices shall be installed in factory provided red back boxes.

1.4.2. On replacement fire alarm projects, the designer shall try to utilize the existing wall/ceiling openings if the openings satisfy NFPA spacing requirements.

1.4.3. Strobes shall be synchronized in a common viewing field as described in NFPA 72.

1.4.4. The designer shall comply with ADA and NFPA 72 requirements when designing the fire alarm system notification appliances, mounted not less than 80 inches and not greater than 96 inches above the finished floor.

1.4.5. Ceiling mounted notification devices will be white.

1.4.6. The designer shall specify that strobe lights used for fire alarm signaling or meant to indicate evacuation of an area or building be clear or nominal white. Lights used to indicate that the occupants need to seek information or instructions shall also be clear, unless the building emergency plan and the authority having jurisdiction for the building mandate a different color. The designer shall review the strobe color with the local AHJ for the project prior to issuing construction drawings.

1.4.7. Notification devices meant for fire alarm signaling shall be labeled FIRE. Notification devices for EVACS or MNS shall be labeled ALERT.

1.4.8. Design a notification system to provide a minimum of 15 dB above ambient for each Acoustically Distinguishable Space.

1.5. Submittals:

1.5.1. The designer shall specify that the information listed in the adopted Minnesota State Fire Code be provided in the shop drawing submittal with the following additional information;

1.5.1.1. Power requirements shall list the supervisory and alarm power requirements for all powered fire alarm equipment.

1.5.1.2. List the power supply loads of the system power supplies and batteries. Indicate the power supply rating justification showing the power requirements for each of the connected circuits to the power supplies.

1.5.1.3. Provide a fire alarm system function matrix. Matrix shall state alarm input/out events in association with initiation devices. Matrix summary shall include system supervisory and trouble output functions.

1.5.1.4. The submittal shall include 1/8" scale floor plans. All plans shall be prepared by a NICET technician with a minimum Level III in fire alarm. Provide the certification number and technician's full name. Copyrighted symbols shall not be reproduced on plans (such as the NICET emblem). Provide a graphic scale, so when plans are reproduced, the scale may still be determined.

1.5.1.5. Indicate all the conduits installed for the fire alarm installation, the installed conductor type and size in the conduit. All raceways shall be shown, marked for size, conductor count with type and size, showing the percentage of allowable National Electrical Code fill used by the system layout technician.

1.6. Installation:

1.6.1. Fire alarm circuits shall be installed in their own dedicated continuous conduit, separated from any open conductors of power, lighting, or Class 1 circuits, and shall not be placed in conduit, junction boxes, or raceways containing such conductors.

1.6.2. The installing company shall employ a NICET (minimum Level 3 Fire Alarm Technology) technician on site to oversee the installation and final checkout and to ensure the systems integrity. All installing technicians shall have a minimum NICET Level 2 Fire.

1.6.3. Specify all fire alarm system devices and control panels shall be flush mounted when located in finished areas and may be surface mounted when located in unfinished areas. Devices installed on concrete walls shall be

surface mounted with factory/professionally painted EMT to match the existing surface in finished areas and red EMT in unfinished areas.

1.6.4. All fire alarm control panels, remote annunciators, remote transponders, battery cabinet, remote power supplies, duct smoke detector remote test stations and monitor modules shall be permanently labeled with a red permanent label with white engraved letters. The label shall indicate the function of the devices and may include the manufacture's address.

1.6.5. All underground, buried fire alarm cabling shall be fiber strands. The fiber strands shall be provided by the Owner. The fiber optic strands shall include all required connectors. Provide a permanent band at each connector labeled FIRE ALARM. A junction box shall be provided by the fire alarm contractor and shall provide the demarcation line for the conversion from the fiber optic strands to the copper fire alarm cabling. The fire alarm contractor shall provide all media interface equipment and connections to the fire alarm system.

1.6.6. The copper and fiber strands between distributed fire alarm panels in a building and connecting fire alarm panels in distributed buildings shall be configured as a Class X fire alarm network. The Class X network shall be provided as described in NFPA.

1.6.7. The designer shall design the fire alarm system to communicate on single mode fiber optic strands.

1.6.8. Alarm, trouble and supervisory signals from all intelligent reporting devices connected to a fire alarm panel shall be wired on NFPA Class B Signaling Line Circuits (SLC).

1.6.9. Initiation Device Circuits (IDC) shall be wired Class B.

1.6.10. Notification Appliance Circuits (NAC) shall be wired Class B.

1.6.11. No conduit or EMT shall be installed below concrete slabs.

1.6.12. Wiremold may not be used in retrofit installations, unless approved by the C/U Project Manager.

1.6.13. Where the building contains other fire related systems, such as sprinklers, hood suppression, etc., these systems shall be connected to the new FACP and monitored and/or controlled for alarms, trouble, or supervisory conditions.

1.6.14. The A/E shall coordinate the sprinkler and fire alarm design to help assure that the number of flow, tamper and pressure switches are identified as accurately as possible in the construction documents.

1.6.15. Where a fire pump is present, a "pump running" condition shall be treated as a supervisory condition, and not an alarm.

1.6.16. Where dry-pipe valves are installed in buildings not normally occupied, where loss of heat in the room could go undetected, and intelligent/addressable heat detector shall be installed and programmed to monitor the room for low air temperature (40 degrees F.). The detector

shall be wall mounted located at the same elevation as the dry valve and provide a supervisory signal.

1.6.17. A supervised tamper switch is required on all exterior post indicator valves on fire protection water supply lines. These valves may be installed at a distance from the building, which will require an underground circuit to be provided to the interior tamper switch. Valves shall be locked and secured at all times.

1.7. Testing/Final Acceptance:

1.7.1. The engineer shall require that the fire alarm contractor provide a complete pre – test of the installed system utilizing the testing procedures outlined in NFPA 72. A report shall be submitted to the A/E prior to final testing. The report shall be reviewed to determine if the system is ready for final testing.

1.7.2. All smoke detectors shall be tested for smoke entry and sensitivity as described in NFPA 72 and prior to building occupancy.

1.7.3. All duct-mounted smoke detectors shall be tested for the correct pressure differential (within the manufacturer's published ranges) between the inlet and exhaust tubes to insure that smoke entry will be achieved in the duct smoke detector as described in NFPA 72 and prior to building occupancy.

2. Security:

2.1. Coordinate security requirements with the C/U Project Manager and the C/U's Campus Security Officer. At Project's Schematic Design phase, it is important to coordinate the required security systems to assure proper security protection. Provide a security system that is compatible with any existing security system(s).

2.2. The following electronic security systems shall be considered, and implemented into each applicable Project as required. Identify the items below as being separate components of an integrated electronic security system provided by a single manufacturer. List only those specific components necessary for the individual Project being specified.

2.2.1. Security Door/Intercom Control and Monitoring with Graphic User Interfaces. Provide an industrial type PLC-based door control and monitoring system. The system shall be software-driven to allow changes in the control or sequencing of doors by a change in software program. Provide electronic access control card readers at the following locations as a minimum:

2.2.1.1. Main public and staff entrances.

2.2.1.2. Telecommunications rooms.

2.2.1.3. Any other areas or rooms requiring electronic access controls and logging of who enters or exits a room or area.

2.2.1.4. All exterior perimeter doors shall include a door contact for monitoring of door open/close status to the security systems.

2.2.2. Mass Notifications and Paging System. System shall be zoned with speakers located indoors and outdoors. System shall be controllable through the telephone system and integrated with the fire alarm system. If the fire alarm system design includes a voice evacuation system, design the voice evacuation system to provide building mass notification and paging services for both emergency and non-emergency messaging.

2.2.3. Duress Alarms and Emergency Phones (both inside facilities and at selected outdoor site locations).

2.2.4. Closed Circuit Television (CCTV) and Video Surveillance Systems. Video Surveillance Systems shall be software based and shall include IP megapixel surveillance cameras. Analog surveillance cameras shall only be used if additions to an existing analog video systems are necessary.

2.2.5. Intrusion Detection – motion sensors, video motion detectors, glass-break sensors.

2.3. State-of-the-art systems shall be specified to meet the C/U's requirements. The A/E shall specifically review these systems with the C/U Project Manager during the Design Development phase.

2.4. A design firm with expertise in the area of security electronics shall do the security electronics design. The security design consultant shall be certified as a Physical Security Professional (PSP) from ASIS.

2.5. Security systems that utilize graphic-user interface screens shall include specifications which incorporate a "Security Control Point Schedule" and "Function Description Sheets" to specify how the user defined interface screens/icons and the controlled security field devices will functionally operate, to provide the intended security.

2.6. Coordinate with C/U Project Manager, Campus Security Officer, and the local police force if the building's security systems will be connected to and compatible with the police central alarm reporting system.

2.7. Uninterruptible Power Supply (UPS) shall be provided for backup of all security system's equipment, controllers, and field devices to keep the security systems operable. UPS battery supply shall provide for a minimum of 30 minutes of power supply when the UPS is fed from an emergency generator and a minimum of two-hour power supply if the UPS is not fed from an emergency generator.

2.8. Electronic security system circuits shall be installed in their own dedicated conduits, separated from both other low voltage systems and any open conductors of power, lighting, or Class I circuits; and shall not be placed in conduit, junction boxes, or raceways containing such conductors.

3. Commissioning and Testing:

3.1. Security:

3.1.1. For any Project involving security electronic systems installation, ensure that a system verification has taken place which meets the following requirement: testing and commissioning shall be performed by a factory-trained,

certified/authorized representative of the system manufacturer in the presence of the C/U Project Manager, and any local authority have jurisdiction regarding specific system(s) being tested.

3.1.2. A point-by-point checkout of the entire system shall be conducted and results tabulated and documented on a systems point checklist. Each security point and operation shall be verified as working properly. If not, action must be specified to achieve proper security point operation. Verification shall be repeated for failed security points until proper operation is achieved.

3.1.3. System verification shall be done on a building-by-building interval, when buildings have been completely constructed and secured. System verification shall be included up front in the Project's Master Construction Schedule.

3.1.4. During the verification, include the Owner's personnel who will be involved in the security operation of the facility and the electronics security contractor to insure proper operation of equipment.

Division 31 – Earthwork

1. General Requirement:

   1.1. For excavation beyond that described in the Contract Documents, include cost per cubic yard on the bid form. Excavation quantities shall be as measured in-place prior to excavating. Fill quantities shall be as measured in-place after compaction.

2. Site Drainage:

   2.1. Incorporate requirements of National Pollutant Discharge Elimination System (NPDES) General Storm Water Permit for Construction Activity requirements for erosion and sediment control and Storm Water Management.

   2.2. Site Drainage shall be designed to comply with the B3 Guidelines (B3), section S.2 for Storm Water Management required performance criteria for Runoff Rate and Runoff Quality.

   2.3. Use plant material and terrain to slow and absorb run-off, filter sediments, and facilitate control. When appropriate, consider overland flows and ponds to temporarily impound water and allow a slower rate of release.

   2.4. Maximize pervious surfaces to permit water infiltration whenever possible.

   2.5. Use natural drainage ways whenever possible.

   2.6. Conform to the additional requirements of the B3 Guidelines (B3), Section S.6, for Erosion and Sedimentation Control

3. Excavations, Backfill and Fill:

   3.1. Define areas where soil retention system is required instead of open excavation.

   3.2. Specify requirements for:

      3.2.1. Preventing surface water from flowing into excavations.

      3.2.2. Water removal from excavations.

      3.2.3. Protection of bottom of excavation from desiccation, where required.

      3.2.4. Disposal of excavated materials.

   3.3. The A/E Design Firm shall define the excavation depth and extent, fill, backfill, compaction, surface drainage, and all other pertinent items based on the recommendations of the Geotechnical Engineer. The definition of excavation depth and extent shall be of simple elevation and simple geometry.

   3.4. Excavation quantities shall be as measured in place prior to excavating. Fill quantities shall be as measured in place after compaction.

   3.5. Minimize the potential for rock excavation. Provide for rock removal where necessary.

3.6. Do not allow frozen backfill or fill for placement and compaction. No fill, footings or slabs shall be placed on soils which have frozen or contain frozen material or soil covered with ice or snow.

3.7. Do not use backfill or fill that contains debris, roots, organic, or other unstable or unsuitable materials.

3.8. All backfill or fill material shall have less than 5% passing the #200 sieve except for topsoil caps adjacent to buildings at exterior walls.

3.9. Specify all earthwork materials field compaction requirements throughout all Construction Documents only as a percentage maximum dry density as determined by ASTM D-1557, modified Proctor test.

3.10. Compact road and parking embankments to minimum of 95% of maximum dry density as determined by ASTM D1557 (modified proctor). Compact other embankments to minimum of 90% modified proctor.

3.11. Specify earthwork requirements for trench excavation, bedding, and backfill for each pipe material, strength, and application.

4. Excavations for Foundations:

4.1. Provide frost protection to bottoms of foundations and slabs excavation.

4.2. Protect all in-place foundations and slabs from frost penetration of the supporting soils until Project completion.

4.3. Specify that foundation wall waterproofing shall be backfilled within 3 days of placements. The toe of the excavations shall be at least 3 feet from foundation walls and footings to be waterproofed.

4.4. Specify dewatering provisions necessary to drain and keep excavations free of water under all circumstances.

4.5. Foundation walls enclosing occupied space below grade shall be drained by tile. Install drain tile level around foundation wall footings and slope not less than ¼" per foot to daylight, to a pumped sump, or to a storm drain.

5. Support and Protective Systems:

5.1. Support Systems:

5.1.1. Defined as structure which provides support to adjacent structure, underground installations or sides of an excavation.

5.1.2. Includes underpinning, bracing, shoring, sheet piling, soldier piling and lagging or other similar system.

5.2. Protective Systems:

5.2.1. Defined as method of protecting employees from cave-ins, from materials that could fall or roll from an excavation face or into an excavation, or from collapse of adjacent structures.

5.2.2. Protective systems include support systems, sloping and benching systems, and other systems that provide necessary protection.

5.3. Design of support and protective systems (including sloping and benching) shall:

5.3.1. Comply with OSHA.

5.3.2. Be performed by a licensed design engineer retained by the Contractor subject to general performance Specifications prepared by the A/E. Such engineer shall have experience commensurate with design duties. Design Work shall be sealed by the design engineer.

5.4. Design engineer shall perform OSHA specified duties including inspection of the Work.

6. Flowable Fill:

6.1. Shall comply with ACI 229R.

6.2. Specify low strength to minimize cost and to allow for future excavation with conventional equipment.

6.3. Use flowable fill as an alternate to compacted backfill for:

6.3.1. Areas where placement and compaction of backfill is difficult or impossible.

6.3.2. Beneath structures sensitive to settlement.

6.3.3. Filling voids created by operations (e.g., voids near ground surface around H-piles).

6.3.4. Around pipes subjected to heavy surcharge.

7. Geotextile Fabric:

7.1. Specify geotextile fabric around poorly graded rock fill to prevent migration of surrounding soil into rock fill voids, potentially causing detrimental effects to structure.

8. Special Designs:

8.1. Specify “Design by Contractor” for temporary support of existing underground utilities exposed by excavation that must remain in service.

8.1.1. Specify requirements in the Contract Documents to prevent change orders to the Contract after award.

9. Testing and Verification:

9.1. Specify requirements per Chapter 18 of the Minnesota Building Code and the Owner’s minimum requirements from Section IV. 01 45 23, Division 31. Specify test requirements, including type, applicable standard and frequency. Include the following:

9.1.1. Testing of proposed backfill and fill materials for compliance to Specifications.

9.1.2. Testing to determine moisture-density and maximum density characteristics of proposed backfill and fill materials.

9.1.3. Sampling and testing of installed materials for moisture content and density.

9.1.4. Testing of in-situ soils at bottom of excavations for compliance with design parameters for allowable load, settlement or properties.

Division 32 – Exterior Improvements

1. Provide for restoration or repair of any damaged items, including but not limited to roads, sidewalks, curbs, utilities, or plant material at no cost to the Owner. The Owner and A/E shall review repair work with the Contractor for acceptance.

2. Bituminous Paving:

   2.1. Specify that the bituminous paving plant shall be MnDOT certified and shall provide MnDOT designated and certified mixes, aggregates, and associated paving materials. Both plant and mix current certifications are to be submitted for the A/E's written approval before the start of the work.

   2.2. Specify the Contractor shall submit all job-mix formulas for pavement and submit a list of materials testing.

   2.3. Specify the following mineral aggregate:

   2.3.1. Fine aggregate shall consist of hard, durable grains of natural sand, crushed stone, or crushed gravel. Course aggregate shall consist of crushed stone, crushed gravel, or crushed slag. Aggregate shall be produced from sources which normally show an abrasion loss not exceeding 40, determined in accordance with AASHTO T96 and a freeze and thaw loss not greater than 10, determined in accordance with AASHTO T104, 5-cycle, sodium sulfate solution.

   2.4. The Contractor shall allow prime coat to cure until it has been absorbed by the substrate surface and will not pick up. Minimum cure time shall be not less than 24 hours. Pools of asphalt material occurring in depressions shall be broomed or squeegeed over surrounding surface same day prime coat is applied. At no time during curing period shall traffic be allowed upon primed surface. Specify that if primed surface is damaged it shall be repaired at no cost to the Owner. Prime coat shall be maintained at all times until cover coat is constructed.

   2.5. Specify asphalt paving may proceed only when specified density can be obtained. Specify that the Contractor shall not place mixture on any wet or frozen surface or when weather conditions will otherwise prevent its proper handling or finishing.

   2.6. Specify that all in-place foundations and slabs be protected from frost penetration of the supporting soils until project completion.

   2.7. Specify asphaltic surface course and/or leveling-binder courses shall not be placed when air temperature is below 40°F. If course is 1" or less in thickness, temperature must be 50°F or above. Do not place asphalt base course when air temperature is below 40°F.

   2.8. Specify the Contractor shall provide one sample of in-place mixture for each days run to laboratory for testing. Sample shall be tested for the requirements specified by MnDOT in accordance with Division 1 provisions of the Specifications.

   2.9. Coal tar-based sealcoats are not allowed.

3. Portland Cement Concrete Paving:

    3.1. Concrete paving plant shall be MnDOT certified and shall provide MnDOT designated and certified mixes, aggregates, and associated paving materials.

    3.2. Specify all testing laboratory reports shall be submitted prior to commencing concrete placement. Provide testing for materials, mix design and in accordance with Division 1 provisions of the Specifications.

    3.3. Specify the Contractor shall not place concrete when weather conditions prevent good workmanship. The Contractor shall not use aggregates containing frozen lumps and shall not place concrete on frozen subgrade. Concrete mixing and placement may be started if temperature is at least 34°F and rising. At time of placement, concrete shall have a temperature of at least 40°F. Concrete placement shall stop when temperature is 38°F and falling.

4. Parking and Pavements:

    4.1. Winter Maintenance:

        4.1.1. Snow Storage: Discuss with the C/U Project Manager the possible locations of snow storage for parking areas.

        4.1.2. De-Icing: Discuss with the C/U Project Manager the facility's methods for de-icing of walkways and roadways. Evaluate the necessity of pavement systems for walkways and roadways to resist corrosion due to Owner de-icing methods.

5. Irrigation Systems:

    5.1. Conform to the requirements of the B3 Guidelines (B3), Section S.7, for Landscape Water Efficiency.

    5.2. Where irrigation systems are used, coordinate the design, locations, zones and requirements with the Landscape Architect and the C/U Project Manager.

    5.3. Design irrigation zones and specify final adjustments such that irrigation systems shall not sprinkle exterior building walls.

6. Landscaping:

    6.1. Design positive site drainage, with exterior grading sloped at a minimum of ¼" per foot away from the building for the maximum distance possible.

    6.2. Specify that all existing on-site topsoil, if adequate, shall be reutilized on site to the maximum extent possible.

    6.3. Specify that topsoil supplied by the Contractor shall be natural friable loam, typical of productive soils in the vicinity, containing from 2% to 15% organic matter. Material shall be obtained from a well-drained site and free of subsoil, foreign matter or objects larger than 1" in any dimension, weeds, toxic substances, and any material or substances that may be harmful to plant growth.

6.4. Specify the Contractor shall be responsible for proper care of turfed areas from completion of turf operations through duration of turf establishment period.

6.5. Specify maintenance requirements that new plant materials shall be maintained until acceptance. Specify a one-year warranty for all new plant material after acceptance. Notwithstanding the requirements of General Conditions, A201 – Clause 12.2.2.3, all defective material shall be replaced and this new material shall also be warranted for an additional complete cycle of the seasons (no less than one year). Defective materials shall be replaced and this new material shall also be warranted for an additional complete cycle of the seasons (not less than one year).

6.6. Specify that existing established turf and other landscaped areas shall be protected from construction operations to the maximum extent possible.

7. Site and Security Lighting:

7.1. Coordinate with the C/U Project Manager the locations and appropriate levels of site and security lighting.

7.2. Specify that lighting styles shall match the surrounding areas, unless approved otherwise by the C/U Project Manager. Also see Division 26- Electrical of these Design Standards.

8. Riprap:

8.1. Trim and dress areas to receive riprap to shape and dimensions provided in the design. Maximum tolerance shall be 3” (plus or minus) from theoretical grade. Areas below minus tolerance shall be filled and compacted with excavated material or filled with bedding material.

8.2. Specify riprap source shall be MnDOT certified with geotextile fabric filter beneath riprap rather than granular filter.

8.3. Specify geotextile fabric filter beneath riprap rather than granular fill.

8.4. Specify riprap placement shall avoid displacing bedding material. Specify placement methods that prevent segregation and sloughing of materials. Final section shall be reasonably uniform using hand placement where necessary.

8.5. Specify that larger riprap stones shall be well distributed, and entire mass of stone shall conform approximately to gradation specified. Placement and distribution shall not allow large accumulations of either larger or smaller sizes of stone.

9. Heat Islands:

9.1. Conform to the additional requirements of the B3 Guidelines (B3), Section S.11, for Heat Island Reduction.

Division 33 – Utilities

1. HVAC Utilities:

    1.1. Design underground heating hot water, chilled water, steam and condensate systems for corrosion protection using either non-corrosive materials or protected metal piping systems. Where appropriate, use HDPE for chilled water systems and pre-insulated and jacketed conduit systems for heating water and steam/condensate systems. When non-metallic pipes are installed, provide trace wires or metallic tape for ability to locate.

2. Foundation Drainage:

    2.1. Provide gravity foundation drainage systems wherever below grade spaces occur and at all elevator pits. Top of drain tile shall be a minimum of 6” below floor level.

    2.2. Provide two pumps per sump, wired to emergency power (to be cycled with one always on standby as backup).

    2.3. Provide positive slope of drainpipe down to sumps. The drainpipe size shall be minimum 6” diameter, perforated rigid schedule 80 PVC, encased by washed, round river rock, and filter fabric.

3. Piped Utilities:

    3.1. Ferrous Piping - Evaluate the need for cathodic protection for underground steel and ductile iron pipe.

    3.2. Sanitary Sewer & Water Service – Maintain 10 feet of horizontal separation between parallel and 18” clear vertical separation between crossing sanitary sewers and water service piping.

    3.3. Coordinate minimum burial depth of water services with local government standard. Where minimum burial depth cannot be obtained, insulation or heating tape may be allowed with the Owner’s approval.

    3.4. Specify that the Contractor shall store, handle, join, lay and otherwise install pipe in conformance to pipe manufacturer’s recommendations. Use proper pipe unloading and handling procedures to prevent damage to pipe and coating. Keep pipe clean of dirt and foreign matter. Touch-up abraded pipe coatings, if required.

    3.5. Specify prior to installation, the Contractor shall verify measurements at the site including: Actual location of connections to existing water and sewer mains; type of joints on existing lines at point of connection; outside diameter of existing pipe; and outside diameter and ovality for each line slope on watermain near point of connection.

    3.6. Specify the Contractor shall make necessary field measurements to determine accurate pipe laying lengths to permit installation without forcing or springing.

    3.7. Sanitary sewer manholes shall be waterproofed on the interior with cement mortar, unless manholes are precast concrete.

3.8. Thrust Restraint – Evaluate the need for thrust restraints for high pressure lines with either thrust blocks or restrained joint pipe.

3.9. Warning Tape –Provide for installation of warning tape above all buried utilities.

3.10. Trace Wires - Where non-conductive piping or piping with no surface features is used, specify the installation of trace wire for future pipe locates.

3.11. Mark each length of pipe with manufacturer's name and class.

3.12. The Contractor shall repair or replace breaks in existing lines caused by construction operations. Provide temporary connections, if required. Specify direct buried utilities may be installed either by open cut and fill or by horizontal directional boring methods. Installation method shall be determined by the type of pipe and soils encountered.

3.13. Performance Test:

3.13.1. Coordinate requirements and Specifications for leakage test and disinfection of water services with local government standards.

3.13.2. Coordinate requirements and Specifications for infiltration tests, exfiltration tests, and internal television inspection of sanitary sewer systems with local government standards.

V. Guideline Specifications

Table of Contents

V. Guideline Specifications - Introduction

Section V provides sample specifications and installation guidelines for key components of the building enclosure and infrastructure. The information contained herein is subject to change based on changes or refinements in state, local or national building codes and changes in material components and systems. The designer is responsible to verify products, the compatibility of products, and make adjustments to the specifications as necessary to fit the specific project requirement, while maintaining the overall intent of the specifications to obtain high quality, constructible, and maintainable building assemblies.

01 57 23 – Temporary Storm Water Pollution Controls

The MS4 permit requires our colleges and universities to develop a construction site storm water runoff control program that reduces pollutants in storm water from construction activity. The MS4 Permit (Part III.D.4.a) requires our colleges and universities to develop a regulatory mechanism that is at least as stringent as the MPCA's current NPDES Construction General Permit (CGP). The MS4 permit identifies the eight sections of the CGP that qualify as erosion and sediment controls or waste controls. Once approved by the C/U, the contractor must electronically submit the permit application to the MPCA at least seven (7) days prior to the start of construction. If the project disturbs 50 acres or more that also has a discharge point is within one mile of an impaired or special water or the discharge flows to these waters, the contractor must deliver a hard copy of the approved permit application to the MPCA at least 30 days prior to the intended start of construction.

1. <u>EROSION PREVENTION PRACTICES</u>

1.1. The Permittee(s) must plan for and implement appropriate Best Management Practices (**BMP**s) such as construction phasing, vegetative buffer strips, horizontal slope grading, inspection and the required maintenance of **BMP**s and other construction practices that minimize erosion as necessary to comply with this permit and protect waters of the state. The location of areas not to be disturbed must be delineated (e.g., with flags, stakes, signs, silt fence etc.) on the Project site before work begins. The Permittee(s) must minimize the need for disturbance of portions of the Project that have steep slopes. For those sloped areas which must be disturbed, the Permittee(s) must use techniques such as phasing and stabilization practices designed for steep slopes (e.g., slope draining and terracing).

1.2. The Permittee(s) must stabilize all exposed soil areas (including stockpiles). Stabilization must be initiated immediately to limit soil erosion whenever any construction activity has permanently or temporarily ceased on any portion of the site and will not resume for a period exceeding 14 calendar days. Stabilization must be completed no later than 14 calendar days after the construction activity in that portion of the site has temporarily or permanently ceased. For **Public waters** that the Minnesota Department of Natural Resources has promulgated "work in water restrictions" during specified fish spawning time frames, all exposed soil areas that are within 200 feet of the water's edge, and drain to these waters must complete the stabilization activities within 24 hours during the restriction period. Temporary stockpiles without significant silt, clay or organic components (e.g., clean aggregate stockpiles, demolition concrete stockpiles, sand stockpiles) and the constructed base components of roads, parking lots and similar surfaces are exempt from this requirement but must be in compliance with the sediment control requirements for stockpiles.

1.3. If using storm water conveyance channels, the Permittee(s) must design the channels to route water around un-stabilized areas on the site and to reduce erosion, unless infeasible. The Permittee(s) must use erosion controls and velocity dissipation devices such as check dams, sediment traps, riprap, or grouted riprap at outlets within and along the length of any constructed storm water conveyance channel, and at any outlet, to provide a non-erosive flow velocity, to minimize erosion of channels and their embankments, outlets, adjacent stream banks, slopes, and downstream waters during discharge conditions.

1.4. The Permittee(s) must stabilize the normal wetted perimeter of any temporary or permanent drainage ditch or swale that drains water from any portion of the construction site, or diverts water around the site, within 200 lineal feet from the property edge, or from the point of discharge into any surface water. Stabilization of the last 200 lineal feet must be completed within 24 hours after connecting to a surface water or property edge.

1.5. The Permittee(s) shall complete stabilization of the remaining portions of any temporary or permanent ditches or swales within 14 calendar days after connecting to a surface water or property edge and construction in that portion of the ditch has temporarily or permanently ceased.

1.6. Temporary or permanent ditches or swales that are being used as a sediment containment system during construction (with properly designed rock-ditch checks, bio rolls, silt dikes, etc.) do not need to be stabilized during the temporary period of its use as a sediment containment system. These areas must be stabilized within 24 hours after no longer being used as a sediment containment system.

1.7. Applying mulch, hydro mulch, tackifier, polyacrylamide or similar erosion prevention practices is not acceptable stabilization in any part of a temporary or permanent drainage ditch or swale.

1.8. Pipe outlets must be provided with temporary or permanent energy dissipation within 24 hours after connection to a surface water.

1.9. Unless infeasible due to lack of pervious or vegetated areas, the Permittee(s) must direct discharges from **BMP**s to vegetated areas of the site (including any natural buffers) in order to increase sediment removal and maximize storm water infiltration. The Permittee(s) must use velocity dissipation devices if necessary to prevent erosion when directing storm water to vegetated areas.

1.10. For areas of the **project** draining to a discharge point on the Project that is within one mile of a special or impaired water as defined by the Minnesota NPDES Permit for construction activity, the time frame stated in this requirement shall be seven (7) days.

2. SEDIMENT CONTROL PRACTICES

2.1. The Permittee(s) must employ Sediment control practices as necessary to minimize sediment from entering surface waters, including curb and gutter systems and storm sewer inlets.

2.1.1. Temporary or permanent drainage ditches and sediment basins that are designed as part of a sediment containment system (e.g., ditches with rock-check dams) require sediment control practices only as appropriate for site conditions.

2.1.2. If the down gradient sediment controls are overloaded (based on frequent failure or excessive maintenance requirement), the Permittee(s) must install additional upgradient sediment control practices or redundant **BMP**s to eliminate the overloading, and the site plans must be amended to identify these additional practices.

2.2. Sediment control practices must be established on all down gradient perimeters and be located upgradient of any buffer zones. The perimeter sediment control practice must

be in place before any upgradient land-disturbing activities begin. These practices shall remain in place until final stabilization has been established. A floating silt curtain placed in the water is not a sediment control BMP to satisfy perimeter control requirements in this part except when working on a shoreline and below the waterline. In those cases, a floating silt curtain can be used as a perimeter control practice if the floating silt curtain is installed as close to shore as possible. Immediately after the short term construction activity (e.g. installation of rip rap along the shoreline) in that area is complete, an upland perimeter control practice must be installed if exposed soils still drain to the surface water.

2.2.1. The Permittee(s) shall re-install all sediment control practices that have been adjusted or removed to accommodate short-term activities such as clearing or grubbing, or passage of vehicles, immediately after the short-term activity has been completed. The Permittee(s) shall complete any short-term activity that requires removal of sediment control practices as quickly as possible. The Permittee(s) must re-install sediment control practices before the next precipitation event even if the short-term activity is not complete.

2.2.2. All storm drain inlets must be protected by appropriate **BMP**s during construction until all sources with potential for discharging to the inlet have been stabilized. Inlet protection may be removed for a particular inlet if a specific safety concern (street flooding/freezing) has been identified by the Permittee(s) or the jurisdictional authority (e.g., city/county/township/MnDOT engineer).The Permittee(s) must document the need for removal in the site plans.

2.2.3. Temporary soil stockpiles must have silt fence or other effective sediment controls, and cannot be placed in any natural buffers or surface waters, including storm water conveyances such as curb and gutter systems, or conduits and ditches unless there is a bypass in place for the storm water.

2.2.4. Where vehicle traffic leaves any part of the site (or onto paved roads within the site):

2.2.4.1. The Permittee(s) must install a vehicle tracking **BMP** to minimize the track out of sediment from the construction site. Examples of vehicle tracking **BMP**s include (but are not limited to) rock pads, mud mats, slash mulch, concrete or steel wash racks, or equivalent systems.

2.2.4.2. The Permittee(s) must use street sweeping if such vehicle tracking **BMP**s are not adequate to prevent sediment from being tracked onto the street.

2.2.5. The Permittee(s) must minimize soil compaction and, unless infeasible, preserve topsoil. Minimizing soil compaction is not required where the function of a specific area of the site dictates that it be compacted.

2.2.6. The Permittee(s) must preserve a 50 foot natural buffer or (if a buffer is infeasible on the site) provide redundant sediment controls, when surface water is located within 50 feet of the project's earth disturbances and storm water flows to the surface water. Natural buffers are not required adjacent to road ditches, judicial ditches, county ditches, storm water conveyance channels,

storm drain inlets, and sediment basins. The Permittee(s) is/are not required to enhance the quality of the vegetation that already exists in the buffer or provide vegetation if none exist. However, Permittee(s) can improve the natural buffer with vegetation.

2.2.7. If the Permittee(s) intend to use polymers, flocculants, or other sedimentation treatment chemicals on the Project site, the Permittee(s) must comply with the following minimum requirements:

2.2.7.1. The Permittee(s) must use conventional erosion and sediment controls prior to chemical addition to ensure effective treatment. Chemicals may only be applied where treated storm water is directed to a sediment control system which allows for filtration or settlement of the floc prior to discharge.

2.2.7.2. Chemicals must be selected that are appropriately suited to the types of soils likely to be exposed during construction, and to the expected turbidity, pH, and flow rate of storm water flowing into the chemical treatment system or area.

2.2.7.3. Chemicals must be used in accordance with accepted engineering practices, and with dosing specifications and sediment removal design specifications provided by the manufacturer or provider/supplier of the applicable chemicals.

3. DEWATERING AND BASIN DRAINING [Part IV. D]

3.1. The Permittee(s) must discharge turbid or sediment-laden waters related to **dewatering** or basin draining (e.g., pumped discharges, trench/ditch cuts for drainage) to a temporary or permanent sedimentation basin on the Project site unless infeasible. The Permittee(s) may discharge from the temporary or permanent sedimentation basins to surface waters, if the basin water has been visually checked to ensure adequate treatment has been obtained in the basin and that nuisance conditions (see Minn. R. 7050.0210, subp. 2) will not result from the discharge. If the water cannot be discharged to a sedimentation basin prior to entering the surface water, it must be treated with the appropriate **BMP**s, such that the discharge does not adversely affect the receiving water or downstream properties. If the Permittee(s) must discharge water that contains oil or grease, the Permittee(s) must use an oil-water separator or suitable filtration device (e.g. cartridge filters, absorbents pads) prior to discharging the water. The Permittee(s) must ensure that discharge points are adequately protected from erosion and scour. The discharge must be dispersed over natural rock riprap, sand bags, plastic sheeting, or other accepted energy dissipation measures.

3.2. All water from dewatering or basin-draining activities must be discharged in a manner that does not cause nuisance conditions, erosion in receiving channels or on downslope properties, or inundation in wetlands causing significant adverse impact to the wetland.

3.3. If the Permittee(s) is/are using filters with backwash water, the Permittee(s) must haul the backwash water away for disposal, return the backwash water to the beginning of the treatment process, or incorporate the backwash water into the site in a manner that does not cause erosion. The Permittee(s) may discharge backwash water to the sanitary sewer if permission is granted by the sanitary sewer authority. The

Permittee(s) must replace and clean the filter media used in dewatering devices when required to retain adequate function.

4. SITE INSPECTIONS AND RAINFALL RECORDS

4.1. The Permittee(s) must ensure that a trained person will routinely inspect the entire construction site at least once every seven (7) days during active construction and within 24 hours after a rainfall event greater than 0.5 inches in 24 hours. Following an inspection that occurs within 24 hours after a rainfall event, the next inspection must be conducted within seven (7) days after the rainfall event.

4.2. All inspections and maintenance conducted during construction must be recorded within 24 hours in writing and these records must be retained with the site plans. Records of each inspection and maintenance activity shall include:

4.2.1. Date and time of inspections

4.2.2. Name of person(s) conducting inspections

4.2.3. Findings of inspections, including the specific location where corrective actions are needed

4.2.4. Corrective actions taken (including dates, times, and party completing maintenance activities) Date and amount of all rainfall events greater than 1/2 inch (0.5 inches) in 24 hours. Rainfall amounts must be obtained by a properly maintained rain gauge installed onsite, a weather station that is within 1 mile of your location or a weather reporting system that provides site specific rainfall data from radar summaries.

4.2.5. If any discharge is observed to be occurring during the inspection, a record of all points of the property from which there is a discharge must be made, and the discharge should be described (i.e., color, odor, floating, settled, or suspended solids foam, oil sheen, and other obvious indicators of pollutants) and photographed. Any amendments to the site plans proposed as a result of the inspection must be documented within seven (7) calendar days.

4.3. Inspection frequency adjustment

4.3.1. Where parts of the Project site have permanent cover, but work remains on other parts of the site, the Permittee(s) may reduce inspections of the areas with permanent cover to once per month.

4.3.2. Where construction sites have permanent cover on all exposed soil areas and no construction activity is occurring anywhere on the site, the site must be inspected during non-frozen ground conditions at least once per month for a period of twelve (12) months. Following the twelfth month of permanent cover and no construction activity, inspections may be terminated until construction activity is once again initiated unless the Permittee(s) is/are notified in writing by the MPCA that erosion issues have been detected at the site and inspections need to resume.

4.3.3. Where work has been suspended due to frozen ground conditions, the inspections may be suspended. The required inspections and maintenance

schedule must begin within 24 hours after runoff occurs at the site or 24 hours prior to resuming construction, whichever comes first.

4.4. The Permittee(s) must inspect all erosion prevention and sediment control **BMP**s and Pollution Prevention Management Measures to ensure integrity and effectiveness during all routine and post-rainfall event inspections. All nonfunctional **BMP**s must be repaired, replaced, or supplemented with functional **BMP**s by the end of the next business day after discovery, or as soon as field conditions allow access unless another time frame is specified below. The Permittee(s) must investigate and comply with the following inspection and maintenance requirements:

4.4.1. All perimeter control devices must be repaired, replaced, or supplemented when they become nonfunctional or the sediment reaches one-half (1/2) of the height of the device. These repairs must be made by the end of the next business day after discovery, or thereafter as soon as field conditions allow access.

4.4.2. Temporary and permanent sedimentation basins must be drained and the sediment removed when the depth of sediment collected in the basin reaches one-half (1/2) the storage volume. Drainage and removal must be completed within 72 hours of discovery, or as soon as field conditions allow access.

4.4.3. Surface waters, including drainage ditches and conveyance systems, must be inspected for evidence of erosion and sediment deposition during each inspection. The Permittee(s) must remove all deltas and sediment deposited in surface waters, including drainage ways, catch basins, and other drainage systems, and restabilize the areas where sediment removal results in exposed soil. The removal and stabilization must take place within seven (7) days of discovery unless precluded by legal, regulatory, or physical access constraints. The Permittee(s) shall use all reasonable efforts to obtain access. If precluded, removal and stabilization must take place within seven (7) calendar days of obtaining access. The Permittee(s) is/are responsible for contacting all local, regional, state and federal authorities and receiving any applicable permits, prior to conducting any work in surface waters.

4.4.4. Construction site vehicle exit locations must be inspected for evidence of off-site sediment tracking onto paved surfaces. Tracked sediment must be removed from all paved surfaces both on and off site within 24 hours of discovery.

4.4.5. Streets and other areas adjacent to the Project must be inspected for evidence of off-site accumulations of sediment. If sediment is present, it must be removed in a manner and at a frequency sufficient to minimize off- site impacts (e.g., fugitive sediment in streets could be washed into storm sewers by the next rain and/or pose a safety hazard to users of public streets).

4.4.6. All infiltration areas must be inspected to ensure that no sediment from ongoing construction activity is reaching the infiltration area. All infiltration areas must be inspected to ensure that equipment is not being driven across the infiltration area.

5. INSPECTIONS AND MAINTENANCE

5.1. All inspections and maintenance conducted during construction must be recorded within 24 hours in writing and these records must be retained with the site plans. Records of each inspection and maintenance activity shall include:

5.1.1. Date and time of inspections.

5.1.2. Name of person(s) conducting inspections.

5.1.3. Findings of inspections, including the specific location where corrective actions are needed.

5.1.4. Corrective actions taken (including dates, times, and party completing maintenance activities).

5.1.5. Date and amount of all rainfall events greater than 1/2 inch (0.5 inches) in 24 hours. Rainfall amounts must be obtained by a properly maintained rain gauge installed onsite, a weather station that is within 1 mile of your location or a weather reporting system that provides site specific rainfall data from radar summaries

5.1.6. If any discharge is observed to be occurring during the inspection, a record of all points of the property from which there is a discharge must be made, and the discharge should be described (i.e., color, odor, floating, settled, or suspended solids, foam, oil sheen, and other obvious indicators of pollutants) and photographed.

5.1.7. Any amendments to the site plans proposed as a result of the inspection must be documented within seven (7) calendar days.

5.2. The Permittee(s) must inspect all erosion prevention and sediment control **BMP**s and Pollution Prevention Management Measures to ensure integrity and effectiveness during all routine and post-rainfall event inspections. All nonfunctional **BMP**s must be repaired, replaced, or supplemented with functional **BMP**s by the end of the next business day after discovery, or as soon as field conditions allow access unless another time frame is specified below. The Permittee(s) must investigate and comply with the following inspection and maintenance requirements:

5.2.1. All perimeter control devices must be repaired, replaced, or supplemented when they become nonfunctional or the sediment reaches one-half (1/2) of the height of the device. These repairs must be made by the end of the next business day after discovery, or thereafter as soon as field conditions allow access.

5.2.2. Temporary and permanent sedimentation basins must be drained and the sediment removed when the depth of sediment collected in the basin reaches one-half (1/2) the storage volume. Drainage and removal must be completed within 72 hours of discovery, or as soon as field conditions allow access (see Part IV.D.).

5.2.3. Surface waters, including drainage ditches and conveyance systems, must be inspected for evidence of erosion and sediment deposition during each inspection. The Permittee(s) must remove all deltas and sediment deposited in

surface waters, including drainage ways, catch basins, and other drainage systems, and restabilize the areas where sediment removal results in exposed soil. The removal and stabilization must take place within seven (7) days of discovery unless precluded by legal, regulatory, or physical access constraints. The Permittee(s) shall use all reasonable efforts to obtain access. If precluded, removal and stabilization must take place within seven (7) calendar days of obtaining access. The Permittee(s) is/are responsible for contacting all local, regional, state and federal authorities and receiving any applicable permits, prior to conducting any work in surface waters.

5.2.4. Construction site vehicle exit locations must be inspected for evidence of off-site sediment tracking onto paved surfaces. Tracked sediment must be removed from all paved surfaces both on and off site within 24 hours of discovery. Streets and other areas adjacent to the Project must be inspected for evidence of off-site accumulations of sediment. If sediment is present, it must be removed in a manner and at a frequency sufficient to minimize off- site impacts (e.g., fugitive sediment in streets could be washed into storm sewers by the next rain and/or pose a safety hazard to users of public streets).

6. POLLUTION PREVENTION MANAGEMENT MEASURES

6.1. The Permittee(s) shall implement the following pollution prevention management measures on the site:

6.1.1. Storage, Handling, and Disposal of Construction Products, Materials, and Wastes: The Permittee(s) shall comply with the following to minimize the exposure to storm water of any of the products, materials, or wastes. Products or wastes which are either not a source of contamination to storm water or are designed to be exposed to storm water are not held to this requirement:

6.1.1.1. Building products that have the potential to leach pollutants must be under cover (e.g., plastic sheeting or temporary roofs) to prevent the discharge of pollutants or protected by a similarly effective means designed to minimize contact with storm water.

6.1.1.2. Pesticides, herbicides, insecticides, fertilizers, treatment chemicals, and landscape materials must be under cover (e.g., plastic sheeting or temporary roofs) to prevent the discharge of pollutants or protected by similarly effective means designed to minimize contact with storm water.

6.1.1.3. Hazardous materials, toxic waste, (including oil, diesel fuel, gasoline, hydraulic fluids, paint solvents, petroleum-based products, wood preservatives, additives, curing compounds, and acids) must be properly stored in sealed containers to prevent spills, leaks or other discharge. Restricted access storage areas must be provided to prevent vandalism. Storage and disposal of hazardous waste or hazardous materials must be in compliance with Minn. R. ch. 7045 including secondary containment as applicable.

6.1.1.4. Solid waste must be stored, collected and disposed of properly in compliance with Minnesota Rule Chapter 7035.

6.1.1.5. Portable toilets must be positioned so that they are secure and will not be tipped or knocked over. Sanitary waste must be disposed of properly in accordance with Minnesota Rule Chapter 7041.

6.1.2. Fueling and Maintenance of Equipment or Vehicles; Spill Prevention and Response: The Permittee(s) shall take reasonable steps to prevent the discharge of spilled or leaked chemicals, including fuel, from any area where chemicals or fuel will be loaded or unloaded including the use of drip pans or absorbents unless infeasible. The Permittee(s) must conduct fueling in a contained area unless infeasible. The Permittee(s) must ensure adequate supplies are available at all times to clean up discharged materials and that an appropriate disposal method is available for recovered spilled materials. The Permittee(s) must report and clean up spills immediately as required by Minn. Stat. § 115.061, using dry clean up measures where possible.

6.1.3. Vehicle and equipment washing: If the Permittee(s) wash the exterior of vehicles or equipment on the Project site, washing must be limited to a defined area of the site. Runoff from the washing area must be contained in a sediment basin or other similarly effective controls and waste from the washing activity must be properly disposed of. The Permittee(s) must properly use and store soaps, detergents, or solvents. No engine degreasing is allowed on site.

6.1.4. Concrete and other washouts waste: The Permittee(s) must provide effective containment for all liquid and solid wastes generated by washout operations (concrete, stucco, paint, form release oils, curing compounds and other construction materials) related to the construction activity. The liquid and solid washout wastes must not contact the ground, and the containment must be designed so that it does not result in runoff from the washout operations or areas. Liquid and solid wastes must be disposed of properly and in compliance with Minnesota Rule Chapter 7035. A sign must be installed adjacent to each washout facility that requires site personnel to utilize the proper facilities for disposal of concrete and other washout wastes.

7. FINAL STABILIZATION

7.1. The Permittee(s) must ensure final stabilization of the site. Final stabilization is not complete until all five requirements in this section are complete:

7.1.1. All soil disturbing activities at the site have been completed and all soils are stabilized by a uniform perennial vegetative cover with a density of 70 percent of its expected final growth density over the entire pervious surface area, or other equivalent means necessary to prevent soil failure under erosive conditions.

7.1.2. The permanent storm water management system is constructed, meets all of the required design parameters and is operating as designed. Temporary or permanent sedimentation basins that are to be used as permanent water quality management basins have been cleaned of any accumulated sediment. All sediment has been removed from conveyance systems and ditches are stabilized with permanent cover.

7.1.3. All temporary synthetic and structural erosion prevention and sediment control **BMP**s (such as silt fence) have been removed on the portions of the site for which the Permittee(s) is/are responsible. **BMP**s designed to decompose on site (such as some compost logs) may be left in place.

7.1.4. For residential construction only, individual lots are considered finally stabilized if the structure(s) are finished, and temporary erosion protection, down gradient perimeter control has been completed and the residence has been sold to the homeowner.

7.1.5. For construction Projects on agricultural land (e.g., pipelines across crop, field pasture or range land) the disturbed land has been returned to its preconstruction agricultural use.

8. TEMPORARY SEDIMENT BASINS

8.1. Where ten (10) or more acres of disturbed soil drain to a common location, the Permittee(s) must provide a temporary sediment basin to provide treatment to the runoff before it leaves the construction site or enters surface waters. A temporary sediment basin may be converted to a permanent basin after construction is complete. The temporary basin is no longer required when permanent cover has reduced the acreage of disturbed soil to less than ten (10) acres draining to a common location. The Permittee(s) is/are encouraged, but not required, to install temporary sediment basins where appropriate in areas with steep slopes or highly erodible soils even if less than ten (10) acres drains to one area. The basins must be designed and constructed according to the following requirements:

8.1.1. The basins must provide live storage for a calculated volume of runoff from a two (2)-year, 24-hour storm from each acre drained to the basin, except that in no case shall the basin provide less than 1,800 cubic feet of live storage from each acre drained to the basin.

8.1.2. Where the calculation above has not been performed, a temporary sediment basin providing 3,600 cubic feet of live storage per acre drained to the basin shall be provided for the entire drainage area of the temporary basin.

8.1.3. Temporary basin outlets must be designed to prevent short-circuiting and the discharge of floating debris. The basin must be designed with the ability to allow complete basin drawdown for maintenance activities, and must include a stabilized emergency overflow to prevent failure of pond integrity. The outlet structure must be designed to withdraw water from the surface in order to minimize the discharge of pollutants, except that the use of a surface withdrawal mechanism for discharge of the basin may be temporarily suspended during frozen conditions. Energy dissipation must be provided for the basin outlet.

8.1.4. Sediment Basins must be situated outside of surface and must be designed to avoid draining water from wetlands unless the impact to the wetland has been properly mitigated for.

8.1.5. The temporary basins must be constructed and made operational prior to ten (10) or more acres of disturbed soil draining to a common location.

8.1.6. Where a temporary sediment basin meeting the requirements of this part is infeasible, equivalent sediment controls such as smaller sediment basins, and/or sediment traps, silt fences, vegetative buffer strips, or any appropriate combination of measures are required for all down slope boundaries of the construction area and for side-slope boundaries as dictated by individual site conditions. In determining whether installing a sediment basin is infeasible, the Permittee(s) must consider public safety and may consider factors such as site soils, slope, and available area on site. This determination of infeasibility must be documented in the site plans.

For areas of the Project draining to a discharge point on the Project that is within one mile of special or impaired water as defined by the Minnesota NPDES Permit for construction activity, the disturbed area stated in this requirement shall be five (5) acres.

NOTICE OF TERMINATION:

The contractor must submit the completed notice of termination form to the MPCA within 30 days of project completion, with a copy to the College or University. The form is available at: http://www.pca.state.mn.us/index.php/view-document.html?gid=7389 .

END SECTION

01 58 00 – Temporary Project Signage

CONSTRUCTION SIGNAGE REQUIREMENTS

Construction signage is used to notify students, staff and visitors of current or upcoming construction or renovation projects that are funded through state appropriations or revenue bonding and shall include names of key firms involved in the design and construction. Construction signage shall be erected prior to or at the start of construction and be maintained through final completion of the project.

Board Policy 3.23.1, Part 2, (Subpart E): Construction project site sign: A sign erected to identify a capital construction project shall contain the affiliation line: ***"a member of the Minnesota State"****.* It shall also include an approved Minnesota State Logo.

Project site signs shall not be erected on public highway rights-of-way. If any possibility exists for obstruction to traffic line of sight, the location and height of the sign will be coordinated with the agency responsible for highway or street safety in the area. Contractor shall coordinate location of sign with campus Project Manager.

MINNESOTA STATE PROJECT CONSTRUCTION SIGN

Signage will designed by the Architect based on lettering and logo information provided by the campus and approved in advance by the campus Project Manager. The Contractor will be responsible to supply, erect, maintained the Project Construction site sign and will be responsible for disposal of the sign at the end of the project.

Minnesota State PROJECT SITE SIGN SPECIFICATIONS

Sizes: 8' x 8'

Materials: ¾" Exterior grade/MDO plywood (APA rating A-B)
All fasteners shall be of a rustproof nature.
All plywood and support lumber shall be painted white

Erection: Signs shall be securely mounted at least (4 feet) above the ground

Paint: Outdoor enamel - Background= White, RGB = 255-255-255

Lettering: **College/University Logo:**

Obtain campus logo standards from the Campus Project Manager
Use lettering typeface and color standards of campus on white Background= White, RGB = 255-255-255

Project Name:

White lettering with Black background
One, two or three lines depending on Project name
Color: Lettering = White, RGB = 255-255-255
Background = Black, RGB 0-0-0
Typeface: 4" minimum, Arial Black

Designer & Contractor:
Designer can be Architect and/or Engineer followed by name of firm

Color: Architect = Black – RGB 0-0-0
Name of Firm = Red – RGB 192-0-0
Background= White, RGB = 255-255-255
Typeface: Architect - 3” Helvetica Regular
Name of Firm - 4” Arial

Contractor can be General Contractor/Construction Manager, etc.

Color: Contractor - Black = RGB 0-0-0
Name of Firm - Blue = 0-112-192
Background= White, RGB = 255-255-255
Type face: Contractor - 3” Helvetica Regular

Name of Firm - 4” Arial

QR Code/Funding/Minnesota State Seal & Tagline:
Color: QR code – Black = RGB 0-0-0
Size: 12” x 12”
QR code can be found on the Minnesota State website under the e-Manual at:

http://www.minnstate.edu/system/finance/facilities/design-construction/pm_emanual/index.html

Under - 2 Project Phases, Construction Documents, CD.20.

Minnesota State Logo - Seal
C Color: Minnesota State Dark Blue (Pantone 2757) = RGB 00-30-96
Size: 12” – Top of Banner to bottom of Lettering
Tagline Color: Dark Blue = RGB 00-30-96
Type Face: 3” Perpetua primary, Palintino – alternate

Contact Minnesota State system office to obtain a copy of the Minnesota State Brand Identity Manual for more detail information on logo and brand requirements.

Obtain the Minnesota State Funding information from the campus Project Manager

Funding Source[1]

Color: Black = RGB 0-0-0
Type Face: 3” Helvetica

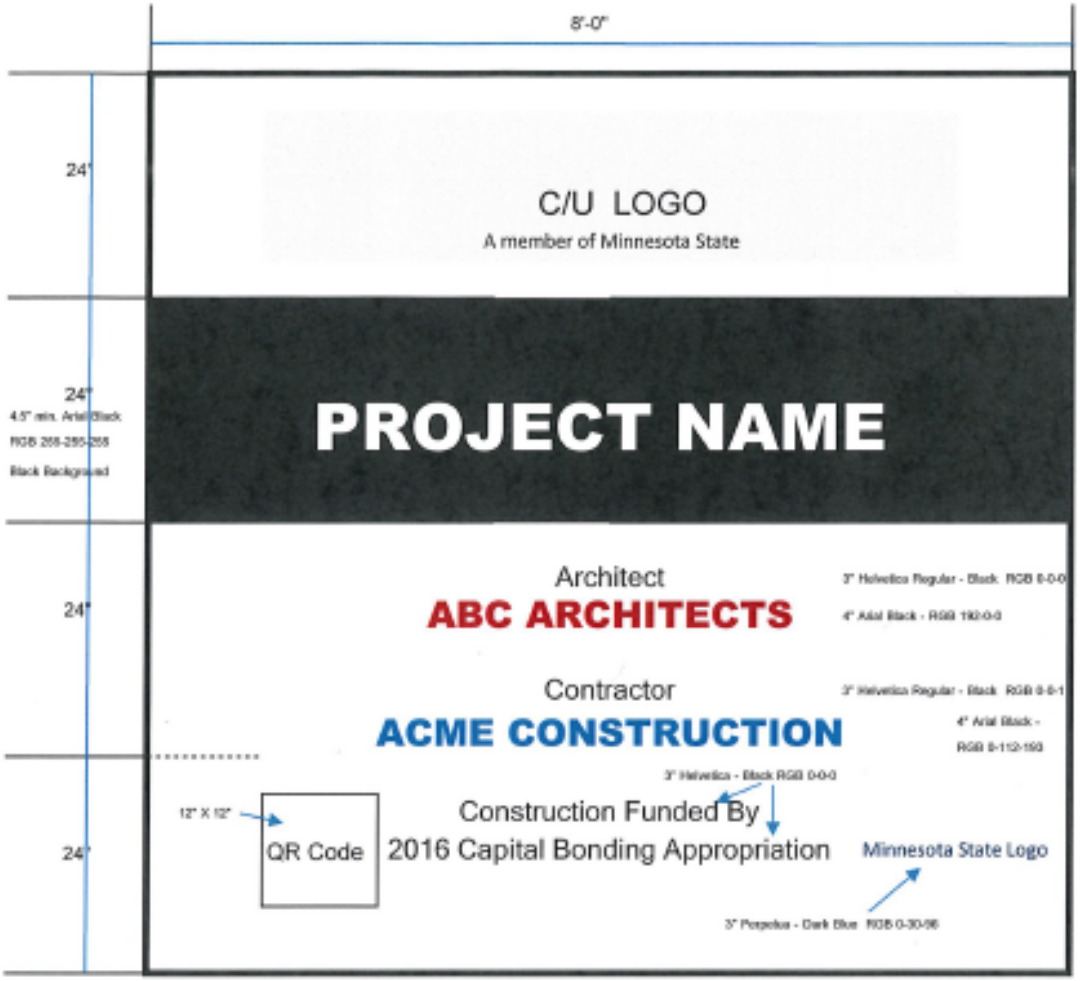
1. Funding source(s) can be Capital, HEAPR, Revenue Bond Funds, Grants or other sources of funding and a project may have multiple funding sources.

The MINNESOTA STATE System Office may permit modifications to these specifications if they conflict with state law or local ordinances or if the project is entirely interior renovation.

The next page is an example of site signage layout.
(Example is not to scale)

SITE SIGN LAYOUT

MnSCU PROJECT SITE SIGN LAYOUT



Site Sign shall be 8' x 8', 3/4" Exterior grade/MDO Plywood
(4) - 2' Sections vertically:

- Campus Name & logo (Obtain from C/U Project Manager)
- Project Name (White lettering on Black background)
- Designer and General Contractor Name (Titles can vary based on project)
- QR code/Funding Info/Minnesota State Logo

Project Name could be 1, 2, or 3 lines with lettering verying in size. Minimum = 4.5"
Obtain QR code & MnSCU Logo information from System Office Program Manager
Use exterior enamel paint for background. Lettering & symbols can be paint or vinyl.

END SECTION

Division 03 – Concrete

03 53 00 – Concrete Toppings

1. General

1.1. Summary

1.1.1. This Section includes the installation of rapid set mortar toppings to be applied over concrete decks as thin in-fills over rough surfaces or as thicker topping fills to create slopes to drain or other flooring fills such as depressions or voids where partitions were demolished and removed.

1.1.2. This material shall be used in conjunction with interior waterproofing products specified under Section 07 18 13 – Pedestrian Traffic Coatings where the substrate requires underlayment in-fills and slopes to drain.

1.2. Application Qualifications

1.2.1. The mortar topping application shall be performed by a single firm experienced and specialized in applying rapid set mortar toppings, as shown and specified, and shall be an Applicator approved and trained by the manufacturer. The field supervisors and the project foreman for the Applicator shall each have at least 3 years approved experience with the application of this mortar topping product.

1.3. Submittals

1.3.1. Product Data (PD): Submit copies of the manufacturer's printed instructions for evaluating, preparing, and treating substrate, technical data, and tested physical and performance properties, and printed instructions for installation of mortar topping, including procedures and materials for bonding, tooling, and finishing.

1.3.2. Submit a copy of the manufacturer's approval letter of the Applicator and indicate by transmittal form, that copies of the Project Specifications and application instructions have been distributed to the Applicator.

1.3.3. Submit written approval of the condition of the substrate(s) to proceed with the mortar topping, signed by all of the following parties: manufacturer's representative, installing Applicator, and Contractor.

1.3.4. Submit MSDS information for all materials proposed for use for this specific Project.

1.4. Quality Assurance

1.4.1. Specify a Pre-Installation Conference in accordance with Section 01 20 00 - Project Meetings. The Applicator shall meet with the manufacturer's representative, Contractor, A/E, and Owner's representatives at the Project site prior to start of the Work of this Section to review the topping installation procedures, acceptance of surfaces, minimum curing period, forecasted weather conditions, special details and coordination of other trades. The Contractor shall provide notice to attendees prior to convening the Pre-Installation Conference as specified in Section 01 20 00 – Project Meetings.

Review methods and procedures related to this Work, including, but not limited to the following:

1.4.1.1. Tour job site areas to be in-filled with mortar topping. Inspect and discuss conditions of substrate(s), existing conditions, drains, curbs, penetrations, required slopes, and other preparatory work performed by other trades.

1.4.1.2. Review required submittals, both completed and yet to be completed. Read the entire Specification, line item by line item.

1.4.1.3. The Contractor shall submit written approval of the condition(s) of the substrate(s) as required by Paragraph 1.3.3.

1.4.1.4. Review and finalize the Construction Schedule related to mortar topping work and verify availability of materials, Applicator's personnel, equipment, and facilities needed to make progress and avoid delays.

1.4.1.5. Review required inspections and testing.

1.4.1.6. Review manufacturer's guidelines with respect to weather conditions.

1.5. Project/Site Conditions

1.5.1. Environmental Requirements: Do not apply mortar topping materials if ambient, materials, and/or substrate temperatures are outside the range of ambient temperatures recommended by the manufacturer. Temperatures shall be rising and stay above the minimum for the following 48 hours. All surfaces to receive the mortar topping shall be free of water, dew, frost, snow and ice, and shall remain dry until cured.

2. Products.

2.1. Mortar Topping Products

2.1.1. Products: Subject to compliance with requirements, provide products by one of the following manufacturer's:

2.1.1.1. SikaTop 122 by Sika.

2.1.1.2. MasterEmaco T1061 Rapid Mortar by BASF Master Builders Solutions, Inc.

2.1.1.3. MasterEmaco T430 Rapid Strength Mortar by BASF Master Builders Solutions, Inc.

2.1.2. Bonding Agents: Manufacturer's standard factory formulated bonding agent recommended for substrate and conditions indicated. Provide water-based epoxy/cementitious bonding agent and rebar coating products by one of the following manufacturer's:

2.1.2.1. Armatec 110 Bonding Agent by Sika.

2.1.2.2. MasterEmaco P-24 Bonding Agent by BASF Master Builders Solutions, Inc.

3. Execution

3.1. General

3.1.1. All Work performed under this Section shall be in accordance with the Specifications, Drawings, and the manufacturer's instructions and recommendations. In the event of a conflict, the stricter requirement shall prevail.

3.1.2. Surface Preparation: Prior to the start of mortar topping work, topping Applicator shall inspect entire area to be in-filled for compliance with requirements and other conditions affecting performance. The Contractor shall submit written approval of substrate(s) per requirements of Paragraph 1.3.3.

3.1.2.1. Any new concrete substrate shall be placed and air-dried for a minimum of 28 days.

3.1.2.2. Sandblast the surface to reveal clean and sound bonding surface. Verify that substrate concrete is sound and properly roughened.

3.1.2.3. Square-cut loose edges of concrete and roughen by sandblasting or scabbling.

3.1.2.4. Dampen with water as recommended by topping manufacturer.

3.1.2.5. Verify that substrate is visibly free of standing water.

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

3.1.3. Bonding Agent Application:

3.1.3.1. Thoroughly scrub a bond coat of the bonding agent into the saturated surface of the concrete substrate with a stiff brush.

3.1.3.2. Do not apply more bonding agent than can be covered with mortar topping before the bond coat dries.

3.1.3.3. Do not temper the bonding agent or re-temper the bond coat.

3.1.3.4. Apply a thickness of bonding agent in preparation for mortar topping, as specified by the manufacturer's recommendations for the bonding agent.

3.1.4. Mortar Topping:

3.1.4.1. Immediately place the mortar topping into the wet bonding agent of the prepared area.

3.1.4.2. As the application proceeds, work the mortar topping material into the bottom and sides of the patch area to assure a good bond.

3.1.4.3. Level the mortar topping material and tool to the required dimensions and slopes.

3.1.4.4. Broom finish the mortar topping in preparation for waterproofing application where required.

3.1.5. Minimum Application Thickness:

3.1.5.1. SikaTop 122: 1/8” thickness with maximum depth of 1” per lift.

3.1.5.2. MasterEmaco T1061: 1/2” thickness.

3.1.5.3. MasterEmaco T430: 1/4” thickness.

3.1.6. Additional Application Thickness: Refer to manufacturer’s recommendations for extending the thickness of the mortar topping fills by adding certain proportions of aggregate to the mortar topping mix, depending on the desired depth.

3.2. Curing, Protecting, and Cleaning

3.2.1. Cure according to manufacturer’s written recommendations, taking care to prevent contamination and damage during application stages and curing.

3.2.2. Wet cure the mortar topping by covering with a dampened burlap material over the entire mortar topping application for a minimum of 3 days. Keep burlap damp to avoid shrinkage cracking due to fast cure and drying.

3.2.3. Application of any curing compounds or coatings is not permitted.

3.2.4. Air dry the mortar topping without any covering for a minimum of 3 additional days after the wet cure, for a total of 6 days of curing wet and dry. The curing period shall be complete before any subsequent moisture content testing of the topping.

3.2.5. Protect topping from damage and wear during remainder of construction period. The Contractor shall prevent any liquid moisture from running or dribbling across the topping area immediately after the placement and during the curing.

3.2.6. Clean spillage and soiling from adjacent construction using cleaning agents and procedures recommended by manufacturer of affected construction. The completed topping surface shall be thoroughly protected from damage by any cleaning agents.

END SECTION

03 64 00 – Injection for Water Control

1. General

1.1. Summary

1.1.1. Under this Section, the contractor shall furnish all necessary materials, labor, supervision, technical services, injection pumps, equipment, and ancillary items required to perform the following work:

1.1.1.1. Inject into existing wall cracks or joints from the building interior for the purpose of controlling water infiltration.

1.1.1.2. Inject to the existing wall exterior from the building interior for the purpose of controlling water infiltration.

1.1.2 Section includes: Drilling of charge and recharge injection portals, installation of mechanical injectors, pressure injection placement of compounds, detailed dress out of portals, and general clean-up.

1.2 Applicator Qualifications

1.2.1 When injected compound is Turbo Seal U by RE-Systems:

1.2.1.1 Installer must be licensed, certified in writing, and approved by manufacturer RE-Systems Group for the installation of pressure injected polymer rubber bentonite gel.

1.2.1.2 The installer shall have not less than three (3) years of total waterproofing experience, not less than one (1) year of experience installing Turbo Seal U, and must have also installed not less than 5,000 gallons of injection.

1.2.2 All other injected compounds:

1.2.2.1 Contractor shall provide and assign to the Project personnel that have received specific training in the use, application, and installation of the products and procedures required in this Section.

1.2.2.2 Contractor and its specific personnel shall have successfully completed similar type projects using similar injection materials as those specified herein for a minimum of five (5) years.

1.2.2.3 Contractor shall have been in business for a minimum of five (5) years.

1.3. Submittals

1.3.1. Product data: Submit product data for injection compounds, injection equipment, and structural mortar.

1.3.2. Sample warranty: Submit a sample of the warranty as described herein.

1.3.3. Proof of quality assurance and applicator qualification compliance: Submit written documentation of qualifications required herein.

1.4. Quality Assurance

1.4.1. Components, materials, and installation procedures shall be in strict accordance with manufacturer's specifications and as defined in this Section.

1.4.2. Pressure injection of compounds, operations of specific equipment required for the pressure injection activities, and supervision of all compound installations shall be performed by experienced, trained individuals meeting the requirements of the compound manufacturer and the additional requirements herein.

1.4.3. The injection contractor shall visit the injection site and review with respect to equipment access, wall construction, infiltration type and history, and crack location (if applicable).

1.5. Delivery, Storage, and Handling

1.5.1. Store all materials in accordance with the manufacturer's recommendations, as approved, and in accordance with the requirements herein specified.

1.5.2. Deliver materials in manufacturer's unopened containers fully identified with brand, type, class, grade, and all other qualifying and product information.

1.5.3. Store all flammable materials in a dry area away from high heat, flames, or sparks.

1.5.4. Provide a sufficient quantity of specified materials to the site, or readily available, prior to starting work to insure that work will be completed without delay due to material storage.

1.6. Warranty

1.6.1. The injection contractor shall furnish to the Owner a performance guarantee that the Contract work shall stop all water infiltration through either the cracks/joints that are injected or through the wall which is blindside injected, whichever the case may be, for a period of five (5) years. Any repair under this guarantee shall be done at no cost to the Owner.

2. Products

2.1. Compounds for Blindside Injection: The injection contractor shall be solely responsible for selecting the appropriate injection compound.

2.1.1. Non-Curing/Self-Sealing Injection Compound: Shall be specifically suited for blindside injection from the building interior to the building exterior through an existing cast-in-place concrete structure for the purpose of stopping the passage of moisture through the wall and shall have the following properties: adheres and creates a watertight seal to wet surfaces, resists project specific hydrostatic pressures, compatible with the project specific existing waterproofing, and is self-sealing.

2.1.1.2. Turbo Seal U injectable polymer rubber bentonite gel compound supplied by RE-Systems Group.

2.1.1.3. Approved equal.

2.1.2. Hydrophilic Compound: Material shall be a one or two part, 100% solids, hydrophilic product which reacts with water to set into a flexible closed-cell foam for the purpose of stopping the passage of water. Product shall be odor free and contain no volatile organic compounds (VOCs). Once cured, the material shall exhibit excellent permanent adhesion

to damp concrete surfaces, and shall remain unaffected by acids, gasses, and microorganisms found in soils.

2.1.2.1. ST-526 by Strata-Tech, Inc.

2.1.2.2. Approved equal.

2.2. Compound for Crack/Joint Injection: The injection contractor shall be solely responsible for selecting the appropriate injection compound.

2.2.1 Non-Curing/Self-Sealing Injection Compound: Shall be specifically suited for blindside injection from the building interior to the building exterior through an existing cast-in-place concrete structure for the purpose of stopping the passage of moisture through the wall and shall have the following properties: adheres and creates a watertight seal to wet surfaces, resists project specific hydrostatic pressures, compatible with the project specific existing waterproofing, and is self-sealing.

2.1.2.1 Turbo Seal U injectable polymer rubber bentonite gel compound manufactured by RE-Systems Group.

2.1.2.2 Approved equal

2.2.2 Hydrophilic Resin (active wet leaks): Material shall be a one or two part, 100% solids, hydrophilic product which reacts with water to set into a flexible closed-cell foam for the purpose of stopping the passage of water through an existing wet joint or crack. Product shall be odor free and contain no volatile organic compounds (VOCs). Once cured, the material shall exhibit excellent permanent adhesion to damp concrete surfaces, and shall remain unaffected by acids, gasses, and microorganisms found in soils.

2.2.2.1 ST-526 by Strata-Tech, Inc.

2.2.2.2 Approved equal.

2.2.3 Hydrophobic Resin (non-active dry leaks): Material shall be a one or two part, high solids, hydrophobic product which sets into a strong void filling rigid foam. Once cured, the material shall exhibit excellent permanent adhesion to dry concrete surfaces and shall remain unaffected by acids, gasses, or microorganisms found in soil.

2.2.3.1 ST-536 by Strata-Tech, Inc.

2.2.3.2 Approved equal.

2.3 Injection Equipment: The injection contractor shall be solely responsible for selecting the appropriate equipment.

2.3.1 Equipment for Turbo Seal U by RE-Systems Group: The equipment used to inject the polymer rubber bentonite gel shall be acceptable to RE-Systems Group and shall conform to all of the following:

2.3.1.1 Capacity to mix and circulate the polymer rubber bentonite gel material.

2.3.1.2 Capacity to inject the polymer rubber bentonite gel under controlled, variable pressures.

2.3.1.3 Capacity to keep polymer rubber bentonite gel material and injection hose at a temperature above freezing, so as to enable the optimal injection flow rate

2.3.2 Equipment for All Other Compounds

2.3.2.1 Injection unit shall be portable and equipped with positive displacement-type pumps with interlock to provide positive ratio control of injection material components. Pumps shall be air or electric powered and shall provide in-line mixing and metering system and shall be equipped with drain-back plugs.

2.3.2.2 Equipment shall be capable of having automatic proportioning of materials within mix ratio tolerance set by material manufacturer, be able to deliver components from separate reservoirs to mixing type discharge head, deliver complete and uniformly mixed components at discharge head, and have the injection material at constant pressures not to exceed 150 psi.

2.3.2.3 Ports: Rubber/metal type injection system parts fitted with zert adapters and capable of handling working pressures of up to 2,500 psi at the nozzle. Mizer injection port of Strata-Tech, Inc., or approved equal.

2.4 Structural Mortar: Accelerated setting, low-slump, high strength mortar for substrate preparation.

2.4.1 Masteremaco N400 by BASF distributed by Brock White. Mix and install in accordance with manufacturer's published recommendations.

2.4.2 Five Star structural concrete V/O by Five Star Products, distributed by Snow-Larson.

2.4.3 Approved equal.

3 Execution

3.1 Blindside Injection

3.1.1 Turbo Seal U by RE-Systems Group shall be installed per manufacturer's directions and as follows:

3.1.1.1 The thickness of the concrete shall be determined.

3.1.1.2 For injection of a restorative waterproofing membrane, 5/8" diameter ports shall be drilled to the waterproofing layer at 3.25' intervals. For high-pressure injection >500 psi, 10mm ports shall be drilled at 1.75" intervals. For injecting cold joints, joints or cracks, entry ports for polymer rubber bentonite gel shall be drilled, spaced in a zig zag pattern on either side of the crack to assure that when the polymer rubber bentonite gel material shows at the adjacent port, it has

completely filled the crack to its full depth. Entry ports shall be spaced along cracks and spacing usually determined by the tightness of the crack and the depth of the concrete substrate. Spacing is generally between 6 and 14 inches.

3.1.1.3 Install the injection packers. For low-pressure injection <500 psi, an injection pipe with an outer diameter of 5/8" shall be used. For high-pressure injection >500 psi, 10 mm zirc fittings shall be used.

3.1.1.4 Injection of the polymer rubber bentonite gel into concrete, unless permitted by the engineer, begin first at the entry port of lowest elevation and continue until uncontaminated polymer rubber bentonite gel flows out of the adjacent port. Injection pressure shall be kept as low as practical and shall generally be between 200 psi and 300 psi plus any hydrostatic head. The connection between the entry port and the mix head of the injection nozzle must be sufficiently tight to prevent polymer rubber bentonite gel from running out on the concrete surfaces.

3.1.1.5 After injection at a given port is complete, this port shall be plugged and injection started at the next adjacent port. This procedure shall be repeated until the affected area is completely filled. Upon completion, surface to be left as noted on the drawings.

3.1.1.6 Holes shall be filled with non-woven cloth and high strength fast set mortar. If high-pressure conditions exist, or the specified drill hole is larger than 5/8", wood dowels or alternative material can be used to fill injection holes. Repeat process as necessary.

3.1.1.7 As installation may be affected by specific project conditions/limitations, all port diameters and spacing, and installation procedures shall be confirmed by RE-Systems, and the installing contractor, during the site visit or Pre-Installation Conference.

3.1.2 All other injection compounds shall be installed per manufacturer's directions.

3.1.2.1 Determine the wall thickness from the Drawings.

3.1.2.2 Drill holes for ports. Diameter of the holes shall be determined by the applicator based on required pressure and other site-specific considerations.

3.1.2.3 Start at the lowest elevations, inject the compound into the entry ports at variable pressures, as required, until uncontaminated compound flows out of the adjacent ports.

3.1.2.3.1 Injection pressure shall be kept as low as practical and shall generally be between 200 psi and 300 psi plus any hydrostatic head. The connection between the entry port and the mix head of the injection nozzle must be sufficiently tight to prevent the compound from running out on the concrete surfaces.

3.1.2.4 After injection at a given port is complete, this port shall be plugged and injection started at the next adjacent port. Repeat this procedure until a continuous, uninterrupted waterproofing membrane of compound has been delivered to the structure exterior.

3.1.2.5 Fill holes with structural mortar. If high-pressure conditions exist or the specified drill hole is larger than 5/8", wood dowels or alternative material can be used to fill injection holes. Repeat process as necessary.

3.2 Crack/Joint Injection

3.2.1 The injection compounds shall be installed per the manufacturer's direction and as follows:

3.2.1.1 The pressure injection process is required at all designated crack or joint locations as determined by the injection contractor.

3.2.1.2 Drill holes to intersect plane of crack within the concrete for charge and recharge ports.

3.2.1.3 Install mechanical injector ports into each charge port hole.

3.2.1.4 Inject compound into each charge port at variable pressures, as required, to effect maximum penetration while monitoring the distribution by observing the recharge ports.

3.2.1.5 After cure of injection compound, remove all ports and fill, as required, with structural mortar. The structural mortar shall be finished flush with adjacent surfaces.

3.3 Cleaning

3.3.1 Remove all compound drainage and other residue from concrete faces and surfaces.

3.3.2 Surface grind, as required, the structural mortar so as to eliminate burrs, protrusions, or surface irregularities

END SECTION

Division 06 – Wood, Plastics and Composites

All roofing related lumber and materials and procedures shall be as specified as per this Section. This is an example which may have to be modified based on specific project requirements or changes or refinements to building codes or materials.

SECTION 06 10 00 - Rough Carpentry

1. GENERAL

1.1 SUMMARY

1.1.1. Section Includes:

1.1.1.1. Roof-related wood blocking

1.1.1.2. Deck sheathing

1.1.1.3. Sheet metal angles

1.1.2. Related Sections:

1.1.2.4. Section 07 51 00 - Built-Up Bituminous Roofing

1.2 QUALITY ASSURANCE

1.2.1. Use adequate numbers of skilled workers who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the Work of this Section.

1.2.2. Codes and Standards: In addition to complying with the pertinent codes and regulations of governmental agencies having jurisdiction, unless otherwise specifically directed or permitted by the Architect/Engineer, comply with the following:

1.2.2.1. Product Use Manual of the Western Wood Products Association for selection and use of products included in that manual.

1.2.2.2. Plywood Specification and Grade Guide of the APA-The Engineered Wood Association.

1.3 DELIVERY, STORAGE, AND HANDLING

1.3.1. Deliver materials to the site, insofar as practicable, in manufacturer's original containers and bearing the trademarks and names thereof. Grademark stamped on all standard yard dimension lumber or certified for compliance. Plywood grade stamped.

1.3.2. Carefully stack lumber and plywood to prevent warping. Keep dry.

1.4 PROJECT CONDITIONS

1.4.3. Existing Conditions: Replace existing wood members intended for reuse that are in unsatisfactory condition with equivalent products.

PRODUCTS

2.1 LUMBER

2.1.1. Non-preservative treated, standard light framing grade, sound and thoroughly seasoned with less than 19 percent moisture content at the time of installation and at time roofing is installed.

2.1.1.1. Douglas Fir

2.1.1.2. Eastern Pine

2.1.1.3. No. 3 Southern Pine

2.1.1.4. No. 2 Western Hemlock

2.1.1.5. Spruce-Pine-Fir

2.1.2. PLYWOOD

2.1.2.1. C-D Exposure 1 or better, APA Rated Sheathing, non-preservative treated, meeting U.S. Products Standard PS1 or Performance Standard PRP-108 for Soft Wood Plywood Construction and Industrial, with less than 19 percent moisture content at time of installation and at the time roofing is installed.

2.1.2.2. Deck sheathing: APA Rated Sheathing, Exposure 1, Exterior, bearing the identification index 48/24 for 3/4" thickness.

2.1.3. FASTENERS

2.1.3.1. Lumber to lumber: Cement coated or annular thread nails with minimum 1-1/4" penetration into adjoining member.

2.1.3.2. Plywood to lumber:

2.1.3.2.1. Nails: Ring shank or annular thread nails with minimum 1-1/4” penetration into adjoining member.

2.1.3.2.2. Screws: Minimum #14 flat head countersunk wood screws, zinc or cadmium plated steel or stainless steel, with minimum 1-1/4" penetration.

2.1.3.3. Lumber or plywood to concrete or masonry: Tapcon or Gripcon anchors, minimum 1/4" diameter with 1" penetration, minimum 300 lb. per anchor installed withdrawal resistance. Other corrosion resistant drilled-in type masonry anchors may be used if equivalent in pull-out strength.

2.1.3.4. Lumber or plywood to steel deck: Minimum #14 sheet metal screw, zinc or cadmium plated; through 5/8" diameter steel washers for lumber.

2.1.3.5. Sheet metal angle to lumber: Minimum #14 flat head wood screws, zinc or cadmium plated steel or stainless steel, with minimum 1-1/4" penetration.

2.1.3.6. Sheet metal angle to steel deck: Self-drilling screw fastener, size 12 - 24 by 7/8, HWH Teks/4 manufactured by ITW Buildex.

2.1.4. MISCELLANEOUS

2.1.4.1. Sheet metal angle: 12-gauge galvanized iron, size as shown on the Drawings.

2.1.4.2. Gypsum sheathing: 5/8" Type X.

3. **EXECUTION**

3.2 REMOVAL OF EXISTING

3.1.1. Removed materials need not be salvaged unless specifically required for reuse. Some existing wood members may be reused at the option of the Contractor as indicated on the Drawings, if in acceptable condition when reinstalled to receive new materials.

3.2 PREPARATION

3.2.1. Grout, shim, patch, or fill existing construction as necessary to properly install wood members.

3.2.2. Inspect fastening of existing wood members left in place for conformance to requirements specified herein. Fastening found not in conformance shall be upgraded to meet these requirements.

3.2.3. Reset or replace existing fasteners for materials exposed but left in place that are loose, deformed, damaged, or corroded.

3.2.4. Perimeter wood blocking installation shall, as a minimum, be in accordance with recommendations of Factory Mutual Loss Prevention Data Sheet 1-49, September 2000.

3.3 WOOD BLOCKING

3.3.1. Install in straight lines, level planes, and at proper elevation.

3.3.2. Top surface of horizontal blocking is to match the surface elevation of the new roof insulation.

3.3.3. Do not use warped wood members unless they can be fastened adequately to permanently hold them in their required alignment.

3.3.4. When constructing wood curbs with multiple vertical blocking and plywood members, provide staggered joints for all layers and minimum 12" laps.

3.3.5. Lumber or Plywood to Lumber:

3.3.5.1. Maximum spacing of 12" on-center, staggered across face of piece and located within 3" of each end of piece.

3.3.5.2. Maximum spacing of 6" on-center, 8' each way from outside corners for roof edge blocking.

3.3.5.3. Heads shall be flush with wood surface and nail shall penetrate adjoining piece minimum 1-1/4".

3.3.5.4. Minimum 100 lb. per nail installed withdrawal resistance.

3.3.6. Lumber or Plywood to Concrete or Masonry:

3.3.6.1. Spacing as shown on Drawings or maximum 3' on-center when not specified, staggered. Maximum 18" on-center, 8' each way from outside corners for roof edge blocking.

3.3.6.2. Countersink head flush with surface but no more than 1/3 the thickness of the fastened piece.

3.3.6.3. Minimum 300 lb. per anchor withdrawal resistance or number of fasteners increased accordingly from that specified, minimum penetration of 1".

3.3.7. Lumber or Plywood to Steel Deck:

3.3.7.1. Verify the presence of conduit below the steel deck prior to installation.

3.3.7.2. Spacing as shown on the Drawings or maximum 18" on-center for screws when not specified, and staggered if lumber is more than 5" wide. Maximum 9" on-center, 8' each way from outside corners for roof edge blocking.

3.3.7.3. Countersink head flush with surface but not more than 1/3 the thickness of the fastened piece.

3.3.7.4. Minimum 150 lb. per anchor withdrawal resistance or number of fasteners increased accordingly from that specified, minimum penetration of 1-1/2".

3.4 FIELD QUALITY CONTROL

3.4.1. Alignment and elevation of installed wood shall be checked by Contractor and may be checked by Architect/Engineer.

3.4.2. Withdrawal tests of installed fasteners may be required if attachment is in question.

3.5 CLEANING

3.5.1. Keep the premises in a neat, safe, and orderly condition, free from an accumulation of sawdust, cut ends, and debris at all times during execution of this Work.

END SECTION

Division 07 – Thermal and Moisture Protection

07 13 00 – Below-grade Membrane Waterproofing

All waterproofing materials and procedures shall be as specified as per this Section. Approved equals shall comply with the minimum requirements set forth in this Section, including, but not necessarily limited to, applicator qualifications, warranty requirements, membrane waterproofing general requirements, and physical property requirements.

1. General

1.1. Applicable Sections: The requirements/provisions of Divisions 00 and 01 apply to this Section.

1.2. Scope: The work under this Section includes all materials, labor, equipment and related incidental services necessary for the complete application of all membrane waterproofing work to the exterior surfaces, exterior face of the foundation walls, and through-wall flashing set in waterproofing, as shown on the Drawings and specified herein.

1.3. Applicator Qualifications:

1.3.1. The membrane waterproofing work shall be performed by a single firm experienced and specializing in applying the specified waterproofing. The membrane waterproofing installation firm shall be an approved and trained Applicator of the waterproofing that is installed.

1.3.2. Foreman/Crew Qualifications: The lead foreman shall have a minimum of 3 years of experience with the specified waterproofing on a minimum of three projects of comparable size and complexity. The lead foreman shall be on site for the duration of the waterproofing installation. The crew shall also have experience with the specified waterproofing. The experience of both the lead foreman and crew shall be documented and submitted to the A/E for approval prior to the start of the waterproofing work.

1.4. Submittals

1.4.1. Shall comply with requirements of Division 00 and 01.

1.4.2. Shop Drawings (SD): Submit showing all pre-detailing, tie-ins, terminations, drain flashing and other detailing required by the project. Shop drawings shall include a construction protection plan. Provide descriptions and drawings of materials and methods to protect waterproofing system from damage by subsequent construction activities.

1.4.3. Product Data (PD): Submit manufacturer's printed instructions for complete installation of waterproofing material, including procedures and materials for priming flashing, splicing and bonding.

1.4.4. Product Data (PD): Submit copies of manufacturer's application instructions for the membrane waterproofing work. Indicate by transmittal form that copies of the Project Specifications and application instructions have been distributed to the membrane waterproofing Applicator. Copies of the manufacturer’s

instructions, guidelines and shop drawings should be kept on site during installation for reference.

1.4.5. Manufacturer's Review of Waterproofing System: Before delivering waterproofing materials to the Project site, submit a written statement signed by the Contractor, waterproofing Applicator and manufacturer's representative stating that the A/E's Project Drawings and Specifications have been reviewed by the manufacturer’s regional manager, and that the representative is in agreement that the selected materials and system for waterproofing are proper and adequate for the application shown. This submittal shall also to be submitted to the Owner.

1.5. Quality Assurance

1.5.1. Specify a Pre-Installation Conference in accordance with Section 01 20 00-Project Meetings. The membrane waterproofing Applicator shall meet with the manufacturer's representative, Contractor, A/E and Owner's representatives at the Project site to review the membrane waterproofing procedures, acceptance of surfaces, special details and coordination of other trades. The Contractor shall provide notice to attendees prior to convening the Pre-Installation Conference as specified in Section 01 20 00-Project Meetings. Review methods and procedures related to this Work, including, but not necessarily limited to the following:

1.5.1.1. Tour job site areas to be waterproofed. Inspect and discuss conditions of substrate(s), existing conditions, drains, curbs, penetrations and other preparatory work performed by other trades.

1.5.1.2. Review required submittals, both completed and yet to be completed. Read the entire Specification line item by line item.

1.5.1.3. Review and finalize the Construction Schedule related to waterproofing work and verify availability of materials, Applicator's personnel, equipment and facilities needed to make progress and avoid delays.

1.5.1.4. Review manufacturer's guidelines with respect to weather conditions.

1.5.1.5. Review required inspections and testing.

1.5.1.6. Review manufacturer’s guidelines with respect to weather conditions.

1.6. Inspection and Testing

1.6.1. Full time inspection is required for Work specified in this Section. Cooperate with any inspection and testing firm engaged by the Owner to perform on-site inspection of the membrane waterproofing work. Comply with the inspector's request in connection with specific test samples, and provide any additional testing that may be requested to confirm that the Work complies with the requirements. The Contractor shall notify the Owner’s inspection and testing firm, A/E and Owner five (5) working days in advance of start of any waterproofing work to be performed on-site, and three (3) working day notice per inspection trip thereafter.

1.6.2. To determine whether the substrates are dry, there shall be three tests performed and paid for by the Contractor and observed by the Owner's inspection personnel. If test methods 1, 2 or 3 fail, then the application of waterproofing shall not proceed until the surface is dried and the test passes. Repeat all three tests after each substrate exposure to moisture such as rain, dew, mist, sleet, etc.

1.6.2.1. Test 1 (moisture test): Install a 3' x 3' sheet of clear polyethylene over the substrate. Seal the sheet to the substrate by installing a continuous bead of water cut-off mastic (or other pre-approved material) under the sheet around all four edges and then duct tape all four edges as well. If moisture condenses on the underside of the sheet, or shows up in any other form after exactly three hours, then the test has failed and the substrate has too high a moisture content to receive the waterproofing. The substrate must be dried by increasing cure time or torch drying, or both, before repeating the test. Do not proceed to Test 2 until Test 1 passes. Completely remove test materials before proceeding with the waterproofing installation.

1.6.2.2. Test 2 (moisture test, hot fluid-applied rubberized asphalt only): Once Test I has passed, then proceed with Test 2 by applying surface conditioner and liquid membrane to a 2' x 2' area of substrate. The temperature of the liquid membrane and the "working in" of the liquid membrane at the test area shall match that of the final membrane installation as required by the manufacturer. If bubbles or blisters are apparent, or if the liquid membrane "tents up" and releases from the substrate when touched, then the test has failed and the substrate has too high a moisture content to receive the waterproofing.

1.6.2.3. Test 3 (adhesion test): Once Tests 1 and 2 have passed, then proceed with test three.

a. Hot fluid-applied rubberized asphalt: Install a 12" x 12" area of the following in ascending order: surface conditioner, 90 mils of liquid membrane, 12" x 14" sheet of elastomeric reinforcing fully bonded into the hot membrane. The temperature of the liquid membrane and the "working in" of the liquid membrane shall match that of the final membrane installation as required by the manufacturer. Once the liquid membrane has cured (minimum 10 minutes), test the adhesion to the substrate by pulling up on the non-bonded 2" strip of elastomeric reinforcing. If any area of the liquid membrane separates from the substrate instead of separating from itself or the reinforcing, then adhesion is inadequate and the test has failed.

b. All other waterproofing: Install a 12" x 12" area of the following in ascending order: surface conditioner, membrane waterproofing, 12" x 14" sheet of elastomeric reinforcing fully bonded into the

membrane. The "working in" of the membrane shall match that of the final membrane installation as required by the manufacturer. Once the membrane has cured (minimum 10 minutes), test the adhesion to the substrate by pulling up on the non-bonded 2" strip of elastomeric reinforcing. If any area of the membrane separates from the substrate instead of separating from either itself or from the reinforcing, then adhesion is inadequate and the test has failed. If the membrane is of a non-curing variety, then a 10-minute wait is not necessary.

1.7. Delivery, Storage and Handling

1.7.1. Store all materials for membrane waterproofing work in accordance with the manufacturer's recommendations, as approved, and in accordance with the requirements herein specified.

1.7.2. Deliver materials in manufacturer’s unopened containers fully identified with brand, type, class, grade and all other qualifying and product information.

1.7.3. Store membrane no more than one pallet high. Provide cover on top and all sides, allowing for adequate ventilation. The membrane shall be stored off the ground or concrete surfaces.

1.7.4. Store primer, waterproofing, mastics, protection course and other flammable products in a dry area away from high heat, flames, or sparks.

1.7.5. Store protection course flat and off the ground, preferably on wood platforms. Provide tarpaulin cover on top and all sides.

1.7.6. Store only as much material at point of use as required for each day's work.

1.8. Environmental Requirements

1.8.1. Do not apply waterproofing materials if ambient, material, and/or substrate temperatures are outside of the waterproofing manufacturer’s recommended limits.

1.9. Warranty

1.9.1. Manufacturer's Warranty: Submit to the A/E for transmittal to the Owner two (2) original copies of manufacturer's standard warranty on all materials used on the Project for a period of fifteen (15) years from the date of Substantial Completion.

1.9.2. Contractor/Applicator Guarantee: Submit to the A/E for transmittal to the Owner two (2) original copies of an unqualified guarantee for a period of three (3) years on all materials, workmanship and water-tightness, signed by the waterproofing Applicator and the Contractor on the complete waterproofing installation for the Project and that any defects in the installation because of materials or workmanship shall be properly corrected during the guarantee period at no cost to the Owner. Upon written notification within the guarantee period of any such defects, the necessary repairs and replacement shall be properly made at the convenience of the Owner.

1.9.3. Applicator Guarantee: Submit to the A/E for transmittal to the Owner two (2) original copies of an unqualified guarantee for a period of twelve (12) years from the expiration of the noted warranty in the above paragraph 1.9.2, on all materials, workmanship and water-tightness, signed by the waterproofing Applicator on the complete waterproofing installation for the Project and that any defects in the installation because of materials or workmanship shall be properly corrected during the guarantee period at no cost to the Owner. Upon written notification within the guarantee period of any such defects, the necessary repairs and replacement shall be properly made at the convenience of the Owner.

2. Products

2.1. Below-Grade Membrane Waterproofing

2.1.1. General Requirements: The waterproofing membrane must meet the following requirements:

2.1.1.1. Must be fluid-applied.

2.1.1.2. Must be permanently bonded to the substrate over the entire coverage area of the membrane.

2.1.1.3. Water tightness characteristics do not require containment pressure.

2.1.1.4. Can be applied during the anticipated Project specific weather conditions with respect to air and substrate temperatures, without loss in bond or other product characteristics.

2.1.1.5. Membrane manufacturer has accessory flashing products, or approves the use of those by other manufacturers, which comply with Minnesota State grade-line through-wall flashing standards.

2.1.1.6. Membrane has been marketed for the intended use in the Project for not less than ten (10) years.

2.1.1.7. Reinforcing requirements:

2.1.1.7.1. Hot fluid-applied rubberized asphalt: The product must adapt to, and the manufacturer must agree in writing to, Minnesota State required method of membrane reinforcement, which embeds and fully bonds an elastomeric sheet of uncured neoprene into the entire liquid membrane component in lieu of the manufacturer's standard recommendation for reinforcement.

2.1.1.7.2. All other: The product must adapt to, and the manufacture must agree to, reinforcing the membrane using an elastomeric reinforcing sheet of the manufacturer's choosing, in lieu of the manufacturer's standard application. The elastomeric reinforcing must be integral with and fully bonded to the fluid-applied

component and can be either placed over or sandwiched between the fluid-applied components.

2.1.2. Physical Property Requirements: The manufacturer's standard application of the waterproofing membrane must meet or exceed the following physical properties using the same test methods listed.

Physical Property	Test Method	Minimum Requirement
Water vapor permeability	ASTM E96, Procedure E, CGSB 37.50-M89	0.27 perm 1.7 ng/Pa(s)m max
Low temperature crack bridging capability	CGSB 37.50-M89	No cracking, adhesion loss, or delamination
Heat stability	CGSB 37.50-M89	No change in viscosity, penetration, flow, or low temperature flexibility
Water resistance (5 days/50º C)	CGSB 37.50-M89	No delamination, blistering, emulsification, or deterioration
Salt water resistance (20% sodium carbonate and calcium chloride)	ASTM D896 similar	No delamination, blistering, emulsification, or deterioration
Fertilizer resistance (undiluted 15/5/5, nitrogen/phosphorus/potash)	ASTM D896 similar	No delamination, blistering, emulsification, or deterioration

2.1.3 Approved Products: The following products are conditionally approved pending performance to 1.3 Applicator Qualifications, and 1.9 Warranty of this section.

2.1.3.1 Hot fluid-applied rubberized asphalt waterproofing membrane:

2.1.3.1.1 Monolithic Membrane 6125 by American Hydrotech

2.1.3.1.2 TREMproof 6100 by TREMCO

2.1.3.1.3 790-11 Hot Rubberized Asphalt Waterproofing by Henry

2.1.3.2 Approved equals conforming to all requirements of this Section, including but not limited to: general requirements, physical properties, quality assurance, and warranty requirements.

2.1.4 Reinforced Membrane Waterproofing:

2.1.4.1 Hot rubberized asphalt

2.1.4.2 Reinforced membrane

2.1.4.2.1 Liquid membrane: Supplied to site as solid cakes meeting manufacturer's specifications and ready for melting.

2.1.4.2.2 Elastomeric reinforcing: Uncured neoprene, 60-mil thick, in uncut rolls for overall coverage of and bonding to the liquid membrane, meeting or exceeding the following physical properties using the test methods listed:

Physical Property	**Test Method**	**Minimum Requirement**
Tensile strength	ASTM D412, Die C	1305 psi
Tensile strength (70 hrs @ 212º F)	ASTM D412, Die C	1205 psi
Elongation	ASTM D412, Die C	200%
Elongation (70 hrs @ 212º F)	ASTM D412, Die C	125%
Tear resistance	ASTM D624, Die C	150 lbs/inch
Brittleness point	ASTM D2137	No break
Water absorption	ASTM D471	+10%

2.1.5 Accessory products:

2.1.5.1 Surface conditioner: As recommended by waterproofing manufacturer.

2.1.5.2 Elastomeric flashing: Uncured neoprene, 60 mil thick, in uncut rolls for overall coverage of and bonding to the liquid membrane, meeting or exceeding the following physical properties using the test methods listed above under “Elastomeric Reinforcing”.

2.1.5.3 Protection course: Semi-rigid, synthetic fiber-reinforced, asphalt impregnated sheet.

- Type 1: For horizontal use over field membrane as recommended by waterproofing manufacturer. (American Hydrotech Flex 30 or equivalent.)
- Type 2: For vertical use. PC-2 by W.R. Meadows in 4' x 8' sheets.
- Type 3: For use at waterproofed brick ledges and through-wall flashing, as recommended by waterproofing manufacturer. (American Hydrotech Flex 10 or equivalent.)

2.1.5.4 Joint and lap cement: Liquid membrane used for sealing laps and edges of the elastomeric reinforcing and elastomeric flashing.

2.1.6 All other membrane waterproofing:

2.1.6.1 Reinforced membrane

2.1.6.1.1 Liquid membrane: Primary waterproofing component of the system as recommended by the manufacturer for sprayed, troweled, or squeegee application.

2.1.6.1.2 Elastomeric reinforcing: A highly flexible sheet product, comparable to uncured 60 mil neoprene, as recommended by the waterproofing manufacturer which becomes integral to the system by being either bonded to or sandwiched within the liquid membrane component. The elastomeric reinforcing sheet must exhibit physical properties comparable to those of 2.1.4.1.a.2.

2.1.6.2 Accessory products

2.1.6.2.1 Surface conditioner: As recommended by waterproofing manufacturer.

2.1.6.2.2 Elastomeric flashing: A highly flexible 60 mil sheet product, comparable to uncured neoprene, as recommended by the waterproofing manufacturer, suitable for use at waterproofed brick ledges and through-wall flashing applications.

2.1.6.2.3 Protection course: A flexible or semi-rigid sheet as recommended by the waterproofing manufacturer that can be bonded to the membrane and offers protection from damage from subsequent work.

2.2 Cap Flashings: Use Fry Reglet Corporation, 24 gauge stainless steel, 6" high, surface mounted with sealant trough along upper edge, complete with stainless steel umbrella head fasteners with neoprene gaskets. Furnished prefabricated exterior and interior corner units. Such reglets shall be non-magnetic (nickel) stainless steel. Ferrous stainless steel is not acceptable.

2.2.1 Cap flashings are required where foundation waterproofing is exposed to sunlight (UV) above grade and shall cover the waterproofing entirely. All laps in the cap flashings shall be 2” minimum.

2.2.2 Typically, stainless steel base flashing is only required to cover and protect foundation waterproofing from UV sunlight degradation, where exposed above grade. Stainless steel flashing is not required where waterproofing is below grade and concealed by backfill.

2.3 Brick Ledge Flashing: 20 gauge stainless steel fabricated and attached per Drawings. (A/E to specify if required by this Project.)

2.4 Insulation: Close-cell extruded polystyrene foam board, thickness and compression strength as shown on the Drawings, Horizontal applications shall have a minimum compressive strength of 60 psi. The substitution of expanded polystyrene "beadboard" is not acceptable.

2.5 Bituminous Mastic Cement: Conform to Federal Specifications SS-C-15C, Type I.

2.6 Sealant: A two-component polyurethane sealant and primer conforming to Federal Specifications TT-S-00227E, Type II, Class A, such as MasterSeal NP-2" as manufactured by BASF, or "Dymeric 240FC", as manufactured by Temco. Sealant and primer application in accordance with Section 07 90 00 or other applicable Section.

2.7 Backer Rod: Reticulated, bi-cellular, non-gassing polyolefin backer rod that complies with ASTM C 1330, Type B such as “Sof Rod” as manufactured by Construction Foam Products, a division of Nomaco, Inc., Soft Type Backer Rod 104 manufactured by Industrial Thermo Polymers, or Sonolastic Soft Backer Rod by BASF.

2.8 Termination Bar: 1/16" thick by 1" high, type 304 stainless steel bar, with pre-drilled holes starting at 2" from each end and continue with a 6” on center spacing therein.

2.9 Anchors For Termination Bar: 1/4" diameter by 1 1/2" long, Zamac Nailin, (Stainless Steel Anchors with alloy body, ¼” diameter).

3 Execution

3.1 General: All Work performed under this Section shall be in accordance with the Specifications, Drawings and the manufacturer's instructions and recommendations. In the event of a conflict, the stricter requirement shall prevail.

3.1.1 Prior to onset of the waterproofing work, the waterproofing Applicator shall inspect the entire area to be waterproofed or through-wall flashed. Defects and improper conditions affecting installation shall be brought to the attention of the general Contractor, in writing, for correction before proceeding with the waterproofing work. The manufacturer’s representative shall be on site for the first two days of a new installation to ensure the waterproofing Applicator gets started properly. Manufacturer's representative shall be available, as needed, throughout the installation.

3.2 Weather Conditions: Do not proceed with waterproofing work during inclement weather, or when weather forecasts are unfavorable. Do not proceed with waterproofing for a minimum of 24 hours of drying time after the surface to be waterproofed has become completely wetted. If surface dryness remains in question, refer to Paragraphs 3.5.7 and 1.6 of this Section.

3.3 Protection: Protect all finish surfaces from damage resulting from spillage, dripping and dropping of materials. Prevent waterproofing materials from entering or clogging drains and water conductors. Repair and restore or replace other Work which is soiled or damaged in connection with performance of the waterproofing work.

3.4 Preparation of New Concrete and Masonry Surfaces: All new concrete and masonry surfaces on which the waterproofing is to be applied shall be air-dried cured for a minimum of 14 days or as recommended by the waterproofing manufacturer, whichever is longer, after forms have been stripped. All surfaces shall be thoroughly clean and additional drying shall be accomplished with torches, if necessary. All surfaces shall be dry, clean and free of other foreign materials detrimental to its performance. Any concrete form release agent or curing compound present shall be removed or approved to remain in writing by the waterproofing manufacturer.

3.4.1 Examine surface conditions of all substrates and adjoining construction to which the membrane is to be applied. Work shall not proceed until any unsatisfactory conditions detrimental to the proper and timely completion of the waterproofing work have been corrected.

3.4.2 Surface(s) shall be free of spalling, voids, loose material and projections, with no course aggregate exposed. Remove all oil, grease and other contaminants. Remove all dirt, dust and debris. Clean all expansion joints back a minimum of 1” from the surface of the joint in a manner acceptable to the waterproofing manufacturer.

3.4.3 Immediately report to the Owner’s representative and General Contractor in writing, any defects in the surface or any conditions which may adversely affect the performance of products installed under this section of work.

3.5 Preparation of Existing Concrete Surfaces: Following the complete removal of all existing subsurface materials, insulation, damproofing, waterproofing, sheet metal, etc., on the concrete surfaces in the designated areas, the surfaces shall be lightly sandblasted to remove all traces of any asphaltic materials and solvents used to remove the original material. Any concrete form work releasing agent present shall be removed unless given written approval to remain by the waterproofing manufacturer. After all existing materials that are to be removed have been removed, the concrete surfaces to which the waterproofing membrane is to be applied shall be examined for any conditions which will be detrimental to the proper and timely application of the membrane. Work shall not proceed until all surface conditions that are unsatisfactory are corrected to the satisfaction of the waterproofing membrane Applicator, as follows:

3.5.1 Repair or patch all concrete and masonry surface spalls, voids, and any honeycombed concrete. Use specified quickset mortar grout patching materials.

3.5.2 Remove all loose material, projections, and concrete fins or "flash" from form boards, leaving the surface uniform.

3.5.3 Remove all dust, dirt, and debris.

3.5.4 Remove all grease, oil, and other contaminants.

3.5.5 Thoroughly clean all expansion joints back one inch from the face of the joint.

3.5.6 Verify that all pipe and conduit penetrations are stable and secured for waterproofing.

3.5.7 Immediately report to the Owner's representative and General Contractor in writing, any defects in the surface or any conditions which may adversely affect the performance of products installed under this section of work.

3.5.8 After all existing surfaces have been examined, corrected, and found acceptable to the waterproofing membrane Applicator, the surfaces shall be thoroughly dried, using torches if necessary. All concrete and masonry surfaces shall be clean, dry, and primed prior to application of the waterproofing membrane; all other surfaces shall be clean and dry.

3.5.9 Tie-ins to existing waterproofing: Manufacturer's representative shall inspect the existing conditions and waterproofing for compatibility with the new. Apply 24" lap onto the existing per Manufacturer's recommendations, employing transition lab membranes as required.

3.6 Priming:

3.6.1 American Hydrotech 6125

3.6.1.1 Apply surface conditioner primer to the surface scheduled to receive the waterproofing, using a Hudson-type sprayer only at a rate of approximately one gallon of primer per 300-600 square feet. Allow to dry. The primed surface shall have 100% coverage and be tanned, but not dark brown or black. Primer shall dry until tack-free.

3.6.1.2 Apply primer to only the area which can be covered with liquid membrane that day. However, if the primed area is protected by tenting, etc., so that it remains clean, frost-free, dry, and free of other foreign materials, the primed area may be left three days before the liquid membrane application.

3.6.2 All other membrane waterproofing

3.6.2.1 Apply primer (if required by manufacturer) to the surfaces scheduled to receive the waterproofing in accordance with waterproofing manufacturer's recommendations.

3.7 Pre-detailing:

3.7.1 American Hydrotech 6125

3.7.1.1 General:

3.7.1.1.1 Install surface conditioner to substrate at all pre-detailing.

3.7.1.1.2 Pre-detailing shall be continuous and materials shall be fully adhered to one another.

3.7.1.2 Construction Joints and Cracks:

3.7.1.2.1 1/16" to 1/4": Sandwich a strip of elastomeric flashing between two 1/8", 125 mil thick (minimum) applications of liquid membrane. Extend the first application of liquid membrane and the elastomeric flashing minimum 3" on either side of the crack and extend the top application of liquid membrane 3" beyond the first two.

3.7.1.2.2 Over 1/4" wide (excluding expansion joints): Notify the Architect and Owner's representative for inspection and direction.

3.7.1.2.3 Inside/outside corners: Follow same procedures as described above (paragraph B.I) while centering detail on the corner.

3.7.1.2.4 Brick ledges and through-wall conditions: Embed a strip of elastomeric flashing into one 1/8", 125 mil thick (maximum) application of liquid membrane.

3.7.1.2.5 Pipe penetrations: Over a 1/8", 125 mil thick (minimum) application of liquid membrane, embed elastomeric flashing. One flashing piece shall be around the pipe and flange to the wall, and the other piece shall be on the wall and flange to the pipe. Wrap base of pipe with elastomeric flashing to seal flange from wall piece. Cover with another application of liquid membrane, 1/8", 125 mil thick (minimum), extending 3" past elastomeric flashing.

3.7.2 All other membrane waterproofing

3.7.2.1 General:

3.7.2.1.1 Install primer to substrate at all pre-detailing.

3.7.2.1.2 Pre-detailing shall be continuous and all materials shall be continuous and all materials shall be fully adhered to one another.

3.7.2.1.3 All pre-detailing listed under 3.7.1.2:

3.7.2.1.4 Pre-detailing shall be in accordance with the manufacturer approved shop drawings.

3.8 Membrane Application

3.8.1 Hot fluid-applied rubberized asphalt waterproofing membrane.

3.8.1.1 Liquid membrane melting: Melt cakes of liquid membrane in a melter, approved by the waterproofing manufacturer, under continuous agitation until the material can be drawn free-flowing and lump free at a temperature as recommended by the manufacturer.

3.8.1.2 Liquid membrane application: Over the entire are to be waterproofed, including all pre-detailing, apply the liquid membrane at a rate to provide a continuous initial coating of hot applied liquid membrane 90 mils thick over surface. Work in the liquid membrane by squeegee or brush while applying.

3.8.1.3 Elastomeric flashing: While the liquid membrane is still warm and tacky, fully adhere the 60 mil uncured neoprene elastomeric reinforcing into the entire area of liquid membrane, lapping the seams 6" and sealing laps and edges with liquid membrane.

3.8.1.4 Inspect the membrane surface for bulges, fishmouths, bubbles, and roll-over seams; which shall be cut back and repaired with additional coatings of liquid membrane, and an additional section of elastomeric flashing installed, lapping at least 6" beyond affected area. After entrapped air is relieved, set elastomeric flashing between layers of liquid membrane as described for crack repair. Comers shall be smooth, free of sharp edges with a smooth dense surface. Repairs shall be made immediately.

3.8.1.5 Apply the final continuous top coat of additional 90 mils of hot applied liquid membrane before embedding protection board.

3.8.2 All other membrane waterproofing

3.8.2.1 Membrane application: Install over entire area to be waterproofed, including all pre-detailing. Apply membrane with same mil thickness as under 3.8.1.2 and incorporate elastomeric reinforcing.

3.8.2.2 Inspect the membrane surface for bulges, fishmouths, tears, openings, or other deficiencies and repair immediately in accordance with manufacturer's recommendations.

3.9 Protection Course:

3.9.1 Installation: Install protection board as soon as possible after elastomeric reinforcing installation and final topcoat application of hot applied liquid membrane. Install protection board over the entire waterproofing membrane to provide continuous, uninterrupted protection. Extend the protection board 2" beyond the waterproofing membrane edges when possible. Lap boards 2" - 3" unless noted otherwise on the Drawings.

3.9.2 Adhesion: Field membrane (spot adhere the protection course). Vertical less than 3 feet (fully adhere the protection course). Brick ledges and through-wall details (fully adhere the protection course).

3.9.3 Plane changes: At corners or other plane changes exceeding 45 degrees, cut the protection board instead of bending for a tight fit and a sharp corner.

3.9.4 Ensure that debris and construction contaminants no not enter behind insulation and/or protection board that may damage or puncture the waterproofing membrane.

3.9.5 Cover installed waterproofing with protection board at the end of each day's work.

3.9.6 No damaging traffic or subsequent construction activities shall be permitted directly on the installed waterproofing and protection board until the permanent overburden is in place.

3.10 Construction Protection System

3.10.1 Install and maintain construction protection systems, such that construction activities cause no damage to the waterproofing system.

3.10.2 Owner's inspector shall be present at removal of construction protection system. Damage to waterproofing system will cause the waterproofing system to be non-conforming work, subject to removal and replacement.

3.11 Insulation: Do not deliver rigid insulation to the Project prior to time of its installation. Protect material during delivery, handling and installation from fire. As soon as practical after the installation of an area of rigid insulation work, protect the material with the other specified Work so that it will not remain exposed longer than necessary.

3.11.1 Do not install rigid insulation or protection board that has become wet or soiled, or covered with ice, frost or snow. Also protect the rigid insulation from exposure to high ambient temperatures, excessive exposure to sunlight or contact with hot surfaces and materials which are in excess of the safe temperature above the sublimation temperature indicated by the manufacturer. Do not install broken or damaged sheets of insulation; where possible use full-size sheets of insulation.

3.11.2 The membrane waterproofing Applicator shall examine all parts of the supporting substrate and the condition under which the rigid insulation work is to be performed, and notify the Contractor in writing of any conditions detrimental to the proper and timely completion of the rigid insulation work. Do not proceed with the installation until all conditions have been corrected in a manner acceptable to the membrane waterproofing Applicator.

3.11.3 Apply the insulation/protection board with staggered joints unless shown otherwise in the drawings. Extend insulation/protection board full thickness over the entire area to be covered. Cut and fit rigid insulation tightly around projections. Lap protection board joints 2-3 inches. Do not leave any voids.

3.12 Stainless Steel Cap Flashing; (Where waterproofing is exposed to sunlight above grade)

3.12.1 Over the membrane waterproofing along foundation walls at finish grade, install the stainless steel cap flashing vertical leg to cover the top edges of the waterproofing and insulation/protection board down approximately 6" below grade. Anchor the metal cap flashing securely in place in accordance with the manufacturer's directions. Lap joints tightly and set in a bed of sealant. Where possible, use through-wall flashings for the terminations at the top of the waterproofing of vertical walls. Apply as per Drawings.

3.12.2 Close and seal ends to maintain water-tightness and fill top trough with sealant to provide a water-tight, surface mounted cap flashing.

3.13 Field Quality Control:

3.13.1 General: Monitor the final layer installation and backfill operations to assure no damage is done to the waterproofing membrane. Alert all parties concerned of any activities which might adversely affect the performance of the waterproofing system.

3.13.2 Field Testing: Testing and all test reports shall be witnessed and confirmed in writing by the Owner's representative and the installer.

3.13.2.1 Conduct flood tests in areas no larger than 15,000 square feet.

3.13.2.2 Install temporary containment dams and plug drains. The top of the dams shall be 4" minimum.

3.13.2.3 Flood to a minimum 2" depth and maximum 4" depth.

3.13.2.4 Maintain flooded condition for a minimum of24 hours.

3.13.2.5 Drain water from test area.

3.13.2.6 Examine spaces below decks for signs of leakage.

3.13.2.7 Repair failures and repeat flood test. Make further repairs and flood test until waterproofing installation is watertight.

3.13.2.8 Install subsequent protection materials immediately after final test.

3.13.2.9 Provide written report of leak locations and identification of repair procedures.

4 Temporary Protection

4.1 If there are any delays in the Work, such that materials will not be properly protected because the specified sequence of Work will not be performed in a timely manner, the Contractor shall provide all necessary temporary protection and remove the temporary protection when the Work is resumed.

END SECTION

07 18 13 – Pedestrian Traffic Coatings

1. General: All pedestrian traffic coating materials and procedures shall be as per this section. No substitutions shall be allowed.

   1.1. Summary:

      1.1.1. This section includes the application of a cold fluid applied, polyurethane concrete deck waterproofing with non-slip aggregate surface that prevents the passage of water.

      1.1.2. This waterproofing is intended for pedestrian traffic only. It may be used as an exposed floor finish or may be used under thinset tile flooring. Refer to Drawings and details for specific locations.

      1.1.3. Mortar Toppings: The concrete deck substrate under the waterproofing membrane may require the application of mortar toppings to infill roughness, craters, and crevices in the concrete, or to provide slope to drain locations. Refer to Section 03 53 00 – Concrete Toppings for approved mortar toppings to use in these situations.

   1.2. Applicator Qualifications: The pedestrian traffic coatings work shall be performed by a single firm experienced and specialized in applying pedestrian traffic coatings, as shown and specified. The pedestrian traffic coatings installation firm shall be an approved and trained Applicator by the manufacturer. The field supervisor and the Project foreman for the pedestrian traffic coatings Applicator shall each have at least 3 years approved experience with the application of this waterproofing product.

   1.3. Submittals:

      1.3.1. Product Data (PD): Submit copies of the manufacturer's printed instructions for evaluating, preparing, and treating substrate; technical data; and tested physical and performance properties; and printed instructions for installation of pedestrian traffic coatings, including procedures and materials for flashing, splicing, and bonding.

      1.3.2. Submit a copy of the manufacturer's approval latter of the Applicator and indicate by transmittal form that copies of the Project Specifications and application instructions have been distributed to the pedestrian traffic coatings Applicator.

      1.3.3. Shop Drawings (SD): Submit shop drawings to indicate tie-in details to existing substrates, termination and non-typical details; show changes from horizontal to vertical elevation, and inside and outside corner applications. Shop drawings shall include a pedestrian traffic coatings protection plan. Provide descriptions and drawings of materials and methods to protect pedestrian traffic coatings system from damage by subsequent construction activities. Copies of the manufacturer's instructions, guidelines and shop drawings should be kept on site during installation for reference.

      1.3.4. Manufacturer's Review of Pedestrian Traffic Coatings System (SR): Before delivering pedestrian traffic coatings materials to the Project site, submit the following:

1.3.4.1. A written statement signed by the Contractor's pedestrian traffic coatings Applicator and manufacturer's representative stating that the A/E's Drawings and Specifications have been reviewed, and that they are in agreement that the selected materials and system for pedestrian traffic coatings are proper and adequate for the application shown. Indicate by transmittal form that a copy of this statement has also been distributed to the Owner.

1.3.4.2. A written approval of the condition(s) of the substrate(s) to proceed with the pedestrian traffic coatings, signed by the all of the following parties: manufacturer's representative, installing Applicator, and General Contractor.

1.3.4.3. Manufacturer's Approval of Moisture Content/Test Results: The manufacturer shall test the moisture content of each floor location scheduled for coatings, immediately prior to waterproofing, and shall submit the written approval of the moisture content of each of the substrates to the A/E based on the attached test results. Tests shall be made no sooner than 28 days after the installation of new concrete substrate, and no sooner than 6 days after the installation of topping mortar. The moisture tests shall comply with ASTM D4263, "Standard Test Method for Indicating Moisture in Concrete by the Plastic Sheet Method" or commonly referred to as the "Rubber Mat Moisture Test". Additional testing may be conducted, if desired, by the manufacturer. The Owner's representative(s) shall observe all moisture content testing, and the Contractor shall notify the Owner's representative(s) at least 5 days in advance of any testing.

1.3.4.4. If any portion of the floors scheduled to be waterproofed become wet after the testing and approval performed per Paragraph 1.3.4.3., but prior to waterproofing, then the moisture testing and approval procedures shall be repeated.

1.3.5. Submit MSDS information for all materials proposed for use for this specific Project.

1.3.6. Maintenance Data: Submit maintenance manuals which identify substrates and type of pedestrian traffic coatings system applied and including recommendations for periodic inspections, cleaning, care, maintenance, and repair of the pedestrian traffic coatings system.

1.4. Quality Assurance:

1.4.1. Specify a Pre-Installation Conference in accordance to Section 01 20 00 - Project Meetings. After completion of shop drawing review and upon completion of the 28 day cure of new concrete, 6 day cure of any mortar topping, and mechanical preparation (shot blasting) of the substrate, the pedestrian traffic coatings Applicator shall meet with the manufacturer's representative, Contractor, A/E, and Owner's representatives at the Project site to review the pedestrian traffic coatings procedures, acceptance of surfaces, minimum curing

periods, forecasted weather conditions, special details and sheet flashings and coordination of other trades. The Contractor shall provide notice to attendees prior to convening the Pre-Installation Conference as specified in Section 01 20 00 – Project Meetings. Review methods and procedures related to this coatings work, including, but not necessarily limited to the following:

1.4.1.1. Tour job site areas to receive pedestrian traffic coatings. Inspect and discuss conditions of substrate(s), existing conditions, drains, curbs, penetrations and other preparatory work performed by other trades. Review the field conditions for each item of Paragraph 1.6.3.

1.4.1.2. Review required submittals, both completed and yet to be completed.

1.4.1.3. Review the entire Specification, line item by line item.

1.4.1.4. Review and finalize the Construction Schedule related to pedestrian traffic coatings work and verify availability of materials, Applicator's personnel, equipment and facilities needed to make progress and avoid delays.

1.4.1.5. Review required inspections and testing.

1.4.1.6. Review manufacturer's guidelines with respect to weather conditions.

1.4.2. Each floor surface shall be inspected after all floor preparation is completed. Written approval of the prepared floor surface, signed by the pedestrian traffic coatings manufacturer's representative, the installing applicator, and the General Contractor, shall be submitted to and approved by the A/E prior to the pedestrian traffic coatings application.

1.4.3. Source Limitation: Obtain pedestrian traffic coatings materials through one source from a single manufacturer.

1.4.4. Mockups: The General Contractor shall prepare a separate concrete slab 9 sq. ft. (.84 sq. m) in area, displaying a typical, slab-to-wall joint/curb transition. Cure mockup slab 28 days, for the mockup pedestrian traffic coatings application. If mortar topping is required on the Project, then the Contractor shall apply topping and wet/dry cure for a minimum of 6 days. Apply topping as specified by Section 03 53 00 after concrete cure is completed. Mechanically abrade the substrate, prime and apply the pedestrian traffic coatings system to the mockup deck to demonstrate surface preparation, crack and joint treatment, corner treatment, thickness, texture, and execution quality. If A/E determines mockups do not comply with requirements, reapply pedestrian traffic coatings until mockups are approved. Mockup slabs shall be stored in areas to receive pedestrian traffic coatings in preparation for mockup application, and shall be retained for reference during the pedestrian traffic coatings application.

1.5. Delivery, Storage, and Handling:

1.5.1. Deliver all materials in original, unopened containers of packaging clearly labeled with manufacturer's name, brand name and type, shelf life, date of manufacture and all identifying numbers.

1.5.2. Store all materials for waterproofing work in accordance with the manufacturer's recommendations, as approved, and in accordance with the requirements herein specified. Store products away from sparks and open flames.

1.5.3. Remove and replace liquid materials that cannot be applied within their stated shelf life.

1.5.4. Remove all solvent soaked rags from the site or place them in proper containers to be removed from site at the end of each day.

1.5.5. Protect stored materials from direct sunlight.

1.6. Project/Site Condition:

1.6.1. Environmental Requirements: Do not apply pedestrian traffic coatings materials if ambient, materials, and/or substrate temperatures are outside the range of ambient temperatures recommended by the manufacturer. Temperatures shall be rising and stay above the minimum for the following 48 hours. All surfaces to receive the pedestrian traffic coatings shall be free of water, dew, frost, snow and ice. Do not apply pedestrian traffic coatings when the surface temperature is below 40°F (4°C) or above 90°F (32°C). Do not apply when temperatures are less than 5°F (3°C) above dew point or when weather rain, snow, fog, or mist can directly interfere with the application and curing period. Do not apply pedestrian traffic coatings until substrates have a moisture content approved by the manufacturer immediately prior to application, and the written approvals have been received and approved by the A/E.

1.6.2. Moisture Testing: The condition of "dry" substrate for the start of pedestrian traffic coatings application shall be determined by the ASTM D4263 moisture test method per Paragraph 1.3.4.3. The A/E or Owner's representative shall be notified at least 5 days in advance of any moisture content testing to observe the testing, and shall be advised in writing of the results of the manufacturer's moisture testing whenever a moisture test is completed and approved, prior to beginning pedestrian traffic coatings.

1.6.3. Inspect and identify existing substrate for conditions requiring special preparation:

1.6.3.1. Verify and discuss method of substrate preparation. Provide advice on the type of machinery required to mechanically shot blast, abrade, rout, grind, and prepare the substrates. Review the cleanup required upon completion of substrate preparation.

1.6.3.2. Metal projections, pipe penetrations, and drain perimeters shall be prepared and primed per Paragraph 3.3.

1.6.3.3. Cracks less than 1/16" wide per Paragraph 3.4.2.

1.6.3.4. Cracks between 1/16" and 1/8" wide per Paragraph 3.4.3.

1.6.3.5. Cracks greater than 1/8" wide per Paragraph 3.4.4.

1.6.3.6. Expansion joints per Paragraph 3.4.6.

1.6.3.7. Review defect projections such as fins, ridges, exposed aggregate, honeycombs, spalls, and granulations to be leveled and made smooth by grinding or by applying approved mortar toppings and their bonding agents as described in Section 03 53 00 – Concrete Toppings.

1.6.3.8. At terminations of pedestrian traffic coatings on flat substrates, verify the location of the ¼”x ¼” keyways to terminate coating per Paragraph 3.3.5.

1.6.3.9. At any existing polyurethane deck coatings being restored or tied into, manufacturer’s representative shall inspect the surface, determine compatibility, and recommend preparation of interface surface, including wire brushing, grinding, sandblasting, solvent washing, and priming necessary.

1.6.3.10. Upon completion of all substrate preparation work, provide written approval of the substrate as required by Paragraph 1.3.4.

1.6.4. Verify whether any fiberglass fiber reinforcing is present in the concrete substrate. If so, any fiber projections shall be burned off the substrate surface with a weed burner flame immediately after abrasion of the concrete surface and just prior to coatings application.

1.6.5. Verify locations of temporary closures at all openings to prevent contamination of pedestrian traffic coatings before, after, and during application, and to coordinate ventilation of area from adjacent, occupied areas. Remove temporary enclosures at completion of coatings application.

1.6.6. Plan and install adequate ventilation for process of application and curing.

1.7. Warranty:

1.7.1. Manufacturer’s and Applicator’s Joint Warranty: Submit to the A/E for transmittal to Owner, two (2) original copies of manufacturer’s standard warranty on all materials used on the Project for a period of five (5) years from the date of Substantial Completion.

1.7.2. Coatings Installation Warranty: Submit to the A/E for transmittal to the Owner two (2) original copies of a Coatings Installation Warranty. The Coatings Installation Warranty shall cover the complete pedestrian traffic coatings installation and any defects in the installation because of materials or workmanship, regardless of any previous inspections and approvals of the installation by the Owner’s representative, and shall be properly corrected during the warranty period at no cost to the A/E or the Owner. Upon written notification within the warranty period of any such defects, the necessary repairs and replacement shall be properly made at the convenience of the Owner.

2. Products:

2.1 Pedestrian Traffic Coatings Products:

2.1.1. Products: Subject to compliance with requirements, provide products by one of the following manufacturers:

2.1.1.1. “Vulkem 350 Base Coat / 351 Top Coat” by Nameco/Vulkem/Tremco International, Inc.

2.1.1.2. “MasterSeal Traffic 2500 by BASF

2.1.2. Physical Requirements: Provide pedestrian traffic coatings complying with ASTM C957, ASTM D412, and ASTM D2240.

2.1.3. Material Compatibility: Provide primers, sealants, detail coat material, vertical application material, base coat material, top coat material, and miscellaneous materials that are compatible with one another and with substrate under conditions of service and application, as demonstrated by the manufacturer based on testing and field experience.

2.1.4. Primer: Manufacturer’s standard factory formulated primer recommended for substrate and conditions indicated. Primer shall be applied to each substrate.

2.1.4.1. Vulkem: Primers #171, #181, and #191

2.1.4.2. MasterSeal P 173, P 220, P122

2.1.5. Sealant: Manufacturer’s recommended two-part polyurethane sealant and primer proven by the manufacturer to be compatible with their deck coating.

2.1.5.1. Vulkem: Vulkem Two-Part; Tremco Dymeric and Primer #1, Primer #6, and 200 Cleaner.

2.1.5.2. MasterSeal NP2 and Primer MasterSeal P 173.

2.1.6. Detail Coats: Single component, slightly thixotropic, aromatic liquid polyurethane coating for liquid applied flashings, particularly on vertical transitions or slopes.

2.1.6.1. Vulkem 350 Base Coat: 30 wet mil thickness minimum; 35 wet mil max.

2.1.6.2. MasterSeal M 200 Base Coat: 25 wet mil thickness minimum; 35 wet mil max.

2.1.7. Base Coat: Single component, slightly thixotropic, aromatic liquid polyurethane elastomeric waterproofing. Apply minimum wet mil thickness of the Base Coat recommended by the manufacturer as follows:

2.1.7.1. Vulkem 350 Base Coat: 30 wet mil thickness minimum; 35 wet mil max.

2.1.7.2. MasterSeal M 200 Base Coat: 25 wet mil thickness minimum; 35 wet mil max.

2.1.8. Intermediate Coat: Single component, slightly thixotropic, aromatic liquid polyurethane elastomeric waterproofing. Apply minimum wet mil thickness of the intermediate coat of “Base Coat” material as recommended by the

manufacturer as follows: (Eliminate this step if waterproofing is used under ceramic floor tile.)

2.1.8.1. Vulkem 350 Base Coat as Intermediate Coat: 20 wet mil thickness minimum; 35 wet mil maximum.

2.1.8.2. MasterSeal M 200 Base Coat as Intermediate Coat: 20 wet mil thickness minimum; 35 wet mil maximum.

2.1.9. Top Coat: Single component, aliphatic liquid polyurethane elastomeric waterproofing. Apply minimum wet mil thickness of the topcoat recommended by the manufacturer as follows:

2.1.9.1. Vulkem 351 Top Coat: 20 wet mil thickness minimum with aggregate; 35 wet mil maximum.

2.1.9.2. MasterSeal TC 225 Top Coat: 20 wet mil thickness minimum with aggregate; 35 wet mil maximum.

2.1.10. Vertical Coat Applications: Single component, aliphatic liquid polyurethane elastomeric waterproofing. Apply minimum wet mil thicknesses of the base coat and top coat recommended by the manufacturer as follows:

2.1.10.1. Vulkem 350 Base Coat for Vertical Application: three layers of 10 wet mil thickness minimum; Vulkem 351 Top Coat: two layers of 10 wet mil maximum with aggregate.

2.1.10.2. MasterSeal Base Coat for Vertical Application: three layers of 10 wet mil thickness minimum; MasterSeal Top Coat: two layers of 10 wet mil maximum with aggregate.

2.1.11. Aggregate: Uniformly graded, washed silica sand composed of clean grit particles at least 6.5 on the MOH's scale of hardness, 80% in the 25-40 mesh size and no more than 2% fines passing a 70 mesh screen. The aggregate shall contain no more than 0.5% iron oxide. Aggregate shall be approved in writing from manufacturer.

2.1.11.1. Spreading Rate: As recommended by manufacturer for substrate and service conditions indicated, by not less than 10 to 20 lb/100 sq. ft. (4 to 12kg/10sq. m.).

2.1.11.2. Aggregate shall be applied to the wet Top Coat, and shall be back rolled into the coating.

2.1.11.3. Contractor shall apply a sample area at the initial application for approval of the texture by the A/E and the Owner.

2.2. Miscellaneous Materials:

2.2.1. Joint Sealant: Two-part component polyurethane sealant and primer recommended by manufacturer for substrate and joint conditions indicated and for compatibility with waterproofing coatings; complying with ASTM C920. Type M, Class 25, Grade NS for sloping and vertical applications or Grade P for deck applications, and use T where subject to traffic or use NT elsewhere.

2.2.2. Reinforcing Strip: Manufacturer's recommended mesh reinforcement embedded in the Base Coat application. MasterSeal 995 Reinforcing Fabric by BASF.

2.2.3. Backer Rod: Reticulated, bi-cellular, non-gassing polyolefin backer rod that complies with ASTM C 1330, Type B such as "Sof Rod" as manufactured by Construction Foam Products, a division of Nomaco, Inc., Soft Type Backer Rod as manufactured by ITP, or Sonolastic Soft Backer Rod by BASF.

2.2.4. Galvanized Sheet Metal: For use in creating waterproofed dams around large pipe or duct penetrations in the floor deck. 20 gauge sheet metal.

3. Execution:

3.1. General:

3.1.1. All Work performed under this Section shall be in accordance with the Specifications, Drawings, and the manufacturer's instructions and recommendations. In the event of a conflict, the stricter requirement shall prevail.

3.1.2. Prior to onset of coatings work, the pedestrian traffic coatings Applicator shall inspect the entire area to be coated for compliance with requirements and other conditions affecting performance.

3.1.2.1. Verify that concrete has cured and aged for minimum of 28 days, and that mortar toppings have then cured and aged for minimum of 6 additional days, as recommended by the pedestrian traffic coatings manufacturer, prior to moisture content testing.

3.1.2.2. Identify equipment pads for waterproofing at mechanical equipment rooms. Coordinate waterproofing application over and around pads prior to the installation of the equipment.

3.1.2.3. Verify that substrate(s) are visibly dry and free of moisture. Test for capillary moisture in the substrate(s) using test submitted by manufacturer per paragraph 1.3.4.3. The A/E shall provide approval of written copy of moisture test report before proceeding with coatings work.

3.1.2.4. Inspect substrate for surface imperfections. Proceed with installation only after unsatisfactory conditions have been corrected.

3.1.2.5. Provide letter of acceptance of the substrate to the A/E prior to beginning the work of this Specification per paragraph 1.3.4.2.

3.1.2.6. Provide temporary protection of existing conditions, work in progress and work in place as described in the shop drawing's construction protection plan. Provide for adequate ventilation.

3.1.2.7. Protect all finish surfaces from damage resulting from spillage, dripping, and dropping of materials. Prevent coating materials from entering or clogging drains and water conductors. Repair and restore

or replace other Work, which is soiled or damaged in connection with performance of the coating work.

3.1.2.8. If floor becomes wet after prior approvals to proceed, then repeat test procedures per paragraph 1.3.4.3 before proceeding.

3.2. Preparation of Concrete, Mortar Toppings, and Masonry Surfaces:

3.2.1. If possible, coordinate with General Contractor prior to pouring the concrete or mortar topping substrate, provide reglet recesses in the concrete substrate in which to apply sealant coves at corner transitions, such as at slab intersections with walls or around mechanical curb perimeters, so that the finish application is flush. Refer to Drawings.

3.2.2. All new concrete and masonry surfaces on which pedestrian traffic coatings are to be applied shall have been air dried for a minimum of 28 days after forms have been stripped prior to any mortar topping installation. All mortar toppings shall wet cure for a minimum of 3 days and air dry for another minimum of 3 days before moisture content testing of the substrates for the pedestrian traffic coatings application. All surfaces shall be dry, clean and free of other foreign matter detrimental to performance.

3.2.3. Apply bonding agents and mortar toppings as required to infill cavities or provide slope to drain as indicated on the Drawings, after substrate is approved and surface prep is completed. When infilling large areas abutting vertical wall surfaces, tool the mortar topping with an edging tool or install form for a reglet recess to accommodate the perimeter sealant application. Install mortar topping per Section 03 53 00.

3.2.4. Mechanically abrade the substrate surfaces in a uniform manner by shot blasting or other method recommended and approved by manufacturer.

3.2.5. Burn off any fiberglass fibers embedded in the concrete substrate using a weed burner.

3.2.6. Surface shall be free of spalling, voids, loose material and projections, with no course aggregate exposed. Remove all oil grease, dirt, dust and debris and other contaminants.

3.2.7. Mask off adjoining surfaces not receiving pedestrian traffic coatings to prevent spillage or over-application affecting other construction.

3.3. Preparation at Terminations and Penetrations:

3.3.1. Prepare vertical and horizontal surfaces at terminations and penetrations through pedestrian traffic coatings and at expansion joints, drains, and sleeves according to ASTM C898 and manufacturer's written instructions. Wire brush and/or sandpaper all metal surfaces to be coated to a clean, shiny surface. Vacuum areas and wipe metal surfaces clean.

3.3.2. Prime substrate as instructed by pedestrian traffic coatings manufacturer.

3.3.3. Apply sealant in fills and perimeter seals as recommended by the manufacturer. Provide sealant cants around penetrations and at inside corners of deck to wall

butt joints when recommended by pedestrian traffic coatings manufacturer. Allow all sealant applications to cure a minimum of 16 hours.

3.3.4. Prime and apply a Detail Coat of pedestrian traffic coating and embed a joint reinforcing strip in Detail Coat when recommended by the pedestrian traffic coating manufacturer, and extend Detail Coat for the full height of any vertical application (10 mil). Allow Detail Coat to cure for 24 hours.

3.3.5. At terminations of pedestrian traffic coatings areas on flat substrates: Route a ¼"x ¼" keyway straight across flat surface, in which to terminate coating.

3.4. Joint and Crack Treatment:

3.4.1. Prepare, treat, rout, and fill joints and cracks in substrate according to ASTM C898 and the manufacturer's written instructions. Remove dust and dirt from joints and cracks complying with ASTM D4258 before coating surfaces.

3.4.2. Cracks less than 1/16" wide:

3.4.2.1. Prime and apply Detail Coat a minimum of 6 inches (150 mm) wide, 3 inches (75 mm) along each side of joint or crack, and extend Detail Coat for the full height of any vertical application (10 mil). Embed a joint reinforcing strip in the wet Detail Coat if recommended by manufacturer. Allow all Detail Coats to cure for minimum 24 hours.

3.4.2.2. Feather terminating edge of Detail Coat to avoid edges from showing through the finished coating.

3.4.3. Cracks between 1/16" and 1/8" wide:

3.4.3.1. Prime, fill with sealant, and tool flush with putty knife. Allow sealant to cure a minimum of 16 hours.

3.4.3.2. Prime and apply a Detail Coat a minimum of 6 inches (150 mm) wide, 3 inches (75 mm) along each side of joint or crack, and extend Detail Coat for the full height of any vertical application (10 mil).

3.4.3.3. Embed a joint reinforcing strip in the wet Detail Coat if recommended by manufacturer.

3.4.3.4. Allow all Detail Coats to cure for minimum 24 hours.

3.4.3.5. Feather terminating edge of Detail Coat to avoid edges from showing through the finished coating.

3.4.4. Cracks greater than 1/8" wide in any length of the crack:

3.4.4.1. Mechanically rout out joint to 3/8" wide and ½" deep, and vacuum clean the joint.

3.4.4.2. Comply with ASTM C1193 for joint sealant installation.

3.4.4.3. Prime substrate within joint.

3.4.4.4. Apply bond breaker or non-gassing backer rod between sealant and bottom of joint.

3.4.4.5. Apply sealant within joint, per manufacturer's instructions, and tool flush at surface. Sealant shall cure for minimum 16 hours.

3.4.4.6. Prime and apply Detail Coat a minimum of 6 inches (150 mm) wide, 3 inches (75 mm) along each side of joint or crack, and extend Detail Coat for the full height of any vertical application (10 mil). Embed a joint reinforcing strip in the wet Detail Coat if recommended by manufacturer. Allow all Detail Coats to cure for minimum 24 hours.

3.4.4.7. Feather terminating edge of Detail Coat to avoid edges from showing through the finished coating.

3.4.5. Cants at inside corners, curbs to floors, walls to floors, wall to wall:

3.4.5.1. Sweep, vacuum and clean joints.

3.4.5.2. Comply with ASTM C1193 for joint sealant installation.

3.4.5.3. Prime substrate within joint.

3.4.5.4. Apply bond breaker or non-gassing backer rod between sealant and bottom of joint.

3.4.5.5. Apply sealant within joint, per manufacturer's instructions, and tool flush at surface. Sealant shall cure for minimum 16 hours.

3.4.5.6. Prime and apply Detail Coat a minimum of 6 inches (150 mm) wide, 3 inches (75 mm) along each side of joint or crack, and extend Detail Coat for the full height of any vertical application (10 mil). Embed a joint reinforcing strip in the wet Detail Coat if recommended by manufacturer. Allow all Detail Coats to cure for minimum 24 hours.

3.4.5.7. Feather terminating edge of Detail Coat to avoid edges from showing through the finished coating.

3.4.6. Expansion joints: Do not apply pedestrian traffic coatings coats across true expansion joints. Terminate on each side and seal to expansion joint seal according to manufacturer's recommendations for sealing expansion joints.

3.5. Waterproof Top Coat Application:

3.5.1. Apply each top coat of waterproof coating according to ASTM C898 and manufacturer's written instructions.

3.5.2. Start installing waterproof top coating in presence of manufacturer's technical representative.

3.5.3. Apply primer over prepared substrate.

3.5.4. Mix materials and apply waterproofing top coat by roller, notched squeegee, trowel, or other application method suitable to slope of substrate.

3.5.5. Apply Base Coat to obtain a seamless membrane free of entrapped gases, with a minimum/maximum wet film thickness as noted in Paragraphs 2.1.7 and 2.1.10 above. Allow Base Coat to cure 24 hours. Check for surface tack.

3.5.6. Base Coat and Intermediate Coat shall each have a slight surface tack to aid in adhesion of the next coating. Coating shall not debond from premature curing. If the Base or Intermediate Coat has cured longer than 24 hours and has no tack, then the surface shall be cleaned with a cloth dampened with Xylene or Xylol, and then primed with waterproofing primer. DO NOT SATURATE THE WATERPROOF COATING SURFACES WITH SOLVENT.

3.5.7. Apply Intermediate Coat in seamless membrane free of entrapped gases, with a minimum/maximum wet film thickness per Paragraphs 2.1.8 and 2.1.10. Allow Intermediate Coat to cure for 24 hours. Check for surface tack (see previous paragraph). (*Eliminate this step if waterproofing is used under ceramic floor tile*.)

3.5.8. Apply initial Top Coat at vertical surfaces only per Paragraph 2.1.10 (10 mil).

3.5.9. Upon completion of previous Paragraph 3.5.8, apply Top Coat of waterproofing in seamless membrane free of entrapped gases, with a minimum/maximum wet film thickness per Paragraphs 2.1.9 and 2.1.10.

3.5.10. Immediately broadcast sand grit aggregate into the wet horizontal and vertical Top Coat at a rate to comply with 2.1.11. Immediately back-roll the surface to fully coat and imbed aggregate particles as the coating is applied.

3.5.11. The A/E or the Owner shall view and approve the finish texture of the aggregate application after the first 100 square feet are applied, and shall compare to the mockup sample.

3.5.12. Apply all waterproofing coatings up vertical pipe penetrations and vertical wall surfaces at transitions to horizontal surfaces. Cove waterproof coating a minimum 6 inches up vertical surfaces. End waterproofing in a straight horizontal line.

3.5.13. Verify wet film thickness of waterproofing on each coat every 100 sq. ft. (9.3 sq. m.).

3.5.14. Allow finished waterproofing application to cure 24 hours before allowing any traffic or work over its surface.

3.6. Field Quality Control:

3.6.1. Periodically check waterproofing layers for any indication of bubbling or trapped air or excess moisture during its application and cure. Any bubbling shall be corrected according to the manufacturer's recommendations prior to any further application of coatings.

3.6.2. Where ceramic tile is applied over waterproofing material, verify that the aggregate finish in the final top coat is applied at the specified rate and is not coated over with the top coat to an extent that smooth, shiny areas develop in the finish. The aggregate roughness is required to develop physical bond with the tile setting bed.

3.6.3. Flood Testing: Prior to testing, verify live load capacity of floor deck to carry ponding water with the Structural Engineer. Test shall be performed at the

Owner's discretion. The Contractor shall construct all watertight dams and shall perform the flood testing. Flood test each deck area for leaks, according to recommendations in ASTM D5957, after completing waterproofing, but before overlying construction is placed. Install temporary containment assemblies, plug or dam drains, and flood with potable water. The Contractor shall repair all damages, or replace damaged materials, as a result of flood testing failures or leakages, at no additional cost to the Owner.

3.6.3.1. Flood to an average depth of 2 ½ inches (65 mm) with a minimum depth of 1 inch (25 mm) and not exceeding a depth of 4 inches (100 mm). Maintain 2 inches (50 mm) of clearance from top of sheet flashings.

3.6.3.2. Flood each area for 48 hours.

3.6.3.3. After flood testing, repair leaks, repeat flood tests, and make further repairs according to the manufacturer's instructions until waterproofing installation is watertight.

3.6.4. The Owner will engage an independent inspection consultant to perform construction observation during installation of all coatings work. The Consultant will observe conditions under which the coatings are installed, observe flood testing, if performed, and observe underside of decks and terminations for evidence of leaks during such flood testing. Notify the inspection consultant per requirements listed in paragraph 1.3.4.3., at least 5 days prior to applications, and coordinate schedule.

3.7. Curing, Protecting, and Cleaning:

3.7.1. Cure coatings according to manufacturer's written recommendations, taking care to prevent contamination and damage during application stages and curing.

3.7.2. Protect coatings from damage and wear during remainder of construction period.

3.7.3. Clean spillage and soiling from adjacent construction using cleaning agents and procedures recommended by manufacturer of affected construction.

END SECTION

SECTION 07 27 00 – Fluid Applied Membrane Air/Moisture Barrier

The whole building air/moisture barrier is a combination of materials and other building envelope sub-components integrated to create an air and moisture tight system. This is an example based on a Minnesota State complaint wall system in which the subject air/moisture barrier is located directly on the back-up wall, inboard of the thermal insulation located within the cavity. This example specification may have to be modified based on specific project requirements or changes or refinements to building codes or materials.

1. GENERAL

1.1 SUMMARY

1.1.1. The building envelope shall contain a continuous air/moisture barrier consisting of a material or a combination of materials to resist the passage of air into or out of the conditioned or semi conditioned space.

1.1.2. The building envelope shall contain a continuous and durable air/moisture barrier consisting of a material or a combination of materials to resist the passage of any moisture into the back-up wall, intentional or unintentionally, through the exterior cladding and exterior sealant joints.

1.1.2.1. The air/moisture barrier shall be integrated, air and watertight, with all other exterior envelope components (below grade waterproofing, curtain walls, windows, roofs, louvers, flashings) to redirect any moisture that accumulates behind the cladding back to the exterior and to establish and maintain the integrity and continuity of the whole building air barrier strategy.

1.1.3. The air/moisture barrier and thermal insulation shall be positioned within the wall assembly and have physical properties so that moisture dissipates and subsequent moisture from weather or occupancy does not accumulate on any back-up walls or interior conditioned spaces.

1.1.4. Materials to bridge and seal the following air/moisture leakage pathways and gaps:

1.1.4.1. Connections of the walls to the roof vapor barrier and/or membrane.

1.1.4.2. Connections of the walls to the foundation waterproofing.

1.1.4.3. Wall expansion and control joints.

1.1.4.4. Wall openings and penetrations of window frames, storefront, curtain walls, louvers, and doors.

1.1.4.5. Wall penetrations: piping, conduit, duct and similar penetrations.

1.1.4.6. Masonry ties, screws, bolts and similar penetrations.

1.1.4.7. All other air leakage pathways in the building envelope.

1.2 RELATED SECTIONS

1.2.1. Section 03 30 00 – Cast-in-Place Concrete

1.2.2. Section 04 20 00 – Masonry and Stone

1.2.3. Section 07 13 00 – Below-Grade Membrane Waterproofing

1.2.4. Section 07 21 00 – Thermal Insulation

1.2.5. Section 07 25 00 – Weather Resistive Barriers (if applicable)

1.2.6. Section 07 51 00 - Built-Up Bituminous Roofing

1.2.7. Section 07 60 00 – Sheet Metal & Cladding (if applicable)

1.2.8. Section 08 44 13 – Glazed Curtain Walls

1.2.9. Section 08 51 13 – Aluminum Windows

1.3 PERFORMANCE CRITERIA

1.3.1. Material Performance: Provide air barrier materials to conform to the State Energy Code with an air permeance not to exceed 0.004 cubic feet per minute per square foot under a pressure differential of 1.57 pounds per square foot (0.004 cfm/ft2 @ 1.57 psf), when tested in accordance with ASTM E2178 (unmodified).

1.3.2. Assembly Performance: Provide a continuous air barrier in the form of an assembly that has an air leakage rate not to exceed 0.04 cubic feet per minute per square foot under a pressure differential of 1.57 pounds per square foot (0.04 cfm/ft2 @ 1.57 psf) when tested in accordance with ASTM E2357. The assembly shall accommodate movements of building materials by providing expansion and control joints as required. Expansion / control joints, changes in substrate and perimeter conditions shall utilize appropriate accessory materials.

1.3.3. Vapor Permeance: The water vapor permeance shall be determined in accordance with ASTM E96 and shall be declared by the material Manufacturer.

1.3.3.1. The A/E shall determine the proper water vapor permeance requirements to satisfy code and project specific needs.

1.3.3.2. If both permeable and impermeable air barriers are to be used in a project, the A/E shall clearly indicate in both the drawings and specifications where the products are to be used.

1.3.4. Adhesion Performance: The membrane shall be fully adhered to the substrate without voids, pinholes, or blisters.

1.3.4.1. Capable of withstanding combined design wind, fan and stack pressures, both positive and negative on the envelope without damage or displacement, and shall transfer the load to the structure. Fluid applied air barriers shall not displace adjacent materials in the air barrier assembly under full load.

1.3.4.2. The air/moisture barrier assembly shall be joined in an air and watertight and flexible manner to the air barrier materials of adjacent assemblies, allowing for the relative movement of assemblies due to thermal and moisture variations and creep.

1.3.4.3. Adhesion rates as stated by the material manufacturer depending on the substrate and tested per ASTM D4541.

1.3.4.4. If other critical building envelope components adhere/seal directly to the air barrier/transition membrane and rely on this adhesion to provide long term performance. The A/E shall specify the minimum adhesion value required to enable the assembly to function properly.

1.3.5. The air barrier must be durable to withstand the construction process and UV stable for the anticipated time that it will be exposed.

1.3.6. Fire, Flame and Smoke Properties: To be determined and edited by the A/E. The A/E shall specify materials and their installation/performance requirements as required to comply with building code:

1.3.6.1. NFPA 285 "*Standard Fire Test Method for Evaluation of Fire Propagation Characteristics of Exterior Non-Load Bearing Wall Assemblies Containing Combustible Components*" (coordinated with other specification sections)

1.3.6.2. ASTM E 119 "*Standard Test Methods for Fire Tests of Building Construction and Materials*"

1.3.6.3. ASTM E 84 "*Standard Test Method for Surface Burning Characteristics of Building Materials*"

1.3.6.4. NFPA 268 "*Standard Test Method for Determining Ignitibility of Exterior Wall Assemblies Using a Radiant Heat Energy Source*"

1.3.7. Compatibility Properties: The wall air/moisture barrier will come into direct contact with various substrates and other exterior building enclosure assemblies to create an air and moisture tight system. All intersecting materials (sealants and transition membranes) shall be compatible and fully bonded to its substrate.

1.4 QUALITY ASSURANCE

1.4.1. Manufacturers Qualifications:

1.4.1.1. Manufacturer that has produced fluid applied air/moisture barriers available and marketed for their intended use in the last 5 years.

1.4.1.2. Manufacture that produces primary materials and regularly engaged in manufacturing specified fluid-applied membranes. Secondary materials from a source acceptable to the primary materials Manufacturer.

1.4.1.3. Manufacturer that has a trained and experienced local technical support staff available to supply on-site technical assistance within 24 hours.

1.4.1.3.1. Manufacturer technical representative trained and familiar with the specified testing methods.

1.4.2. Contractor Qualifications:

1.4.2.1. A company experienced in applying fluid applied air/moisture barrier materials similar in material, design, and extent to those indicated for this Project, whose work has resulted in applications with a record of successful in-service performance in the last 5 years.

1.4.2.2. A company approved to install the specified fluid applied air/moisture barrier with an on-site lead installer familiar and thoroughly trained by the specified Manufacturer.

1.4.2.3. Use adequate number of skilled workers who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the Work of this Section.

1.4.2.4. A company approved to install the specified with an on-site lead installer familiar and trained by the specified air/moisture barrier manufacturer.

1.4.2.5. The installer shall have on-site and continuously test the thickness of material as it is being applied with a wet mil gauge.

1.4.2.6. If requested, supply AIA Document A305, Contractor's Qualification Statement including written evidence of a satisfactory experience record with work of this type and scope. If requested, provide five references for projects of a size exceeding 75 percent of the area included in this Project that are at least five years old. These references shall include project schedules, including bid date, start and completion dates, Owner and/or A/E contacts including names, addresses and telephone numbers, and the specific products/systems installed on each referenced project

1.4.3. Administration Submittals:

1.4.3.1. Letter from the Manufacturer certifying that they meet the Manufacturer Qualification requirements including the name and contact information of the local technical representative.

1.4.3.2. Letter from the Manufacturer certifying that the Contractor and Lead Installer is approved by the Manufacturer and have been thoroughly trained and meet the Contractor Qualification Requirements.

1.4.4. Performance Criteria Submittals

1.4.4.1. Material and assembly performance data sheets and testing results showing compliance with the air resistive Performance Criteria specified.

1.4.4.2. Material data sheets and testing results showing compliance with the air barrier's vapor permeance Performance Criteria properties specified.

1.4.4.3. Material data sheets and Manufacturers acceptable adhesion criteria for each membrane (liquid applied membrane and transition membranes) for the various project specific substrates in which the material will be bonded against.

1.4.4.4. Material data sheets and testing results showing compliance with Fire, Flame and Smoke Performance Criteria properties specified. Contractor shall submittal with other exterior enclosure manufacturers for assembly tests requirements.

1.4.4.5. Submit letter from primary material Manufacturer stating that materials proposed for use are permanently chemically compatible and adhesively compatible with adjacent materials proposed for use.

1.4.4.5.1. Compatibility and adhesion testing shall be performed early in the construction process.

1.4.4.5.2. Contractor and Manufacturer will be required to coordinate with other trades and other Manufactures to supply and verify compatibility.

1.4.5. Material and System Installation Submittals

1.4.4.1. Product and technical data sheets for all materials, transition membranes, sealants, termination mastics and other accessories.

1.4.4.2. Include manufacturer's written instructions for evaluating, preparing, and treating each substrate that will receive the air/moisture barrier. Submit letter from Manufacturer stating that cleaning materials used during installation are chemically compatible with adjacent materials proposed for use.

1.4.4.3. Include manufacturer's written instructions for the installation of the air/moisture barrier and all accessories.

1.4.4.4. Include manufacture's wet and dry film thickness requirements and contractor testing frequency requirements.

1.4.4.5. Include VOC content of each material, and applicable legal limit in the jurisdiction of the project.

1.4.4.6. Include manufacturer's approved repair material and written instructions for preparing, treating and repairing the membrane where other trades may penetrate it with post installed anchors after installation. Regardless of Manufacturer claims, the air/moisture

barrier shall be considered “not self-sealing/healing” and all penetrations shall be sealed air and watertight.

1.4.4.6.1. If the air barrier installer will not be sealing post installed penetrations/anchors created by others, then those contractors shall be trained on-site by the air barrier installer and Manufacturer to perform these auxiliary repairs in accordance with the Manufactures approved repair mythology.

1.4.4.6.2. It shall be the Contractors responsible to coordinate the training between trades and to ensure the repairs are performed in accordance with the Manufactures written instructions.

1.4.5. Shop Drawing Submittal

1.4.5.1. Show locations and extent of air-barrier materials, accessories, and assemblies specific to project conditions coordinated with other trades.

1.4.5.2. Include details for project specific substrate joints and cracks, control and expansion joints, counterflashing strips, inside and outside corners, window and door wraps, terminations, tie-ins with adjoining construction, miscellaneous penetrations, electric boxes, post installed anchors and similar items.

1.4.5.3. Include details installation method at all types of wall openings in which the transition membrane will extend into the wall return, such as windows, louvers, and doors. Detail and identify the type of compatible sealant/ mastic used to seal the splice joints located within the return.

1.4.5.4. Include details where the membrane will not wrap into the opening (curtain walls) and how this return is protected.

1.4.5.5. Building expansion joint detail shall include the size of the joint’s anticipated movement, as supplied by the A/E, and the materials and installation methods required to accommodate such movement.

1.4.5.6. Consult air barrier manufacturer for additional installation guidelines illustrations to assist with meeting shop drawing requirements

1.4.3. Samples:

1.4.3.1. Submit clearly labeled samples, three (3) inch by four (4) inch minimum size of each material specified.

1.4.3.2. Contractor shall coordinate and supply any other trades/manufacturers with physical samples in which their material will come into direct contact with the air barrier to obtain chemical and adhesive compatibility testing and certification early in the project.

1.4.4. Pre-Installation Meeting:

1.4.4.1. Air/moisture barrier Pre-Installation meeting and mock-up shall be an integrated exterior envelope meeting including waterproofing, masonry, through wall flashing. Refer to section 04 20 00 for additional requirements.

1.4.4.2. Convene a minimum of two weeks prior to commencing Work of this Section. All submittals, compatibility testing and shop drawings shall be submitted and approved prior to the meeting.

1.4.4.3. Agenda for air/moisture barrier shall include, at a minimum, construction and testing of mock-up, sequence of construction, coordination with substrate preparation, air barrier materials approved for use, compatibility of materials, shop drawings, coordination with installation of adjacent and covering materials, and details of construction and chemical/fire safety plans.

1.4.4.4. Attendance is required by: Manufacturer Technical Representative, General Contractor, Installer, Lead Mechanic, Consultant, Architect and representatives of related trades including covering materials, substrate materials and adjacent materials.

1.4.5. Mock-Up:

1.4.5.1. Refer to section 04 20 00 & 07 13 00 for integrated masonry and waterproofing mock-up for additional requirements. **(A/E shall coordinate the requirements of this mock-up in other related sections.)**

1.4.5.2. Mock-up and dimensions and wall configuration, including window/curtain wall opening of mock-up as specified in section 04 20 00 and on the Contract Drawings.

1.4.5.3. Include typical air/moisture barrier sealing/flashing around penetrations such as plumbing and electrical penetration within the wall located above the elevation of the through-wall flashing.

1.4.5.4. Include air/moisture barrier sealing around built-in ladder type masonry and post installed masonry ties.

1.4.5.5. Include air/moisture barrier transition between waterproofing and air barrier.

1.4.5.6. Include air/moisture barrier transition between roof and roof vapor barrier if present in mock-up.

1.4.5.7. Include air/moisture barrier transition at window/curtain wall within mock-up. If window, air/moisture barrier shall transition within the window return. If curtain wall, air/moisture barrier shall not extend into opening but mock-up shall show how the return is protected.

1.4.5.8. The mock-up shall be conducted by the lead mechanic and air barrier Manufacturer's technical representative.

1.4.5.9. Contractor shall have on-site and continuously test the thickness of materials as it is being applied with a wet mil gauge.

1.4.6. Mock-Up Testing: After the curing period recommended by material manufacturer, but prior to installation of insulation and cladding, Owner's Testing agency and/or Consultant will perform the following tests:

1.4.6.1. ASTM D4541 to test adhesion of air/moisture barrier membrane and transition membrane.

1.4.6.2. ASTM E1186-4.2.7 to test laps, seams, ladder type masonry ties and post installed masonry tie/anchor.

1.4.7. Field Quality Control Observation and Testing

1.4.7.1. Periodic observation and wet mil testing by Owner's Consultant during construction. Periodic ASTM E1186-4.2.7 during Owner's Consultants site visits.

1.4.7.2. ASTM D4541 testing if workmanship appears to be unacceptable.

1.5 DELIVERY, STORAGE, AND HANDLING

1.5.1. Sequence deliveries to avoid delays, and to minimize on-site storage.

1.5.2. Remove and replace liquid materials that cannot be applied within their stated shelf life. Remove damaged material from site and dispose of in accordance with applicable regulations.

1.5.3. Deliver materials to Project site in original packages with seals unbroken, labeled with material Manufacturer's name, product, date of manufacture, and directions for storage.

1.5.4. Store materials in their original undamaged packages in a clean, dry, protected location and within temperature range required by material manufacturer. Protect stored materials from direct sunlight and other sources of ultra-violet light.

1.5.5. Handle materials in accordance with material manufacturer's recommendations.

1.6 PROJECT CONDITIONS

1.6.1. Environmental Limitations: Apply air barrier within the range of ambient and substrate temperatures recommended in writing by air-barrier manufacturer.

1.6.2. Protect substrates prior and after installation from environmental conditions that affect air-barrier performance.

1.6.3. Do not apply air barrier to a damp or wet substrate or during snow, rain, fog, or mist.

1.6.4. Sequencing:

1.6.4.1. Do not install air barrier material before the roof, wall openings and parapet walls have been sufficiently protected to prevent a buildup of water in the interior of the building or within the back-up wall.

1.6.4.2. Sequence the installation of the wall insulation and cladding in such a manner to protect the membrane from UV deterioration. Membrane shall not be exposed longer than manufacturer's written instructions.

2. WARRANTY

2.1 Material Warranty: Provide material manufacturer's standard product warranty, for a minimum five (5) years from date of Substantial Completion.

2.2 Subcontractor Warranty: Provide a two (2) year installation warranty from date of Substantial Completion, including all accessories and materials of the air barrier assembly, against failures including loss of air tight seal, loss of watertight seal, loss of attachment, loss of adhesion and failure to cure properly.

3. PRODUCTS

3.2 AIR/MOISTURE BARRIERS

3.2.3. Fluid-Applied Membrane Air Barrier: Use regular, high temperature or low-temperature formulation depending on site conditions, within temperature ranges specified by manufacturer. Subject to compliance with Performance Criteria Requirements specified.

3.2.4. Manufactures:

3.2.4.6. Minnesota State does not have pre-approved manufactures. The A/E shall select at least three manufactures that have air/moisture assemblies that meet and exceed the specified Performance Requirements.

3.2.5. Vapor Impermeable Air/Moisture Barrier Assemblies:

3.2.5.7. Minnesota State does not have pre-approved vapor impermeable manufactured assemblies. The A/E shall select at three or four manufacturer's assemblies that have air/moisture assemblies that meet and exceed the specified Performance Requirements.

3.2.6. Vapor Permeable Air/Moisture Barrier Assemblies:

3.2.6.8. Minnesota State does not have pre-approved vapor permeable manufactured assemblies. The A/E shall select at three or four manufacture's assemblies that have air/moisture assemblies that meet and exceed the specified Performance Requirements.

3.2.7. Accessory Materials:

3.2.7.9. Requirement: Provide primers, transition strips, termination strips, joint reinforcing fabric and strips, joint sealants, counterflashing strips, flashing sheets and metal termination bars, termination mastic, substrate patching materials, adhesives, tapes, foam sealants, lap

sealants, and other accessory materials that are recommended in writing by air-barrier manufacturer to produce a complete air-barrier assembly and that are compatible with primary air-barrier material and adjacent construction to which they may seal.

3.2.7.10. Depending on the manufacturers selected, A/E shall specify project specific accessory materials and cross reference them in other relevant sections that are compatible with adjoining building enclosure assemblies.

4. EXECUTION

4.1 EXAMINATION

4.1.1. Contractor shall examine substrates, areas, and conditions under which the air barrier assembly will be installed, with air barrier technical representative present, for compliance with requirements.

4.1.1.1. Confirm site access logistics and scheduling requirements, including but not limited to use of scaffolding, lifts and staging.

4.1.1.2. Verify that surfaces and conditions are suitable prior to commencing work of this section. Do not proceed with installation until unsatisfactory conditions have been corrected.

4.1.1.3. Ensure that the following conditions are met:

4.1.1.3.1. Surfaces are sound, dry, even, and free of excess mortar or other contaminants.

4.1.1.3.2. Inspect substrates to be smooth without large voids or sharp protrusions. Inform General Contractor if substrates are not acceptable and need to be repaired by the concrete sub-trade.

4.1.1.3.3. Remove fins, ridges, mortar, and other projections and fill honeycomb, aggregate pockets, holes, and other voids in concrete with substrate-patching material.

4.1.1.3.4. Inspect masonry joints to be reasonably flush and completely filled, and ensure all excess mortar sitting on masonry ties has been removed. Inform General Contractor if masonry joints are not acceptable and need to be repaired by the mason sub-trade.

4.1.1.4. Verify substrate is visibly dry and free of moisture. Test for capillary moisture by plastic sheet method according to ASTM D4263 and take suitable measures until substrate passes moisture test as required by the Manufacturer.

4.1.1.5. Verify sealants are compatible with membrane proposed for use. Perform field peel-adhesion test on materials to which sealants are adhered. Ensure that sealant and backer rod are in place and have cured

within masonry back-up wall control and expansion joints prior to application of transition membrane.

4.1.1.6. Notify Architect in writing of anticipated problems using fluid-applied membrane over substrate prior to proceeding.

4.2 SURFACE PREPARATION

4.2.1. Clean, prepare, and treat substrate according to material Manufacturer's written instructions. Provide clean, dust-free, and dry substrate for air barrier application.

4.2.2. Ensure that penetrating work by other trades is in place and complete.

4.2.3. Prepare surfaces by brushing, scrubbing, scraping, grinding or compressed air to remove loose mortar, dust, oil, grease, oxidation, mill scale and other contaminants which will affect adhesion of the fluid-applied membrane.

4.2.4. Wipe down metal surfaces to remove release agents or other non-compatible coatings using clean sponges or with a material chemically compatible with the primary air material.

4.2.5. Concrete and Masonry: Prepare, treat, rout, and fill joints and cracks in substrate according to ASTM C 1193 and air-barrier manufacturer's written instructions. Remove dust and dirt from joints and cracks complying with ASTM D 4258 before coating surfaces.

4.2.6. Prepare, treat, rout, and fill joints and cracks in substrate according to ASTM C 1193 and air-barrier manufacturer's written instructions.

4.2.7. Remove dust and dirt from joints and cracks complying with ASTM D 4258 before coating surfaces.

4.2.8. Prime substrate for installation of sheet membrane transition strips and as follows:

4.2.8.1. Prime masonry, concrete substrates with conditioning primers.

4.2.8.2. Prime glass-fiber surfaced gypsum sheathing an adequate number of coats to achieve required bond, with adequate drying time between coats.

4.2.8.3. Prime wood, metal, and painted substrates with primer.

4.2.8.4. Prepare, treat, and seal vertical and horizontal surfaces at terminations and penetrations through air barrier at protrusions.

4.2.8.5. Clean, prime, treat and seal all seams any transitions membranes that have been installed to the liquid applied membrane after it has cured in accordance with the manufactures requirements.

4.2.8.6. Apply primer for transition and self-adhering materials at all porous substrates at the rate instructed by the air barrier material Manufacturer for 1 inch beyond terminating edge of transition

membrane. Allow primer to set/cure completely before transition strip application.

4.2.9. Prime substrate for installation of fluid-applied air barrier if recommended by material manufacturer based on project conditions.

4.2.10. Protection from spray-applied materials:

4.2.10.1. Mask off adjoining surfaces not covered by air barrier to prevent spillage and overspray affecting other construction such as curtain wall surroundings. Masking shall be material that is readily removable without producing residue that will negativity affect the adhesion of the curtain walls primary sealant joint.

4.2.10.2. Ensure any required foam stop or back up materials are in place to prevent over-spray and achieve complete seal.

4.2.11. At changes in substrate plane, apply sealant or termination mastic beads at sharp corners and edges to form a smooth transition from one plane to another.

4.2.12. Cover gaps in substrate plane and form a smooth transition from one substrate plane to another with stainless-steel sheet mechanically fastened to structural framing to provide continuous support for air barrier.

4.2.13. Bridge isolation and expansion joints and minor discontinuous wall-to-wall, deck-to-wall, and deck-to-deck joints with air-barrier accessory material that accommodates joint movement according to manufacturer's written instructions and details.

4.3 INSTALLATION

4.3.1. Install air barrier accessories and air barrier material to provide continuity throughout the building envelope in a shingle fashion. Install materials in accordance to air/moisture barrier manufacturer's written instructions, approved shop drawing and Contract Documents to form a seal with adjacent construction and ensure continuity of air and water barrier.

4.3.2. Coordinate and connect and seal compatible exterior wall air/moisture barrier transition material continuously to roofing membrane vapor retarder, concealed flashing, below grade waterproofing, floor-to-floor construction, window, door and louver systems, and other construction used in exterior wall openings, using accessory materials according to air/moisture barrier manufacturer's written instructions, approved shop drawing and Contract Documents to form a seal with adjacent construction and ensure continuity of air and water barrier.

4.3.3. Provide transition material at changes in substrate plane (with bead of sealant/mastic, membrane counter-flashing or other material recommended by material Manufacturer) under membrane to eliminate all sharp 90 degree inside corners and to make a smooth transition from one plane to another.

4.3.4. Use full sheets of transition membrane to minimize and limit the number of seams within the sill, head and jamb return of windows, doors and louvers. Cut and tightly overlap material at head-jamb and sill-jamb intersections in

accordance with the approved shop drawings to minimize build-up. Coordinate with other trades and install only compatible sealant/mastic at exposed or rough cut seams within window, door and louver openings. Do not extend air barrier transition membrane into curtain wall returns that will receive the primary sealant joints of the curtain wall.

4.3.5. Position subsequent sheets of self-adhering transition material so that membrane overlaps the membrane sheet below by a minimum of 2 inches, unless greater overlap is recommended by the material Manufacturer.

4.3.6. Ensure self-adhering transition membrane is securely adhered with specialized hand roller. Utilizing other tools, such as knife blades and hand pressure are not acceptable.

4.3.7. Seal around all penetrations with termination mastic/sealant, membrane counter-flashing or other procedure in accordance with material Manufacturer's instructions, ensuring chemical and adhesive compatibility with adjoining materials.

4.3.8. Apply a bead or trowel coat of mastic along self-adhering transition membrane seams at reverse lapped seams, rough cuts, and as recommended by the material Manufacturer. Exposed upper edges of membranes are not allowed.

4.3.9. Terminate top edge of the self-adhered membrane to substrate with termination mastic at end of each working day and protect the wall above from accumulating moisture that may negatively affect the bond of the in-place air barrier.

4.3.10. Install fluid-applied membrane using equipment and methods recommended by Manufacturer. Installer shall continually test the thickness of surface applied membrane using a wet mil gauge during installation to ensure that the dry film thickness meets the required project and material Manufacture requirements.

4.3.11. Install fluid applied membrane uniformly and air/water tight around all embedded masonry ties.

4.3.12. Coordinate with other trades so that all post installed anchors/straps or supports (installed by other trades) are set in manufacturer compatible sealant and cap sealed around plate/strap and anchor air and watertight.

4.3.13. Inspect installation prior to enclosing assembly and repair punctures, damaged areas and inadequately lapped seams with a patch of membrane lapped as recommended by material Manufacturer. Coordinate with other trades that may be penetrating or covering the air barrier.

4.3.14. Do not cover air barrier until it has been tested and inspected by testing agency.

4.4 CLEANING AND PROTECTION

4.4.1. Protect air-barrier system from damage during application and remainder of construction period, according to manufacturer's written instructions.

4.4.1.1. Protect air barrier from exposure to UV light and harmful weather exposure as recommended in writing by manufacturer. If exposed to these conditions for longer than recommended, remove and replace air barrier or install additional, full-thickness, air-barrier application after repairing and preparing the overexposed materials according to air-barrier manufacturer's written instructions.

4.4.1.2. Protect air barrier from contact with incompatible materials and sealants not approved by air-barrier manufacturer.

4.4.2. Clean spills, stains, and soiling from construction that would be exposed in the completed work using cleaning agents and procedures recommended in writing by manufacturer of affected construction.

4.4.3. Remove masking materials after installation.

4.5 FIELD QUALITY CONTROL

4.5.4. Refer to section 01 45 23.

END SECTION

Division 08 – Openings

08 41 13 – Aluminum-Framed Entrances: Guidelines and Minimum Requirements

1. Performance Criteria:

   1.1. If any changes have been made to the product within the past four years, submit a Manufacturer's test report on a representative entrance assembly of the type, size and model proposed for this Project,.

   1.2. Air Infiltration: Manufacturer's testing shall be in accordance with ASTM Standards E283 for compliance with maximum permissible air infiltration rate of 1.0 cfm/sq. ft. when tested at a minimum pressure differential of 1.567 lbs/sq. ft. based on requirements of the Minnesota Energy Code.

   1.3. Thermal Movements: Provide entrance systems, including anchorage, that accommodates thermal movements of system and supporting elements when subjected to a temperature differential from -30 degrees F to +180 degrees F without buckling, damaging stresses on glazing, failure of sealant joints, overstressing of components, damaging loads on fasteners, noise or vibrations, and other detrimental effects.

   1.4. Thermal Transmittance:

      1.4.1. When tested in accordance with AAMA 1503, thermal performance for each type of fixed lites of aluminum-framed entrance shall not exceed a Ufixed of ____ BTU/hr. /sq. ft./ degree F.

      1.4.2. As required by the Minnesota State Energy Code, the Solar Heat Gain Coefficients (SHGC) for the fixed lite area of the aluminum-framed entrances when tested in accordance with National Fenestration Ratings Council (NFRC) 201 test method shall be:

      SHGCall: ____

      SHGCnorth: _____

      [Specify the appropriate SHCGs based on the Minnesota State Energy Code requirements and the total percent wall area of fenestration.]

      1.4.3. **Test results may be derived by computer simulations for compliance with NFRC U-Factor, Solar Heat Gain Coefficient, Visible Transmittance, and Condensation Resistance Value. Simulations shall comply with NFRC 100 - Procedure for Determining Fenestration Product U-Factors; NFRC 200 - Procedure for Determining Fenestration Product Solar Heat Gain Coefficient and Visible Transmittance at Normal Incidence**

2. Submittals:

   2.1. Product Data (PD): Submit manufacturer's specifications, technical product data, performance values, standard details for the products specified and manufacturer's recommendation for installation and certification of the Installation Subcontractor.

2.2. Shop Drawings (SD): Submit shop drawings prepared by the aluminum entrance manufacturer for each type of product. Include the following:

2.2.1. Indicate location of each door type, component dimensions and field verified openings. Continue the door numbering system established in the Architectural Drawings.

2.2.2. Elevations of each unit, drawn at 1/2" = 1'-0" scale. Indicate frame joinery.

2.2.3. Full size section details of every typical member.

2.2.4. Anchorage fastener type and location, straps/plates, and reinforcing steel as required by structural calculations.

2.2.5. Glass and glazing.

2.2.6. Perimeter sealants.

2.2.7. Provide four final, complete, shop drawing sets to the A/E, Owner's Representative, and Owner (2 copies) prior to the start of fabrication. These sets shall incorporate all review comments and notations from previous shop drawing submittals.

2.3. Test Reports: The Contractor shall submit test reports on each entrance type, if applicable. Each report shall be complete, prepared by an independent testing laboratory certified by AAMA, and shall indicate that each entrance type has been tested in accordance with these Specifications and performance criteria established in Part 1 of this Section.

2.4. Structural Calculations: Depending on the Project, submit structural calculations and anchorage details for any curtain wall framing prepared by an independent structural engineer licensed in the State of Minnesota, indicating adequacy of all installed materials, to meet the structural load requirements as required by the uniform load structural test and the uniform load deflection test, or submit a letter signed by the Structural Engineer registered in the State of Minnesota, along with the curtain wall shop drawings, confirming that the type, size, spacing of curtain wall anchors and component framing has been reviewed and are adequate.

2.5. Door manufacturer shall confirm that they have received approved hardware shop drawings and associated cut outs and templates for proper door preparation.

2.6. Manuals (O&M): Submit manufacturer's operating and maintenance manuals for entrance hardware per requirements of Division 1.

2.7. Contract Close-Out Submittals: As-built set of shop drawings, prepared by the aluminum entrance manufacturer, showing the final configuration of the entrance installation per requirements of Division 1.

3. Quality Assurance:

3.1. Installer's Certification: The Installation Subcontractor shall be a firm with a minimum of five years of experience specializing in the proper installation of the specified aluminum entrance assemblies.

3.2. Manufacturer's Certification: Manufacturers shall submit written certification that the Installation Subcontractors have been approved by them to install their products.

3.3. The aluminum-framed entrances manufacturer shall certify in writing that the completed aluminum-framed entrances have been fabricated and shop assembled in the manufacturer's authorized plant in accordance with the Specifications and final approved shop drawings.

4. Warranty:

4.1. Provide copies of warranties as specified under provisions of Division 1.

4.2. The aluminum entrance manufacturer shall certify in writing, separate from the all-inclusive warranty, that entrances meet or exceed specified criteria; that component parts were properly designed and selected for locale and installation intended; that installation was made in accordance with manufacturer's instructions. ***[Request certification on compatibility with curtain wall system Manufacturer if door fabricator is different]***

4.3. A. Provide written all-inclusive warranty to the Owner, executed by the General Contractor, the Installation Subcontractors and the respective manufacturers of each product, that all parts of Work in this Section, including insulating glass units, shall be free from defects in materials, workmanship and installation for a period of three (3) years from the date of Substantial Completion. Should any defect develop during warranty period, such defects shall, upon request, be repaired or replaced at no additional cost to the Owner. Cost of such Work shall be borne by the Contractor.

4.4. B. Provide written all-inclusive warranty to the Owner, executed by the Installation Subcontractor and the respective manufacturers of each product, that all parts of Work in this Section, including insulating glass units, shall be free from defects in materials, workmanship and installation for a period of seven (7) years from the expiration of noted warranty in the above paragraph. In the case of manufacturers' warranties for laminated glass or heat-soaked tempered safety glass, these warranties shall be for a period of two (2) years from the expiration of noted warranty in the above paragraph. Should any defect develop during warranty period, such defects shall, upon request, be repaired or replaced at no additional cost to the Owner. Cost of such Work shall be borne by the Installation Subcontractor.

4.5. Warranties shall be dated on the date of Substantial Completion and notarized by a duly authorized Notary Public of the State of Minnesota.

5. Manufacturers:

5.1. Appendix 1 of these Design Standards has a current listing of aluminum entrance and frame manufacturers approved for bidding.

5.2. Single Source Responsibility: Provide aluminum entrances produced by a single manufacturer of units identical to those specified.

6. Materials:

6.1. Extruded aluminum prime billet 6063T6, ASTM B221. Aluminum sheet 5005 H34 (anodic), ASTM B209.

6.2. Steel, conforming to ASTM A36, hot-dipped galvanized in accordance with ASTM A123.

6.3. Nonferrous, nonmagnetic stainless steel, Type 304.

7. Fabrication:

7.1. Aluminum Entrance Doors:

7.1.1. Aluminum entrance doors shall be monumental quality, with seamless, hollow tube section stiles and rails not less than 2” deep and a minimum wall thickness of not less than 3/16”.

7.1.2. Each corner of the door shall be factory welded inside the tubes allowing stiles and rails to be accurately fitted to flush hairline joints. Ends of rails shall be sealed prior to abutting stiles for a weather tight connection.

7.1.3. Entrance doors shall be reinforced with a stainless steel tie rod of 3/8” diameter running full width of top and bottom rails and fixed with stainless steel nuts and lock washers against extruded aluminum lugs. Lock nuts shall be cadmium plated steel.

7.1.4. Hinge stile shall be reinforced for door hinge anchorage with a hot-dipped galvanized, 1-1/4” by 1/4” thick steel bar, which runs continuously for full height and is mechanically fastened for the full height of stile. Hinges shall be anchored directly into steel reinforcing.

7.1.5. Doors shall be shop mortised and reinforced per hardware manufacturer’s templates for specified hardware items such as pulls, exit devices, closers and overhead stops. Reinforcing shall be hot-dipped galvanized 3/16” thick steel.

7.1.6. Door glazing channel shall be snapped in and be made non-removable from the exterior, without visible fasteners. Minimum wall thickness shall be 0.060”. Glazing channels shall be sized accordingly to accommodate 1” laminated insulating safety glass units and single pane glass units in thickness specified and where required. Glazing channels butting against door members and butt joints between glazing channel members shall be backsealed to prevent air and water intrusion to the interior. Allow glazing channel to weep infiltrating water to the exterior.

7.1.7. Vision lights shall be glazed with a wet/dry glazing system using wet silicone sealant glazing at the exterior and dry gasket glazing at the interior.

7.2. Aluminum Entrance Frames:

7.2.1. Provide framing with 2” by 4-1/2” extruded aluminum profiles. Curtain wall frames shall be of thermal break construction; Perimeter inset door frames are not thermally broken. Frames shall have a minimum wall thickness of 1/8” at hinge locations.

7.2.2. Hinge jamb shall be reinforced by a hot-dipped galvanized 1-1/4” by 1-1/4” by 3/16” steel angle which runs continuously full height of the jamb and is mechanically fastened to the jamb. Hinges shall be anchored directly into steel reinforcing.

7.2.3. Intermediate jamb frames shall be screwed to floor mounted hot-dipped galvanized steel support angles concealed within the frame.

7.2.4. Frames shall be shop mortised and reinforced per hardware manufacturer's templates for specified hardware items. Reinforcing shall be hot-dipped galvanized 3/16" thick steel.

7.2.5. Weather-stripping shall be polypropylene pile inserted into extruded races in the door stops. Weather-stripping for exterior doors shall be continuous at head and jambs. Door bottoms shall be weather-stripped.

7.3. Glazed Aluminum Curtain Wall Door Frame Inserts/Sub-Frames:

7.3.1. Provide extruded aluminum door frame inserts/sub-frame with applied extruded aluminum stop, approximately 7/8" x 4" deep. Hardware reinforcement on door frame inserts/sub-frames shall be completely concealed and fastened in-place without the method of attachment being visible. Hardware attachment to door frames inserts/sub-frames shall also be completely concealed. Weather stripping shall be polypropylene pile insert. Insert into keyway grooves on the stops of the jambs and head sections of the frame. Coordinate door size, hardware locations and requirements with aluminum entrance shop drawings and the manufacturer.

7.3.2. Internal Reinforcement at Door Frame Inserts/Sub-Frames: Door frame inserts/sub-frames shall be reinforced by a hot dipped galvanized 1-1/4" x ¼" thick steel bar which runs continuously full height of the insert and is mechanically fastened to the insert. All fasteners, nuts and washers used to secure reinforcement shall be stainless steel.

7.3.3. Base of curtain wall jamb frames receiving door frame inserts/sub-frames shall be anchored to prevent movement.

8. Accessories:

8.1. Frame Anchors: Anchors, heavy duty sleeve or expansion style, vibration resistant and removable, used to secure frame to concrete and grout filled concrete block shall be stainless steel. Type, size and spacing shall be per Project's structural requirements.

8.2. Shims: PVC horseshoe shims in non-load bearing conditions and Korolath multipolymer plastic bearing shims per structural calculations and final shop drawing set.

8.3. Provide insulation in tops of door stiles to retard air movements. Cap seal with compatible silicone sealant to provide an air and water tight seal.

8.4. Provide extruded aluminum rain drips above exit only, non-vestibule door locations. Finish shall match doors.

9. Hardware:

9.1. Continuous hinges are preferred for main entrance doors.

9.2. Entrance doors using butt hinges for support in its frame, shall have hinges of stainless steel with a non-rising pin and a minimum of four ball bearing supports.

9.3. Provide a minimum of 3 hinges per door for doors up to 7'-0" in height. Provide a minimum of four hinges per door for doors up to 8'-0" in height.

10. Finishes:

    10.1. Exposed surfaces of all aluminum shall receive an anodized color finish conforming to the Aluminum Association Designation, Architectural Class 1, AA-M10C22 and the following:

        10.1.1. The anodic coating shall be continuous, fully sealed and free from powdery surfaces.

        10.1.2. Coating thickness shall be a minimum of 0.7 mils when tested in accordance with ASTM B244.

        10.1.3. Anodic coating shall be: ***[The A/E to specify anodic coating A41-Clear or A44-Electrolytically Deposited Color.]***

11. Installation:

    11.1. Thresholds shall be set in a full bed of sealant.

    11.2. The entrance Installation Subcontractor shall furnish and supply all isolation, caulking, and sealant materials required to caulk all joints between entrance frames and other construction to provide a complete thermal broken, weather-tight installation.

    11.3. Erection Tolerances: Permissible dimensional tolerances in the building frame and other work adjacent to the aluminum-framed entrances are specified in Section IV, Division 3 and 4 of the Design Standards. The aluminum-framed entrance assemblies shall be designed to accommodate these tolerances. Provided irregularities do not exceed them, and clearance shown on approved shop drawings are maintained, all parts of the aluminum-framed entrance assemblies when completed, shall be within the following tolerances:

        11.3.1. Maximum variation from plane or location shown on approved shop drawings: 1/8 inch per 12 feet of length or ½ inch in any total length.

        11.3.2. Maximum offset from true alignment between two identical members abutting end to end in line: 1/16 inch.

END SECTION

08 44 13 – Glazed Aluminum Curtain Walls: Guidelines and Minimum Requirements

1. General:

    1.1. Include in this Specification division, all fire and smoke containment requirements for aluminum curtain wall assemblies. Verify fire stopping at floor edges. Curtain wall manufacturer shall be responsible for these requirements.

2. Performance Criteria:

    2.1. If any changes have been made to the product within the past ten years, submit a Manufacturer's test report on a representative curtain wall assembly, identical in all appropriate functional and technical respects to the model and type proposed for this Project.

    2.2. Air Infiltration: Manufacturer's testing shall be in accordance with ASTM E283 for compliance with maximum permissible air infiltration rate using the following criteria:

        2.2.1. Maximum rate of 0.06 cfm /sq. ft.

        2.2.2. All testing at a minimum of 6.24 lbs. /sq. ft. pressure differential.

    2.3. Water Resistance: Manufacturer's lab testing shall be in accordance with ASTM E331 for water resistance with no leakage as defined by the following criteria: No water shall penetrate through the perimeter framing or primary sealant joint; be visible on interior surfaces; be visible on sub-sill flashing; pass beyond the vertical plane intersecting the innermost framing member; or be present within or enter the wall cavity during the water resistance test. All testing shall be done at a minimum of 12 lbs/sq. ft. differential pressure.

    2.4. Uniform Load Deflection: Uniform load deflection test of the curtain wall system shall be conducted in accordance with ASTM E330. The Project Structural Engineer shall calculate and provide negative and positive wind design pressures on the structural drawings, specific to the Project site for exterior components and cladding. The calculated design wind pressure values shall be listed in this article. The curtain wall manufacturer shall not be responsible for calculating the Project's design wind pressure values. The deflection of any framing member in a direction normal to the plane of the wall when subjected to the calculated design wind pressure, at both a positive and negative load, shall not exceed L/175 of its clear span except for the following:

        2.4.1. When a plastered surface or drywall subjected to bending is affected, deflection shall not exceed L/360 of the span.

        2.4.2. When a framing member overhangs an anchor point, deflection shall be limited to 2L/175, where L is the length of the cantilevered member. When a plaster surface or gypsum wallboard subjected to bending on a cantilevered member is affected, defection shall not exceed 2L/360."

        2.4.3. At perimeter frames, deflection shall be limited to 1/2 the perimeter sealant joint width (assuming a Class 50 or better sealant is used in the joint) minus anticipated movement from thermal and other movement, unrelated to deflection related loads, from adjacent materials and the curtain wall.".

2.4.4. For spans greater than 13'-6" deflections at design wind pressure shall be limited to L/240 + 1/4", but not exceed a maximum deflection of 1".

2.5. Uniform Load Structural: Uniform load structural tests of the curtain wall system shall be conducted in accordance with ASTM E330. The curtain wall system shall be subjected to inward and outward acting uniform loads equal to 1.5 times the design wind pressure. After each specified loading, there shall be no: glass damage or breakage; damage to fasteners or anchors; malfunctioning of doors and operating hardware; or permanent deformation or set of any framing member in excess of 0.2% of its span.

2.6. Dead Load: Under dead load, for horizontal framing members which support glass, deflection of those members in the direction parallel to the plane of the wall shall not exceed an amount which will reduce the glass bite below 75% of the design dimension, nor an amount which would infringe upon necessary glazing clearances below. Deflection shall also be limited in this direction to provide at least 1/8" minimum clearance between the member and the top of the fixed glazed panel, glass or other fixed part immediately below. The clearance between the frame member and an operable window or door below shall be at least 1/16".

2.7. Framing: Framing members for each individual glass pane shall be designed so the deflection perpendicular to the glass plane shall not exceed 1/175 of the glass edge length or 3/4", whichever is less, when subjected to loads specified in the current Minnesota State Building Code.

2.8. Condensation Resistance: When tested in accordance with AAMA 1503, the condensation resistance factor for each type of curtain wall shall be not less than the following minimum levels of thermal performance on unit size as required to produce representative areas of framing, vision glass and spandrel glass.

2.8.1. Architect shall specify appropriate condensation resistance factor for each curtain wall type, in accordance with AMMA 1503. Use 99.6% Exterior Design Temperature listed in ASHRAE 90.1 when considering condensation resistance weather criteria.

When interior relative humidity is expected to exceed 30%, provide analysis that indicates the curtain wall system can perform against condensation in extreme Minnesota winter temperatures and adjust CRF accordingly.

2.8.2. Except for size, test units shall contain the same assembly and weep holes configurations as the specified curtain wall.

2.8.3. Data from calculations or simulations, such as NFRC 500-2010, test results on units of different size or unrepresentative framing/glass proportions are unacceptable.

2.9. Thermal Transmittance:

2.9.1. The curtain wall thermal performance for each type of curtain wall shall not exceed what is allowed by the State Energy Code.

2.9.2. Architect shall specify appropriate U-Factors for each type of curtain wall and insulating glass assembly.

2.9.3. The Solar Heat Gain Coefficients (SHGC) shall conform to the Minnesota State Energy Code.

[Specify the appropriate SHCGs based on the Minnesota State Energy Code requirements and the total percent wall area of fenestration and list the values in the Construction Documents.].

2.9.4. **Test results may be derived by computer simulations for compliance with NFRC U-Factor, Solar Heat Gain Coefficient, Visible Transmittance, and Condensation Resistance Value. Simulations shall comply with NFRC 100 - Procedure for Determining Fenestration Product U-Factors; NFRC 200 - Procedure for Determining Fenestration Product Solar Heat Gain Coefficient and Visible Transmittance at Normal Incidence; and NFRC 500 - Procedures for Determining Fenestration Product Condensation Resistance Values. (Note that NFRC's Condensation Resistance Value is not equivalent to a Condensation Resistance Factor (CRF) determined by AAMA 1503.)**

2.9.5. Curtin wall assemblies shall have a VT of ____. Visible Transmittance (VT) shall conform to the Minnesota Energy Code. Specified VT shall be determined in accordance with NFRC 200 by an accredited independent laboratory and certified by the manufacturer.

2.10. Movements: Provide glazed curtain wall systems, including anchorage, that accommodates thermal movements of curtain wall system and supporting elements when subjected to a temperature differential from -30 degrees F to +180 degrees F without buckling, damaging stresses on glazing, failure of sealant joints, overstressing of components, damaging loads on fasteners, noise or vibrations, reduction in performance and other detrimental effects.

2.11. Sound Transmission: If sound generating sources such as freeways, railroads, airports and industrial facilities are located adjacent to exterior windows, the Architect shall manage the sound transmission through the curtain walls.

3. Submittals:

3.1. Product Data (PD): Submit the manufacturer's specifications, technical product data, performance values, standard details of the products specified and the manufacturer's certification of the Installation Subcontractor and the manufacturer's recommendation for installation.

3.2. Shop Drawings (SD): Submit shop drawings prepared under the direct supervision of the curtain wall manufacturer or exclusively authorized fabrication shop, approved by the Owner and their structural engineer for each type of product. Include the following:

3.2.1. Indicate layout and location of each curtain wall and door type, component dimensions and field verified openings. Continue the curtain wall designation established in the Architectural Drawings.

3.2.2. Elevations of each unit, drawn at 1/2" =1'-0" scale. Indicate frame joinery.

3.2.3. Full size section details of every composite member.

3.2.4. Anchorage fastener types and locations, clips/straps/plates and reinforcing steel as required by structural calculations.

3.2.5. Anodized finish.

3.2.6. Installation and glazing instructions.

3.2.7. Glass and glazing.

3.2.8. Sealants, including those selected by the curtain wall manufacturer.

3.2.9. Vapor containment systems, if applicable.

3.2.10. Submit four final, complete, shop drawing sets to the A/E, the Owner's Representative and the Owner (2 copies) prior to the start of fabrication. These final shop drawing sets shall incorporate all review comments and notations from previous shop drawing submittals. Final shop drawings shall be submitted at a minimum of 10 work days prior to the Pre-Installation Conference.

3.3. Samples (S): Submit one curtain wall assembly sample showing typical joints, weep system, anchorage at corner section of typical curtain wall sill/jamb intersection. Samples shall be retained to verify installed units are in conformance with the Construction Documents and the approved final shop drawings.

3.4. Test Reports / Calculations: The Contractor shall submit test reports on each curtain wall type. Each report shall be complete, prepared by an independent testing laboratory certified by AAMA, and shall indicate that each curtain wall has been tested in accordance with these Specifications and performance criteria established in Part 1 of this Section. Previous independent test reports on curtain wall systems identical to the specified product and model are acceptable if no change have been made to the product or the referenced tests have not changed.

3.5. Structural Calculations (SC): Submit structural calculations and anchorage details prepared by an independent structural engineer licensed in the State of Minnesota, indicating adequacy of all installed materials, including glass and glazing, to meet the structural load requirements as required by the uniform load structural test and the uniform load deflection test and dead load and framing criteria.

3.6. Compatibility: Submit written statement from the Manufacturer of the curtain wall materials that the Manufacturer has reviewed the all materials proposed for use for cleaning, for use on the window opening substrates, and the materials used to adhere and seal to the underlying substrates, are chemically and adhesively compatible with, materials used in their curtain wall assemblies and other products they may contact within the curtain wall assembly.

3.7. Compatibility: Submit written letter from Manufacturer of the curtain wall materials stating that materials proposed for use are permanently chemically compatible and adhesively compatible with adjacent materials proposed for use. Submit letter from Manufacturer stating that cleaning materials used during installation are chemically compatible with adjacent materials proposed for use.

3.8. Certifications, Lists, and Warranties:

3.8.1. Installer's Certification of Experience stating the minimum 5 years' experience installing the specified windows.

3.8.2. Manufacturer's Certification of approval of the Installation Subcontractor to install the specified curtain wall products.

3.8.3. Manufacturer's Certification of Approved Plant Fabrication according to Project specifications and approved final shop drawings.

3.8.4. List of Key Installation Personnel proposed to be present throughout Project.

3.9. Contract Close-Out Submittals: As-built set of shop drawings, prepared by the curtain wall manufacturer, showing the final configuration of the curtain wall installation per requirements of Division 1.

4. Quality Assurance:

4.1. Installer's Certification: The curtain wall Installation Subcontractor shall be a firm with a minimum of five years of experience specializing in the proper installation of the specified aluminum curtain wall assembly.

4.2. Manufacturer's Certification: Manufacturers shall submit written certification that the Installation Subcontractors have been approved by them to install their products.

4.3. Manufacturer's Confirmation: Manufacturer's with products listed on the Approved Manufacturer's Product List and utilizing a manufacturer's sole, exclusively authorized fabrication shop to provide curtain wall framing for this project, shall submit written confirmation that final shop drawings and structural calculations have been reviewed and approved; that the curtain wall fabrication has been reviewed and approved; and that the authorized fabrication shop curtain wall frames and components shall be identical to curtain wall products listed, fabricated, and provided by the approved manufacturer. All assembly shall be done per the manufacturer's procedures and tolerances.

4.4. Specify the Contractor shall provide certification that welders to be employed for this Work have satisfactorily passed AWS qualification tests. Fabricator(s) and erector(s) shall submit current welding certifications, for fabrication plant and field welding, to the A/E for written approval prior to the start of welding. If re-certification of welders is required, retesting shall be the Contractor's responsibility.

4.5. Specify the Contractor shall provide written confirmation, 10 work days prior to scheduling a curtain wall pre-installation conference, from the curtain wall installation subcontractor that the wall opening conforms to the construction documentation and has been reviewed and is acceptable for commence the pre-installation conference trail installation.

4.6. The Contractor shall note that all building façade work is complete, including brick cleaning, air barrier, installation of cavity wall sealant joints, and all roofing work prior to convening the Pre-Installation Conference.

5. Pre-Installation Conference

5.1. There shall be a Pre-Installation Conference, in accordance with requirements of Division 1 - Project Meetings, after shop drawing review and prior to curtain wall installation. All curtain walls shall be on-site prior to commencing the Conference. The Contractor shall provide a minimum of 10 working days written notice to all required attendees to schedule the Conference and testing and to confirm that the curtain wall openings are complete and prepared for the trial curtain wall installation(s). The Contractor shall provide a minimum of 10 working days written notice for re-scheduled meetings and testing. The Owner, the Contractor, the A/E, Installation Subcontractors, curtain wall manufacturer's representative and other representatives directly associated with performance of the Work shall be in attendance to review.

Pre-Installation Conference shall include review of: Specifications; final shop drawings; objectives of the Pre-Installation trial installation and testing; trial test procedures; schedule for curtain wall installation; and observe trial installation(s) and testing. Trial installation and testing shall be completed and performed on each type of curtain wall unit, with the Owner retaining the right to randomly select units for installation**.**
[The A/E shall list additional specific items like split mullions, spandrel panels, vapor containment, etc. for inclusion in the trial installation.]

Verify that all key personnel who participate in the trial installation are committed to complete the remainder of the curtain wall installation for the Project.

5.2 Pre-Installation Conference trial installation and testing shall include:

5.2.1 The Contractor shall confirm that the trial installation(s) shall be complete in every detail, conforming to a final installation and shall serve as a test demonstration installation for the remaining Work. Curtain wall anchorage system, specified curtain wall components, glass and glazing, weeps, exterior perimeter sealant and primary sealant joint shall be included in the trial installation.

5.2.2 The Owner will engage an independent, AAMA accredited testing agency to field test the completed trial curtain wall installation(s) for compliance with specified performance criteria for air infiltration and water resistance. The trial installation testing shall be by AAMA and ASTM test standards and per additional requirements, definitions and criteria listed in field quality control testing in Part 3 of this section. If curtain wall assembly exceeds constructability limits for a test chamber, the Owner retains the option to utilize AAMA 501.2 (perimeter joint sealants) and AAMA 503 field test standards as tabulated and defined in field quality control testing in Part 14 of this section. Testing shall occur prior to interior finish work, including interior perimeter sealant joint, to allow visual access to areas being tested to check for water penetration.

5.2.3 The Contractor shall assist with testing procedures and otherwise cooperate with the testing agency, including provide all necessary scaffolding, lifts, enclosures,

temporary heat and other equipment and utilities, including water and 220V single phase power to facilitate testing. The Contractor shall provide an uninterrupted power supply and uninterrupted water flow that delivers water uniformly against the test area at a minimum rate of 5.0 gal/sq. ft./hr. with a minimum water line pressure necessary to deliver 12 PSI for the entire test area with a maximum test area of 100 sq. ft. Contractor shall make provisions with the local fire department /public works department to rent or utilize adjacent fire hydrants to provide required water supply when required.

5.2.4 The remainder of the curtain wall installation shall not proceed until trial installations have passed project requirements. If failures develop under testing, the reasons for failures shall be identified by the Contractor and failures shall be repaired and retested until the installation is completely free of defects. All retests shall be by the Owner's testing agency. If failures develop under testing, the Contractor shall notify the Owner and the A/E as to when corrective work will be under taken and determinations will be made by them as to their presence for such Work. All re-observation, re-testing and associated costs shall be the responsibility of the Contractor and deducted from the Contract Sum by Change Order. No payments, partial or otherwise, will be made for the curtain wall products until the trail installations pass testing.Provide copies of warranties as specified under provisions of Division 1.

6.2. The curtain wall manufacturer shall certify in writing, separate from the all-inclusive warranty, that the curtain wall system meets or exceeds specified criteria; that component parts were properly designed and selected for locale and installation intended; that installation was made in accordance with the manufacturer's instructions; ***[that a vapor tight barrier has been installed preventing the formation of condensation; and that installation of aluminum doors is compatible with installation of curtain wall system.]*** The A/E shall include these required additions if specified within this section.

6.3. A. Provide written all-inclusive warranty to the Owner, executed by the General Contractor, the Installation Subcontractors and the respective manufacturers of each product, that all parts of Work in this Section, including insulating glass units, shall be free from defects in materials, workmanship and installation for a period of three (3) years from the date of Substantial Completion. Should any defect develop during warranty period, such defects shall, upon request, be repaired or replaced at no additional cost to the Owner. Cost of such Work shall be borne by the Contractor.

6.4. B. Provide written all-inclusive warranty to the Owner, executed by the Installation Subcontractor and the respective manufacturers of each product, that all parts of Work in this Section, including insulating glass units, shall be free from defects in materials, workmanship and installation for a period of seven (7) years from the expiration of noted warranty in the above paragraph. Should any defect develop during warranty period, such defects shall, upon request, be repaired or replaced at no additional cost to the Owner. Cost of such Work shall be borne by the Installation Subcontractor.

6.5. Warranty shall be dated and notarized by a duly authorized Notary Public of the State of Minnesota.

7. Manufacturers:

7.1. Appendix 1 of these Design Standards has a current listing of aluminum curtain wall manufacturers approved for bidding.

7.2. Exterior and interior decorative perimeter sealant joints and other related curtain wall sealant work shall match products selected for use by the building sealant Subcontractor. ***[Required if sealants specified within this Section.]***

7.3. Primary Sealant Joints ***[and vapor containment assembly if applicable]****:* Silicone Sealants are preferred. As a minimum, use a multi-component polyurethane sealant. Curtain wall manufacturer is responsible for selecting the sealant manufacturer whose products can be warranted with the sealant products used in conjunction with curtain wall frame assembly, curtain wall frame installation at interlocking male/female stack joints, and decorative perimeter joints. Contractor shall be responsible for selecting sealants that are compatible with the curtain wall's primary sealant joint at cavity wall sealant work, any stainless steel drip, drip tray, or sealant work, and related building sealant work. Specify that no sealants or primes shall not be applied when the air or substrate temperatures are 40 degrees F or below.

8. Materials:

8.1. Reference Minnesota State Facilities Design Standards; Section V; Divisions 04, 07 and 08; 04 20 00-Masonry; 07 90 00-Joint Protection; and 08 80 00-Glazing.

8.2. Extruded aluminum prime billet 6063T6, ASTM B221. Aluminum sheet 5005 H34 (anodic), ASTM B209.

8.3. Steel, conforming to ASTM A36, hot-dipped galvanized in accordance with ASTM A123.

8.4. Nonferrous, nonmagnetic stainless steel, Type 304.

9. Fabrication:

9.1. Fabrication shall not proceed until masonry details and field conditions have been verified and accepted by the curtain wall manufacturer, and the final review of shop drawings has been completed.

9.2. Curtain Wall:

9.2.1. Fabricate framing members into unitized assemblies of the largest possible expanse, in curtain wall manufacturer's plant or in a manufacturer's exclusively authorized fabrication shop, approved by the Owner. Provide basic rectangular units sized for ease of erection and transportation. Entire finishing, fabrication and assembly operations shall be produced by a single manufacturer of units identical to those specified.

9.2.2. The curtain wall manufacturer shall certify in writing that the completed curtain wall systems have been fabricated and shop assembled in the manufacturer's plant or in the manufacturer's exclusively authorized fabrication shop, as authorized by the Owner, in accordance with the Specifications and the final approved shop drawings. Curtain wall and related components shall be from the same manufacturer. The manufacturer shall stand behind their product by issuing warranties per article 5 above.

9.2.3. Systems using individual field fabricated, field assembled or installer fabricated assemblies are not acceptable.

9.2.4. Shear block connections shall not be used between horizontal and vertical framing members.

9.2.5. Provide grid frame curtain wall members and components with joints neatly made, free of burrs, and assembled using extruded screw spline frame joinery resulting in tight fitting hairline joints fastened or joined in the factory to develop full structural value of members and provide permanent air and water tight joints.

9.2.6. Provide interlocking male/female type splice and stack joints between adjacent grid frame members to allow for expansion and contraction of frame units. "Stick" system type one piece tubular members, which do not allow for expansion and contraction in members, shall not be acceptable.

9.2.7. Interlocking joints shall be weather stripped to provide an air and watertight seal.

9.2.8. Conceal fasteners at vertical to horizontal framing connections.

9.3. Drainage System:

9.3.1. Individual glass lites shall have pressure equalized weepage.

9.3.2. Provide weep slots in pressure plates and weep slots in aluminum trim snap-on covers to drain any and all condensation or accumulating water within the system, to the exterior.

9.3.3. Provide adequate clearance at the ends of the installed snap covers to allow for thermal expansion. Center the snap covers during installation to equalize the gaps on either end.

10. Curtain Wall and Components:

10.1. Curtain Wall Frame:

10.1.1. Minimum principal curtain wall member wall thickness 1/8”.

10.1.2. Exterior face sightlines shall be a minimum of 2”.

10.1.3. Overall depth shall be as required by structural calculations and as shown on the Drawings.

10.1.4. Provide extruded aluminum members with sharp, well defined corners, integral screw splines for frame joinery and flush sightlines.

10.1.5. Framing members requiring use of snap-trim for closure are not acceptable.

10.1.6. Curtain wall framing shall fully capture each glass lite via pressure plate attachment, on all sides.

10.1.7. Curtain wall assemblies shall be field glazed.

10.1.8. Internal Structural Members and Reinforcement: Structural steel members and shapes to suit curtain wall framing, as required by structural calculations and as recommended and detailed by the curtain wall manufacturer, hot-dipped galvanized steel.

10.2. Thermal-break and Zone Dams:

10.2.1. Curtain wall assembly shall be thermally broken by manufacturer's standard 3/8" thick isolator, sealing against air and water infiltration. Provide continuous, unbroken isolators in horizontal frame members.

10.2.2. Horizontal framing member intersection to vertical members shall be made air and water tight by installation of manufacturer's standard zone dam members.

10.2.3. Butter zone dams and set in place per manufacturer's printed installation instructions. The top and bottom of each zone dam shall be completely covered with sealant. Carefully tool sealant surface so sufficient area is provided to allow air and water to pass around the glass corner.

10.3. Vapor Containment Assembly at Spandrel Panel: ***[The A/E to specify if spandrel panel are required for this Project.]***

10.3.1. Provide a 1/8" thick aluminum backpan vapor barrier with formed return legs on all four sides of opening. Verify required metal and configuration of backpan at firestop conditions. Backseal corner joints at return legs to create an air and vapor tight seal.

10.3.2. A/E shall specify additional components of the vapor containment assembly such as curtain wall insulation, inpaling pins, washer clips, tape, shims, sealants approved by the curtain wall manufacturer and stainless steel fasteners to provide a vapor tight installation.

10.3.3. The A/E shall coordinate detailing of vapor containment assemblies at spandrel panels with fire-resistance-rated construction requirements as required by the Minnesota State Building Code.

10.3.4. Bent Aluminum Condensation Control Angle: Where a vapor containment assembly is installed, provide a 1/8" thick, 1" x 1-1/2" bent aluminum angle attached to curtain wall frame to direct condensation to weep holes in glazing pocket trim. Factory install, making joinery to curtain wall frame air and water tight.

10.3.5. The Contractor shall ensure that the spandrel cell insulation is be kept dry at all times until it is protected by glazing.

10.3.6. **Aluminum foil backed insulation is not allowed in vapor containment systems.**

10.4. Anchor Clips and Lateral Load Clips: Concealed and formed dimensional stainless steel or steel, hot-dipped galvanized. Shape, size and spacing shall be per final shop drawings and submitted structural calculations. Anchor clips and lateral load clips shall not penetrate the primary sealant joint nor inhibit independent frame movement. Profile anchor clips and lateral load anchor clips at sill locations to avoid altering conflict with other perimeter built-in features of the opening.

10.5. Formed Aluminum Sills:

10.5.1. Formed Aluminum Sills at Masonry Cavity Walls:

10.5.1.1. Provide 0.090 thick formed aluminum sills in profile as shown on the Drawings. Slope sills to provide positive drainage to exterior. Furnish sills in one piece for full width of curtain wall openings when permissible.

10.5.1.2. Provide continuous anodized aluminum end caps to facilitate sealant installation and backer rod placement. Back seal for an air and water tight closure.

10.5.1.3. Provide ¼" wide slotted weep holes in drip profile. Confirm spacing with the manufacturer. Install reticulated foam baffles over inner surface of weeps.

10.5.1.4. Provide 20 gauge, formed Type 304 stainless steel keeper clips, conforming to the sill shape and anchored with predrilled holes at 1'-0" on center. Diameter to predrilled holes shall correspond to recommendations and specifications off the anchor manufacturer.

10.5.1.5. Anchors for keeper strip clips shall be metal alloy body with Type 304 stainless steel nail similar to the masonry through-wall flashing termination bar fastener.

10.5.1.6. Provide splice joints and expansion joints where shown on the Drawings and final approved shop drawings. At splice and expansion joints, provide 20 gauge, Type 304 stainless steel continuous backer plate formed to match the aluminum sill profile. Create a working sealant joint between sill sections and provide bond breaker tape where required.

10.5.1.7. Where support of the sill is required, provide 11 gauge stainless steel angle support brackets, 3" wide, to support formed aluminum sill. Spacing shall be per curtain wall manufacturer' recommendations. Support brackets shall be secured to the brick wall at its base and screw fastened to the formed aluminum sill at its top edge.

10.5.2. Formed Aluminum Sills at Precast Sills:

10.5.2.1. Formed aluminum sills shall be 0.090 thick in profile as shown on the Drawings. Slope sills to provide positive drainage to exterior.

10.5.2.2. Provide splice joints and expansion joints where shown on the Drawings and final approve shop drawings. At splice and expansion joints, provide a 20 gauge stainless steel continuous backer plate, formed to match the aluminum sill profile. Create a working sealant joint between sill sections and provide bond breaker tape where required.

10.6. Accessories:

10.6.1. Shims: PVC horseshoe shims in non-bearing locations and Korolath multipolymer plastic bearing shims per structural calculations and final shop drawing set. Horseshoe shaped Korolath shaped shims are not acceptable in dead load locations.

10.6.2. Curtain Wall Frame Anchorage Fasteners: Stainless Steel Anchors, heavy duty sleeve or expansion style, vibration resistant and removable, used to secure curtain wall and associated anchor clips and lateral load clips to concrete and grout-filled concrete block. Type, size and spacing shall be per structural calculations and final shop drawings. Mechanically Galvanized or Stainless steel, heavy-duty screw fastener may be used if conditions warrant or if required to comply with the current Minnesota State Building Code.

10.6.3. Lighter-duty fasteners like Tap Con style fasteners shall not be permitted.

10.6.4. Bond Breaker Tape: As recommended by the curtain wall manufacturer.

10.6.5. Dissimilar Metals: Dissimilar metals shall be separated to prevent galvanic action. Clearly indicate method of separation and location in the Shop Drawings.

10.7. Glass and Glazing:

10.7.1. Provide glazing according to the curtain wall and the glass manufacturer's recommendation for sealants, glazing gaskets and tapes.

10.7.2. Provide setting blocks and edge blocking in material, hardness and locations according to the curtain wall and the glass manufacturer's recommendations.

10.7.3. Interior glazing gaskets corner butt joints shall be sealed per the curtain wall manufacturer's installation instructions.

11. Finishes:

11.1. Exposed surfaces of all aluminum curtain wall, components and trim shall receive an anodized color finish conforming to the Aluminum Association Designation, Architectural Class 1, AA-M10C22 and the following:

11.1.1. The anodic coating shall be continuous, fully sealed and free from powdery surfaces.

11.1.2. Coating thickness shall be a minimum of 0.7 mils when tested in accordance with ASTM B244.

11.1.3. Anodic coating shall be: ***[A/E to specify anodic coating A41-Clear or A44-Electrolytically Deposited Color.]***

12. Delivery, Storage and Handling:

12.1. Handle aluminum products of this section in accordance with AAMA CW-10.

12.2. Make no deliveries to the Project until ready to install or until approve storage is provided. Where this provision is neglected and materials are delivered to the Project site prior to the Project being ready for installation, such materials shall be properly stored elsewhere

at the expense of the Contractor with adequate insurance coverage provided for the off-site storage.

12.3. Deliver materials in original, un-opened containers with labels intact and legible.

12.4. Provide above-grade platform storage for materials and that will protect the materials from moisture damage and minimize damage to ground surfaces. Use tarpaulins to provide protection of stored materials. Factory raps alone are not sufficient.

12.5. Store materials and provide and operate material handling equipment in a manner as to not damage existing or new construction.

13. Examination:

13.1. Construction at curtain wall openings and adjoining materials shall be verified as ready to receive the Work of this Section. Installation start-up indicates acceptance of as-built conditions.

13.2. Each curtain wall opening shall be properly prepared and cleaned before installation of curtain wall system and trim. Confirm that areas shown to receive sealant joints have been cleaned according to sealant manufacturer's instructions.

13.3. Wall conditions at sill, jamb, and head shall not short circuit thermal break in frame when installed.

14. Installation:

14.1. The curtain wall shall be installed in accordance with approved manufacturer's instructions.

14.2. Provide anchor clips, lateral load clips, anchorage fasteners, shims and internal reinforcement as shown on the shop drawings and structural calculations, to secure and properly support the curtain wall assembly to the wall surrounds. Account for differential movement between curtain wall frame and wall surrounds caused by but not limited to: calculated thermal expansion and contraction of curtain wall frame sections; building live and dead load movement; supporting structure movement such as story drift, column shortening, or long term creep; and lateral loads while maintaining perimeter expansion tolerances and independent frame movement as shown on the final approved shop drawings.

14.3. Install bond breaker tape and sealant, as recommended by the curtain wall manufacturer, such as at joint between interlocking mullions when required.

14.4. No bolts, screws, or other components, etc., shall impair independent frame movement.

14.5. Sealants or other components shall not impede the removal of water from the system.

14.6. No fasteners shall be permitted within the weep system.

14.7. The sill frame of curtain wall shall not project towards the exterior beyond the head frame.

14.8. Torque pressure plate screws to manufacturer's standard compression value.

14.9. Prior to installing vapor containment assembly, continuously cap seal curtain wall frame joinery within the spandrel panel area to prevent vapor intrusion and bypass.

14.10. Vapor containment assembly installation shall provide a vapor tight barrier to prevent the formation of condensation. Install only the amount of vapor containment assembly insulation that can be protected or covered over by the end of the work day. Vapor barrier shall not be punctured.

14.11. Anchor clips, lateral load clips and associated anchorage fasteners that penetrate the interior perimeter sealant joint shall be cap sealed to prevent air and vapor migration.

14.12. Erection Tolerances: Permissible dimensional tolerances in the building frame and other work adjacent to the curtain wall assemblies are specified in Section IV, Division 3 and 4 of the Project Specifications. The curtain wall assemblies shall be designed to accommodate these tolerances. Provided irregularities do not exceed them, and clearance shown on approved shop drawings are maintained, all parts of the curtain wall assemblies, when completed, shall be within the following tolerances:

14.12.1. Maximum offset from true alignment between two identical members abutting end to end in line: 1/16 inch.

14.12.2. Within any rectangular opening, there shall be no more than 1/8 inch difference in the measured lengths of the diagonals.

14.12.3. Maximum variation of mullions from plumb or horizontals from level shall not exceed +/- 1/8 inch in 12 feet or +/- ¼ inch in any single run.

15. Field Quality Control:

15.1. The Contractor shall provide written notice to the appropriate firms and/or laboratories that all the curtain wall installation is complete and ready for field quality control testing. The Contractor shall provide a minimum of 10 working days' notice for both initial and re-scheduled testing.

15.2. The Owner will engage an independent, AAMA accredited testing agency to field test the completed curtain wall installation for compliance with specified performance criteria for air infiltration, water resistance. Testing for the completed curtain wall installation testing shall be by AAMA and ASTM test standards and per additional requirements, definitions and criteria listed the field quality control testing below. If curtain wall assembly exceeds constructability limits for an AAMA 502 test chamber, the Owner retains option to utilize AAMA 501.2 (perimeter joint sealants) and field test standards as tabulated and defined below. Testing shall occur prior to interior finish work, including interior perimeter sealant joint, to allow visual access to areas being tested to check for water penetration. The Owner will randomly select curtain wall to be tested.

15.3. The Contractor shall assist with testing procedures and otherwise cooperate with the testing agency, including provide all necessary scaffolding, lifts, enclosures, temporary heat and other equipment and utilities, including water and 220V single phase power to facilitate testing. The Contractor shall provide an uninterrupted power supply and uninterrupted water flow that delivers water uniformly against the test area at a minimum rate of 5.0 gal/sq. ft./hr. with a minimum water line pressure necessary to deliver 12 PSI for the entire test area with a maximum test area of 100 sq. ft. Contractor shall make provisions with the local fire department /public works department to rent or utilize adjacent fire hydrants to provide required water supply when required.

15.4. If failures develop under testing, reasons for the failure shall be identified by the Contractor and failures shall be repaired and retested until the installation is completely free of defects. If failures develop under testing, the Contractor shall notify the Owner and the A/E as to when corrective work will be undertaken and determinations will be made by them as to their required presence for such Work. All retests shall be by the Owner's testing agency.

15.5. All re-observation, re-testing and associated costs shall be the responsibility of the Contractor and deducted from the Contract Sum by Change Order.

15.6. Field Quality Control Testing requirements are as follows:

13.1.

08 44 13 – Glazed Aluminum Curtain Walls: Quality Control Field Testing Requirements

Method of Testing	Standard/Criteria (Pass/Fail)	Frequency	Action Required (If Failure)
Air Leakage: Conduct air leakage test per AAMA 503, as modified by these Standards; including the adjacent wall substrate, exterior perimeter sealant joint and the primary sealant joint. • Note that all air infiltration testing to be done at lab Design Pressures, with no allowance reductions in pressure or test criteria for field testing conditions. Test Chamber shall be AAMA 503, requirements and applied to the exterior of the wall except where the testing agency determines that an interior test chamber is required.	Maximum allowable rate of air leakage shall not exceed 0.06 cfm/sq. ft. Minimum air leakage test pressure shall be 6.24 lbs./sq. ft.	10% or a minimum of 3 curtain wall assemblies, whichever is greater.	For each failed test: 1. Identify reason for failure. 2. Repair failure and retest the installation unit until it is completely free of defects. 3. Test two additional curtain wall assemblies, except at initial curtain wall installation test location 4. The cost for all additional curtain wall tests are the responsibility of the Contractor, including costs for the Owner, the Owner's consultants, and the Architect/Engineer.

Method of Testing	**Standard/Criteria (Pass/Fail)**	**Frequency**	**Action Required (If Failure)**
Water Penetration: Conduct water penetration tests per AAMA 503, as modified by these Standards; including the adjacent wall substrate, exterior perimeter sealant joint and the primary sealant joint. • Note that all water resistance testing to be done at lab Design Pressures, with no allowance reductions in pressure or test criteria for field testing conditions. Test chamber shall be AAMA 503, requirements and applied to the exterior of the wall except where the testing agency determines that an interior test chamber is required.	No water shall: penetrate through the perimeter frame or primary sealant joint, be visible on interior surfaces, be visible on sub-sill flashing; pass beyond the plane parallel to the glazing (the vertical plane) intersecting the innermost projection of the curtain wall: or be present within or enter the wall cavity during the water penetration test. Minimum water penetration test pressure shall be 12 lbs./sq. ft.	As defined above.	As defined above.

Method of Testing	**Standard/Criteria (Pass/Fail)**	**Frequency**	**Action Required (If Failure)**
Owner Optional Field Tests: Owner optional field tests shall be per AAMA 501.2 or 503. Air leakage and water penetration tests shall be per AAMA 503 with an interior test chamber. In all cases, the test chamber shall be applied to the wall construction to create a pressure differential across the exterior face of the primary sealant joint. The perimeter sealant joint shall also be tested per AAMA 501.2 using a brass spray nozzle.	As defined above.	As defined above.	As defined above.

16. Protection and Cleaning:

    16.1. Completed systems shall be cleaned, inside and outside, promptly after erection of framing, glass and sealants. Remove excess sealants, dirt or other contaminants from aluminum, glass surfaces and wall surrounds.

    16.2. Take protective measures to assure that the installation shall be without damage or deterioration at time of acceptance other than normal weathering. Should any defect develop prior to the Date of Substantial Completion of the Work, such defects shall, upon request, be repaired or replaced at no additional cost to the Owner.

END SECTION

08 51 13 - ALUMINUM WINDOWS

1. Performance Criteria:

   1.1 Aluminum windows shall as a minimum conform to requirements set forth in AAMA/WDMA/CSA 101/I.S.2/A440 Voluntary North American Fenestration Standard/Specifications and per criteria outlined in the Minnesota State Building Code.

   1.2 Windows shall be performance class AW. In certain conditions, a variance may be granted for use of performance class CW for low rise buildings with fixed windows that are of light use, such as cold storage buildings.

   1.3 Performance Grade: Minimum Performance Grade of 60

   1.4 Manufacturer's testing sequence shall be completed as follows, per the requirements of AAMA/WDMA/CSA 101/I.S.2/A440-11 Clause 9.1.2:

      1. Operating force for operable units.
      2. Air Leakage Resistance Test
      3. Water Penetration Resistance Test
      4. Uniform Load Deflection Test
      5. Uniform Load Structural Test

   1.5 Operating Force: Manufacturer's testing shall be in accordance with ASTM E2068 for operating of windows. ***[The A/E shall determine the operating force requirements of each unit based on the specific product type, Product Class, and project specific requirements. Refer to* AAMA/WDMA/CSA 101/I.S.2/A440-11*, Table 7.2 for maximum permissible force values]***

   Where operable windows are intended for use in accessible spaces, operating forces shall be in accordance with the current Minnesota Accessibility Code along with confirmation with ADA Accessibility per AAMA 513.

   1.6 If any changes have been made to the product within the past ten years, submit a Manufacturer's test report on a representative window assembly, identical in all appropriate respects to the type proposed for this Project.

      1.6.1. Receptor framing shall only be utilized in special cases where deflection of the rough opening header would impinge on the window frames.

      1.6.2. Air Infiltration: Manufacturer's testing shall be in accordance with ASTM E 283 for compliance with maximum permissible air infiltration rate using the following criteria:

         1.6.2.1. Fixed Windows: Maximum rate of 0.10 cfm/sq. ft.

         1.6.2.2. Operating-projecting: Maximum rate of 0.10 cfm/sq. ft.

         1.6.2.3. Sliding Windows: Maximum rate of 0.30 cfm.

         1.6.2.4. All testing at a minimum of 6.27 lbs./sq. ft. pressure differential.

   1.7 Water Resistance: Manufacturer's testing shall be in accordance with ASTM E 331 for water resistance with no leakage as defined by the following criteria: No water shall penetrate through the perimeter framing; the exterior perimeter sealant joint; be visible on interior surfaces; be visible on sub-sill flashing; pass beyond the vertical plane intersecting the innermost framing

member; or be present within or enter the wall cavity during the water resistance test. All testing shall be done at a minimum of 12 lbs/sq. ft. differential pressure.

1.8. Uniform Load Deflection: Uniform load deflection test of the window system shall be conducted in accordance with ASTM Standards E330 Procedure A. Deflections shall be measured at the design pressures calculated by the Project Structural Engineer, whichever is greater. A minimum uniform load, as specified above, shall be applied to the test specimen, first to the exterior surface (positive) and then to the interior surface (negative). ***[The Project Structural Engineer shall calculate the specific design wind pressure values for their Project site. The calculated design wind pressure values shall be listed in this article. The Project Structural Engineer shall provide a negative and positive wind design pressure for exterior components and cladding on the structural drawings as required by the IBC. The window manufacturer shall not be responsible for calculating the Project's design wind pressure values.]*** The deflection of any framing member in a direction normal to the plane of the wall when subjected to the calculated design wind pressure, at both a positive and negative load, shall not exceed L/175 of its span.

1.8.1. When a plaster surface or gypsum wallboard subjected to bending is affected, defection shall not exceed L/360.

1.8.2. When a framing member overhangs an anchor point, deflection shall be limited to 2L/175, where L is the length of the cantilever member. When a plaster surface or gypsum wallboard subjected to bending on a cantilevered member is affected, defection shall not exceed 2L/360.

1.8.3. At perimeter frames, deflection shall be limited to ½ the perimeter sealant joint width (assuming a Class 50 or better sealant is used in the joint) minus anticipated movement from thermal and other movement unrelated to deflection related loads from adjacent materials and the aluminum-framed entrance.

1.9. Uniform Load Structural: Uniform load structural tests of the window system shall be conducted in accordance with ASTM Standards E330, Procedure A. The window system shall be subjected to a minimum structural test pressure of 1.5 times the design wind pressure specified in Uniform Load Deflection above, and in the same load sequence as specified in Uniform Load Deflection above. After each specified loading, there shall be no: glass damage or breakage; damage to fasteners or anchors; hardware parts; support arms; actuating mechanisms; or any other damage which causes the window to be inoperable. There shall be no permanent deformation or set of any main frame, sash, sash member, leaf or panel in excess of 0.3% of its span for CW products or of 0.2% of its span for AW products.

1.10. Dead Load: Under dead load, for horizontal framing members which support glass, deflection of those members in the direction parallel to the plane of the wall, shall not exceed an amount which will reduce the glass bite below 75% of the design dimension nor an amount which would infringe upon necessary glazing clearances below. Deflection shall also be limited in this direction to provide at least 1/8" minimum clearance between the member and the top of the fixed glazed panel, glass or other fixed part immediately below. The clearance between the frame member and an operable window shall be at least 1/16".

1.11. Framing: Framing members for each individual glass pane shall be designed so the deflection perpendicular to the glass plane shall not exceed 1/175 of the glass edge length or 3/4",

whichever is less, when subjected to loads specified in the *current Minnesota State Building Code.*

1.12 Condensation Resistance: When tested in accordance with AAMA 1503, the condensation resistance factor for each type of window shall be not less than the following minimum levels of thermal performance on unit size as required to produce representative areas of framing and vision glass:

1.12.1. Architect shall specify appropriate condensation resistance factor for each type of window, in accordance with AAMA 1503. Use 99.6% Exterior Design Temperature listed in ASHRAE 90.1 when considering condensation resistance weather criteria.

When interior relative humidity is expected to exceed 30%, provide analysis that indicates the window system can perform against condensation in extreme Minnesota winter temperatures and adjust CRF accordingly.

1.12.2. Greater than or equal to ____CRF from frame and greater than or equal to ___ CRF for glass.

1.12.3. Except for size, test units shall contain the same weep holes, hardware and operating characteristics as the specified windows.

1.12.4. Data from calculations or simulations, such as NFRC 500-2010, test results on units of different size or unrepresentative framing/glass proportions are unacceptable.

1.13. Thermal Transmittance:

1.13.1. The thermal performance for each type of window shall not exceed what is allowed by the State Energy Code.

1.13.2. When tested in accordance with AAMA 1503, thermal performance for each type of window shall not exceed a Ufixed and Uoper of ____and ____ BTU/Hr/Sq. Ft./degrees F respectively. ***[A/E to coordinate U-Value with the specified CRF values.]***

1.13.3. As required by the Minnesota State Energy Code, the Solar Heat Gain Coefficients (SHGC) for aluminum-framed windows when tested in accordance with National Fenestration Ratings Council (NFRC) 201 test method shall be:

SHGC all: ____
SHGC north: ____
[A/E to specify the appropriate SHCGs based on the Minnesota State Energy Code requirements and the total percent wall area of fenestration.]

1.13.4. Test results may be derived by computer simulations for compliance with NFRC U-Factor, Solar Heat Gain Coefficient, Visible Transmittance, and Condensation Resistance Value. Simulations shall comply with NFRC 100 - Procedure for Determining Fenestration Product U-Factors; NFRC 200 - Procedure for Determining Fenestration Product Solar Heat Gain Coefficient and Visible Transmittance at Normal Incidence; and NFRC 500 - Procedures for Determining Fenestration Product Condensation Resistance Values. (Note that NFRC's Condensation Resistance Value is not equivalent to a Condensation Resistance Factor (CRF) determined by AAMA 1503.)

1.13.5. Visible Transmittance: The window units shall have a VT of _____. Visible Transmittance (VT) shall conform to the Minnesota Energy Code. Specified VT shall be determined in accordance with NFRC 200 by an accredited independent laboratory and certified by the manufacturer.

1.13.6. Thermal Movements: Provide glazed window systems, including anchorage, that accommodates thermal movements of window system and supporting elements when subjected to a temperature differential from -30 degrees F to +180 degrees F without buckling, damaging stresses on glazing, failure of sealant joints, overstressing of components, damaging loads on fasteners, noise or vibrations, and other detrimental effects.

1.14. Forced-Entry Resistance: Locks shall provide reasonable security against forced entry. All windows shall be tested according to ASTM F588, Grade 10.

1.15. Life Cycle Testing: For all Performance Class AW windows, when tested in accordance with AAMA 910, there shall be no damage to fasteners, hardware parts, support arms, actuating mechanisms or any other damage which would cause the window to malfunction, or to be inoperable, or exceed air infiltration and water resistance tests shall not exceed specified performance criteria.

1.16. Polyamide Thermal Barriers: Window Manufacture shall certify in writing that thermal barriers conform to quality assurance procedures outlined in AAMA QAG-2-12, and AAMA TIR-A8-08 - Structural Performance of Composite Thermal Barrier Framing Systems and AAMA 505-09 - Dry Shrinkage and Composite Performance Thermal Cycling Test Procedure.

1.17. Auxiliary Durability Tests: Perform additional performance tests on operable windows, dependent on specific product types, based on the design, function, and construction of the individual product such as deglazing test; sash/leaf tests; and hardware load tests.

[The Project Architect shall determine what tests are applicable to test the durability of the Project products. Refer to AAMA/WDMA/CSA 101/I.S.2/A440-11, Clause 9.3.6.]

1.18. Sound Transmission: If sound generating sources such as freeways, railroads, airports and industrial facilities are located adjacent to exterior windows, the Architect shall manage the sound transmission through the windows.

2. Submittals:

2.1. Product Data (PD): Submit manufacturer's specifications, technical product data, performance values, standard details of the products specified and manufacturer's certification of Installation Subcontractor and manufacturer's recommendations for installation.

2.2. Shop Drawings (SD): Submit Shop Drawings prepared under the direct supervision of the window manufacturer and their structural engineer for each type of product. Include the following:

2.2.1. Indicate layout and location of each window type, component dimensions and field verified openings. Continue the window designation established in the Architectural Drawings.

2.2.2. Elevations of each unit, drawn at 1/2" =1'-0" scale. Indicate frame joinery.

2.2.3. Full size section details of every composite member.

2.2.4. Anchorage fastener type and location, straps/plates and reinforcing steel as required by structural calculations.

2.2.5. Anodized finish.

2.2.6. Glass and glazing.

2.2.7. Sealants.

2.2.8. Submit four final, complete, Shop Drawing sets to the Architect, Owner's Representative, and the Owner (2 copies) prior to the start of fabrication. These final shop drawing sets shall incorporate all review comments and notations from previous Shop Drawing submittals. Final shop drawings shall be submitted at a minimum of 10 work days prior to the Pre-Installation Conference.

2.3. Samples(S): Submit window assembly sample showing corner section of typical window sill/jamb intersection, typical joints, weep system and sample anchorage. Samples shall be retained to verify installed units are in conformance with Construction Documents and the final approved shop drawings.

2.4. Test Reports / Calculations: The Contractor shall submit test reports on each window type. Each report shall be complete, prepared by an independent testing agency accredited by the AAMA, and shall indicate that each specified window type has been tested in accordance with these Specifications and performance criteria established in Part 1 of this Section. Previous independent test reports on window assemblies identical to the specified product and model are acceptable if, no change have been made to the product or the referenced tests have not changed. Test reports shall not be more than 10 years old.

2.5. Structural Calculations: Depending on the Project, submit structural calculations and anchorage details for any window framing prepared by an independent structural engineer licensed in the state of Minnesota, indicating adequacy of all installed materials including glass and glazing, to meet the structural load requirements as required by the uniform load structural test, the uniform load deflection test and dead load and framing criteria.

2.6. Compatibility: Submit written statement from the Manufacturer of the window materials that the Manufacturer has reviewed the all materials proposed for use for cleaning, for use on the window opening substrates, and the materials used to adhere and seal to the underlying substrates, are chemically and adhesively compatible with, materials used in their window assemblies and other products they may contact within the window assembly.

2.7. Contract Close-Out Submittals: As-built sets of Shop Drawings, prepared by the window manufacturer, showing the final configuration of the window installation per requirements of Division 1.

3. Quality Assurance:

3.1. Installer's Certification: Installation Subcontractor shall be a firm with a minimum of five years of experience specializing in the proper installation of the specified aluminum window assembly.

3.2. Manufacturer's Certification: Manufacturer shall submit written certification that the Installation Subcontractors have been approved by them to install their products.

3.3. The window manufacturer shall certify in writing that the completed windows have been fabricated, shop assembled, sealed and glazed in the manufacturer's plant in accordance with the Specifications and the final approved shop drawings.

3.4. Specify the Contractor shall provide written confirmation, 10 work days prior to scheduling a window pre-installation conference, from the window installation subcontractor that the wall opening conforms to the construction documentation and has been reviewed and is acceptable for commence the pre-installation conference trail installation.

3.5. The Contractor shall note that all building façade work is complete, including brick cleaning, air barrier, installation of cavity wall sealant joints, and all roofing work prior to convening the Pre-Installation Conference.

4. Pre-Installation Conference

4.2. There shall be a Pre-Installation Conference, in accordance with requirements of Division 1 - Project Meetings, after shop drawing review and prior to window installation. All windows shall be on-site prior to commencing the Conference. The Contractor shall provide a minimum of 10 working days written notice to all required attendees to schedule the conference and testing and to confirm that the window openings are complete and prepared for the trial window installation. The Contractor shall provide a minimum of 10 working days written notice for re-scheduled meetings and testing. The Owner, Contractor, Architect, Installation Subcontractors, window manufacturer's representative and other representatives directly associated with performance of Work shall be in attendance to: review Specifications; final approved shop drawings; objectives of Pre-Installation trial installation and testing; trial test procedures; schedule for window installation; observe trial installation(s); and testing. Trial installation and testing shall be completed and performed on each type of window unit, with the Owner retaining the right to randomly select units for installation. Verify that all key personnel who participate in the trial installation are committed to complete the remainder of the curtain wall installation for the Project.

4.2 Pre-Installation Conference trial installation and testing shall include:

4.2.1 The Contractor shall confirm that the trail installation(s) shall be complete in every detail, conforming to a final installation and shall serve as a test demonstration installation for the remaining Work. Window anchorage system, aluminum sills, weeps and exterior perimeter sealant joint shall be included in the trial installation.

4.2.2 The Owner will engage an independent, AAMA accredited testing agency to field test the completed trial window installation(s) for compliance with specified performance criteria for air infiltration and water resistance. The trial installation testing shall be by AAMA and ASTM test standards and per additional requirements, definitions and criteria listed in field quality control testing in Part 3. Testing shall occur prior to interior finish work, including interior perimeter sealant joint, to allow visual access to areas being tested to check for water penetration.

4.2.3 The Contractor shall assist with testing procedures and otherwise cooperate with the testing agency, and provide all necessary scaffolding, lifts, enclosures, temporary heat and other equipment and utilities to facilitate testing. The Contractor shall provide an uninterrupted power supply and uninterrupted water flow that delivers water uniformly against the test area at a minimum rate of 5.0 gal/sq. ft./hr. with a minimum

water line pressure necessary to deliver 12 PSI for the entire test area with a maximum test area of 100 sq. ft. Contractor shall make provisions with the local fire department /public works department to rent or utilize adjacent fire hydrants to provide required water supply when required.

4.2.4 The remainder of the window installation shall not proceed until trial installations have passed project requirements. If failures develop under testing, reasons for failure shall be identified by the Contractor and failures shall be repaired and retested until the installation is completely free of defects. All retests shall be performed by the Owner's testing agency. If failures develop under testing, the Contractor shall notify the Owner and the A/E as to when corrective work will be under taken and determinations will be made by them as to their presence for such Work. All re-observation, re-testing and associated costs shall be the responsibility of the Contractor and deducted from the Contract Sum by Change Order. No payments, partial or otherwise, will be made for the window products until the trail installations pass testing.

5. Warranty:

5.1. Provide copies of Warranties as specified under provisions of Division 1.

5.2 The window manufacturer shall certify in writing, separate from the all-inclusive warranty that the windows meet or exceed specified criteria; that component parts were properly designed and selected for locale and installation intended and that installation was made in accordance with the manufacturer's instructions.

5.2.1. Provide written all-inclusive warranty to the Owner, executed by the General Contractor, the Installation Subcontractors and the respective manufacturers of each product, that all parts of Work in this Section, including insulating glass units, shall be free from defects in materials, workmanship and installation for a period of three (3) years from the date of Substantial Completion. Should any defect develop during warranty period, such defects shall, upon request, be repaired or replaced at no additional cost to the Owner. Cost of such Work shall be borne by the Contractor.

5.2.2. Provide written all-inclusive warranty to the Owner, executed by the Installation Subcontractor and the respective manufacturers of each product, that all parts of Work in this Section, including insulating glass units, shall be free from defects in materials, workmanship and installation for a period of seven (7) years from the expiration of noted warranty in the above paragraph. Should any defect develop during warranty period, such defects shall, upon request, be repaired or replaced at no additional cost to the Owner. Cost of such Work shall be borne by the Installation Subcontractor.

5.3 Warranties shall be dated on the date of Substantial Completion and notarized by a duly authorized Notary Public of the State of Minnesota.

6. Manufacturers:

6.1. Appendix 1 of these Design Standards has a current listing of aluminum window manufacturers products approved for bidding.

6.2. Exterior perimeter sealant joints, shall match products selected for use by the building sealant Subcontractor.

6.3. Interior perimeter sealant joints shall be chemically compatible while also allowing for adhesive bonding to the air barrier detail membrane to provide a vapor tight installation. (Reference Minnesota State Exterior Masonry Design Standards Manual for work relating to the air barrier detail membrane.)

6.4. Specify that no sealants or primers shall not be applied when the air or substrate temperatures are 40 degrees F or below.

7. Materials:

7.1. Extruded aluminum prime billet 6063T6, ASTM B221. Aluminum sheet 5005 H34 (anodic), ASTM B209.

7.2. Steel, conforming to ASTM A36, hot-dipped galvanized in accordance with ASTM A123.

7.3. Nonferrous, nonmagnetic Stainless Steel, Type 304.

8. Aluminum Window And Components:

8.1. Minimum principal window member wall thickness: 1/8".

8.2. Overall depth shall be as required by structural calculations and as shown on the Drawings.

8.3. Thermal-break frame:

8.3.1. All window framing shall be of thermal break construction.

8.3.2. Provide thermal break construction that has been processed and tested to demonstrate resistance to thermal conductance and condensation, and has been tested to show adequate strength and security of glass and frame retention. The thermal barrier shall be concealed and located between exterior window members and window members exposed on interior, in a manner that eliminates direct metal-to-metal contact.

8.3.2.1. All exterior aluminum shall be separated from interior aluminum by a rigid, structural thermal barrier. For purposes of this specification, a structural thermal barrier is defined as a system that shall transfer shear during bending and, therefore, promote composite action between the exterior and interior extrusions.

8.3.2.2. No thermal short circuits shall occur between the exterior and interior.

8.3.2.3. The thermal barrier shall be INSULBAR® or equal, and shall consist of two glass reinforced polyamide nylon 6/6 struts mechanically crimped in raceways extruded in the exterior and interior extrusions. Polyamide shall be reinforced with 25% glass fibers in three axes.

8.3.2.4. Quality assurance records shall be maintained and available as requested.

8.4. Anchor Clips, Lateral Load Clips and Plates: Concealed and formed from dimensional stainless steel or steel, hot-dipped galvanized. Shape, size and spacing shall be per final shop drawings and submitted structural calculations. Anchor clips and lateral load clips shall not inhibit independent frame movement. Profile anchor clips and lateral load anchor clips at sill locations to avoid altering or contracting the stainless steel drip tray.

8.5. Formed Aluminum Sills:

8.5.1. Provide 0.090 thick formed aluminum sills in profile as shown on Drawings. Slope sills to provide positive drainage to the exterior. Furnish sills in one piece for full width of the window opening when permissible.

8.5.2. Provide continuous end caps to facilitate sealant installation and backer rod placement. Back seal for an air and water tight closure.

8.5.3. Provide ¼" wide slotted weep holes in drip profile. Spacing shall be 24" o.c. with two minimum, spaced 4" from each jamb. Install reticulated foam baffles over inner surface of weep.

8.5.4. Provide a 16 gauge formed stainless steel continuous keeper, with predrilled holes at 16" on-center. Diameter of predrilled holes shall correspond to recommendations and specifications of anchor manufacturer.

8.5.5. Anchors for keeper strip shall be metal alloy body with Type 304 stainless steel nail similar to the through-wall flashing termination bar fastener.

8.5.6. Provide splice joints and expansion joints where shown on the Drawings and final approved shop drawings. At splice and expansion joints, provide a 1/16" thick stainless continuous backer plate, formed to match the aluminum sill profile. Create a working sealant joint between sill sections and provide bond breaker where required.

8.5.7. Where support of the sill is required, provide 11 gage stainless steel angle support brackets, 3" wide, to support formed aluminum sill. Spacing shall be per aluminum window manufacturer's recommendations. Support brackets shall be secured to the brick wall at its base and screw fastened to the formed aluminum sill at its top edge.

8.6. Accessories:

8.6.1. Shims: PVC horseshoe shims in non-load bearing conditions and Korolath multipolymer plastic bearing shims per structural calculations, final shop drawing set. Horseshoe shaped Korolath shaped shims are not acceptable.

8.6.2. Window Frame Anchorage Fasteners: Stainless steel anchorage fasteners, heavy duty sleeve or expansion style, vibration resistant and removable, used to secure window frame and associated anchor clips and lateral load clips to concrete and grout-filled concrete block wall surrounds. Type, size and spacing shall be per structural calculations, final shop drawing set, and with current Minnesota State Building Code.

8.6.3. Mechanically galvanized or stainless steel, heavy duty screw fasteners may be used if conditions warrant or if required to comply with current Minnesota State Building Code.

8.6.4. Lighter-duty fasteners like Tap Con style fasteners shall not be permitted.

8.6.5. Sealant Backer Plate: Continuous PVC snap-in frame sealant backers as manufactured by window supplier.

8.6.6. Existing Window Replacement, Sub-flashing Membrane: Butyl Core, High Temperature Resistant, Self-adhering Membrane.

8.6.6.1. ProtectoWrap

8.6.6.2. WR Grace: Ice & Watershield Ultra

8.6.6.3. Dupont: Flex Wrap or Straight Wrap

Verify compatibility with all sealants and window components.

8.6.7. Hardware for Operable Windows: Specify hardware components such as concealed four-bar hinges, locks, keepers, roto-operators, concealed limited opening devices, and concealed friction adjusters. All steel components including attachment fasteners shall be stainless steel except where noted.

8.6.8. Insect Screens: Tubular extruded aluminum frames shall meet requirements of ANSI/SMA 1201. Aluminum screening mesh shall conform to ISWA IWS 089, with 18 by 16 mesh. Architect shall specify frame and mesh color.

9. Fabrication:

9.1. General:Units substituting built-up or snap-in pieces where specified unit has extruded materials shall not be accepted.

9.1.2 Fabrication shall not proceed until wall opening details have been verified and accepted by the window manufacturer and the final shop drawings has been completed.

9.1.3 Finish, fabricate and shop assemble in window manufacturer's authorized plant, under responsibility of one manufacturer, frame and glass members into complete windows.

9.1.4 No bolts, screws or fastenings shall attach through or into nor bridge thermal barriers or impair independent frame movement.

9.2. Frame:

9.2.1 Miter or cope, then heliarc weld or mechanically fasten each corner and seal weather tight. Joinery methods shall not discolor finish or be unsightly. Joinery shall be sealed weather tight with a free flowing small joint compound. Sill corner joinery shall be back sealed after assembly.

9.2.2 Provide weep slots at glazing pockets to drain any water within the pocket, to the exterior.

9.3. Glass and Glazing:

9.3.1 Provide glazing according to window and glass manufacturer's recommendation for sealants, glazing gaskets and tapes.

9.3.2 Provide setting blocks and edge blocking in material, hardness and locations according to window and glass manufacturer's recommendations.

9.3.3 Window units shall be factory glazed per manufacturer's standard wet/wet glazing system employing a silicone sealant cap seal at both exterior and interior conditions and glazing tape/gasket below the exterior and interior cap seals for a dual glazed condition. Provide a continuous sealant heel bead bridging between the perimeter of the interior lite of the insulating glass unit and the window frame, forming an air and water tight seal. Glazing and sealants shall be suitable for application specified and as tested and approved by the window and glass manufacturers.

9.3.4 Window framing shall fully capture each glass lite on all sides.

9.3.5 Weatherstripping: Bulb or fin-type neoprene, EPDM, dual-durometer PVC, polypropylene, TPE, as tested and approved by the window manufacturer. Miter, crowd, stake or join at corners per manufacturer's standard detailing. Provide drainage to the exterior as necessary. Weatherstripping shall provide an effective pressure-equalization seal at the interior face of the sash ventilator.

10. Finishes:

10.1. Exposed surfaces of all aluminum windows, components and trim shall receive an anodized color finish conforming to the Aluminum Association Designation, Architectural Class 1, AA-M10C22 and the following:

10.1.1 The anodic coating shall be continuous, fully sealed and free from powdery surfaces.

10.1.2 Coating thickness shall be a minimum of 0.7 mils when tested in accordance with ASTM B244.

10.1.3 Anodic coating shall be: ***[Architect to specify anodic coating A41-Clear or A44-Electrolytically Deposited Color.]***

11. Examination:

11.1. Construction at window openings and adjoining materials shall be verified as ready to receive the Work of this section. Installation start-up indicates acceptance of conditions.

11.2. Each window opening shall be properly prepared and cleaned before installation of window system and trim. Confirm that areas shown to receive sealant joints have been cleaned according to sealant manufacturer’s instructions.

11.3. Wall conditions at sill, jamb, and head shall not short circuit thermal break in frame when installed.

12. Installation:

12.1. Windows shall be installed in accordance with approved manufacturer’s instructions.

12.2. Provide anchor clips, lateral load clips, anchorage fasteners, shims and internal reinforcement as shown on the final approved shop drawings and structural calculations, to secure and properly support the window assembly to the wall surrounds. Account for differential movement between window frame and wall surrounds caused by but not limited to: calculated thermal expansion and contraction of window frame sections; building live and dead load movement; supporting structure movement such as story drift, column shortening, and long term creep; and lateral loads while maintaining perimeter expansion tolerances and independent frame movement as shown on the final approved shop drawings.

12.3. Continuously install sealant backers into frame prior to installation. Where insertion becomes discontinuous, provide special snap-in trim for uninterrupted continuity of sealant backer.

12.4. Tape side of sealant joint where it overlaps onto face of window frame to provide a straight line accurate match to the window frame edge. Freehand sealing shall not be permitted. Taping requirements shall be per sealant manufacturer’s recommendations.

12.5. Fasteners shall not be screwed into nor through the thermal barrier, nor short circuit the thermal barrier. Fasteners shall not be permitted in the weep system.

12.6. Anchor clips, lateral load clips and associated anchorage fasteners that penetrate the interior perimeter sealant joint shall be cap sealed to prevent air and vapor migration.

12.7. Anchor clips and lateral load clips shall not bridge the thermal barrier or create areas of thermal bypass.

13. Field Quality Control:

13.1. The Contractor shall provide written notice to the appropriate firms and/or agencies that the window installation is complete and ready for field quality control testing. The Contractor shall provide a minimum of 10 working days' notice for both initial and re-scheduled testing.

13.2. The Owner will engage an independent, AAMA accredited testing agency to field test the completed window installation for compliance with specified performance criteria for air infiltration and water resistance. Testing for the completed window installation testing requirements shall be by AAMA and ASTM test standards and per additional requirements, definitions and criteria listed in the field quality control testing requirements below. Testing shall occur prior to interior finish work, including interior perimeter sealant joint, to allow visual access to areas being tested to check for water penetration. The Contractor shall assist with testing procedures and otherwise cooperate with the testing agency and provide all necessary scaffolding, lifts enclosures, temporary heat and other equipment and utilities to facilitate testing. The Owner retains the option to waive portions of testing as specified. Owner will randomly select windows to be tested.

13.3. The Contractor shall assist with testing procedures and otherwise cooperate with the testing agency, and provide all necessary scaffolding, lifts, enclosures, temporary heat and other equipment and utilities to facilitate testing. The Contractor shall provide an uninterrupted power supply and uninterrupted water flow that delivers water uniformly against the test area at a minimum rate of 5.0 gal/sq. ft./hr. with a minimum water line pressure necessary to deliver 12 PSI for the entire test area with a maximum test area of 100 sq. ft. Contractor shall make provisions with the local fire department /public works department to rent or utilize adjacent fire hydrants to provide required water supply when required.

13.4. If failures develop under testing, reasons for failure shall be identified by the Contractor and failures shall be repaired and retested until the installation is completely free of defects. If failures develop under during testing, the Contractor shall notify the Owner and the Architect as to when corrective work will be undertaken and determinations will be made by them as to their required presence for such Work. All retests shall be by the Owner's testing agency.

13.5. All re-observation, re-testing and associated costs shall be the responsibility of the Contractor and deducted from the Contract Sum by Change Order.

08 51 13 Window Field Quality Control Testing requirements are as follows:

Method of Testing	Standard/Criteria (Pass/Fail)	Frequency	Action Required (If Failure)
Air Leakage: Conduct air leakage test per AAMA 502 and ASTM E783	AW Fixed: Maximum allowable rate of air leakage shall not exceed 0.10 cfm/sq. ft. AW Operating: projecting or casement: Maximum allowable rate of air leakage shall not exceed 0.10 cfm/sq. ft. AW Sliding: Maximum rate of air leakage shall not exceed 0.30 cfm/sq. ft. Minimum Positive test pressure: shall be 6.24 lbs. /sq. ft.	10% or a minimum of 3, whichever is greater.	For each failed test: 1. Identify reason for failure. 2. Repair failure and retest the installation unit until it is completely free of defects. 3. Test two additional window units, except at initial window installation test locations 4. The cost for all additional window tests are the responsibility of the contractor, including costs for the Owner, the Owner's consultants, and the Architect/Engineer.

Method of Testing	**Standard/Criteria (Pass/Fail)**	**Frequency**	**Action Required (If Failure)**
Water Penetration: Conduct water penetration tests per AAMA 502 and ASTM E1105.	No water shall: penetrate through the perimeter frame, the exterior perimeter sealant joint; be visible on interior surfaces, be visible on sub-sill flashing; pass beyond the plane parallel to the glazing (the vertical plane) intersecting the innermost projection of the window: or be present within or enter the wall cavity during the water penetration test. Minimum water penetration test pressure shall be minimum 12 lbs/sq.ft.	As defined above.	As defined above.

14. Protection and Cleaning:

    14.1. Completed systems shall be cleaned, inside and outside, promptly after installation of windows and sealants. Remove excess sealants, dirt or other contaminants from aluminum and glass surfaces and wall surrounds.

    14.2. Take protective measures to assure that the installation shall be without damage or deterioration at time of acceptance other than normal weathering. Should nay defect develop prior to the Date of Substantial Completion of the Work, such defects shall, upon request, be repaired or replaced at no additional cost to the Owner.

END SECTION

23 09 23 - DIRECT-DIGITAL CONTROL SYSTEM FOR HVAC

[This Division is currently under review.]

END SECTION

Appendix 1 - Approved Manufacturer's Product List

Fixed Windows

EFCO Series 550-I, fixed window (insulbar break)
EFCO Series 810-I, fixed window (insulbar break)
EFCO Series 3903, fixed window (insulbar break)

St. Cloud Window Series 2500, fixed window (insulbar break)

Wausau Series 2250i Invent fixed window (insulbar break)
Wausau Series 3250i Invent fixed window (insulbar break)
Wausau Series 4250i-Invent fixed window (insulbar break)

Wausau Series 2250i-XLT fixed window (HP insulbar break & dual/triple glazing)
Wausau Series 3250i-XLT fixed window (HP insulbar break & dual/triple glazing)
Wausau Series 4250i-XLT fixed window (HP insulbar break & dual/triple glazing)

Projected Windows

EFCO Series 550-I, projected window (insulbar break)
EFCO Series 810-I, projected window (insulbar break)
EFCO Series 3903, projected window (insulbar break)

Oldcastle Glass Engineered Products (formerly Moduline 324E), Signature 3250 projected window (insulbar break)

St. Cloud Window Series 2500, projected window (insulbar break)

Wausau Series 2250i-Invent projected window (insulbar break)
Wausau Series 3250i-Invent projected window (insulbar break)
Wausau Series 4250i-Invent projected window (insulbar break)

Wausau Series 2250i-XLT projected window (HP insulbar break & dual/triple glazing)
Wausau Series 3250i-XLT projected window (HP insulbar break & dual/triple glazing)
Wausau Series 4250i-XLT projected window (HP insulbar break & dual/triple glazing)

Horizontal Sliding Windows – Dual Track Sash

Wausau Series 4100i Horizontal Sliding Window

Horizontal Sliding Windows – Single Track Sash

Wausau Series 410i Horizontal Sliding Window

Pressure Wall/Curtain Wall

Graham Architectural Products 2000C Series (2” Face) Pressure Wall System
Graham Architectural Products 2500C Series (2½” Face) Pressure Wall System

Tru-Therm 25000 by Interclad (2½” Face) Pressure Wall System

Wausau 4375 Superwall (2-1/2” Face)
Wausau 4750 Superwall (2-1/2” Face)
Wausau 5250 Superwall (2-1/2” Face)
Wausau 6250 Superwall (2-1/2” Face)
Wausau 7250 Superwall (2-1/2” Face)
Wausau 7750 Superwall (2-1/2” Face)
Wausau 8250 Superwall (2-1/2” Face)
Wausau 10250 Superwall (2-1/2” Face)

Zero Net by Fremarq Innovations

<u>Aluminum Doors and Entrances</u>

Glazed Doors:

<u>For 3" wide stiles</u>:

Empirehouse	Magnum EM Series
Tru-Therm/Interclad	Endura II Series
CRL-US Aluminum	Durafront 800 Door
W.L. Hall	Tubecraft 30M Series

<u>For 5" wide stiles</u>:

CRL-US Aluminum	Durafront 850 Door

<u>For 6" wide stiles</u>:

Graham F-M Enterprises CMS 60	Campus Door Series
Empirehouse	Varsity Door Series
Tru-Therm/Interclad	Endura II Series
US Aluminum	Duracraft 900 Door
W.L. Hall	Tubecraft 60M Series

Thermally Broken Aluminum Doors and Entrances

Glazed Doors: *(Recommended only if interior humidity exceeds 55% in ASHRAE winter conditions)*

<u>For 6" wide stiles:</u>

Tru-Therm/Interclad	Perfect-Therm Thermal Door Series

Waterproofing – Exterior Membrane

Surface Conditioner:

American Hydrotech	Pre-Mixed Surface Conditioner

Liquid Membrane:

American Hydotech	Monolithic Membrane 6125
Tremco	TREMproof 6100
Henry	790-11 Hot Rubberized Asphalt Waterproofing
RE-Systems Group	Turbo-Seal U *(repair only)*

Sheet:

American Hydrotech	Flex-Flash UN 60 Mils

Protection Board:

American Hydrotech	Hydroflex 10 (Horizontal Only)
W. R. Meadows	PC-2 Sealtight Protection Coarse (Vertical)

Pedestrian Traffic Coating – Interior Concrete Deck

Primers:

Tremco	Vulkem #171, #181, and #191
BASF	MasterSeal P220/P222 *(formerly Sonneborn, Sonoguard #733, #770, and #772)*

Pedestrian Traffic Coating – Interior Concrete Deck (Continued)

Base Coat:

Tremco	Vulkem #350
BASF	MasterSeal M200*(formerly Sonneborn, Sonoguard Base Coat)*

Top Coat:

Tremco	Vulkem #351
BASF	MasterSeal TC225 *(Formerly Sonneborn, Sonoguard Top Coat)*

Sealants (For Exterior Walls):

Tremco	Dymeric 240FC

Joint Backer: (Compliance with ASTM C 1330, Type B, reticulated, bi-cellular, non-gassing polyolefin/polyethylene backer rod – For Exterior Walls)

Construction Foam Products, Inc.	Sofrod
Industrial Thermo Polymers	ITP Soft Type Backer Rod 104
BASF	Sonolastic Soft Backer Rod

Mortar Toppings

Toppings:

Sika	SikaTop 122
BASF Master Builders Solutions, Inc.	MasterEmaco T 1061 Rapid Mortar *(formerly Thoroc 10-61)*
BASF Master Builders Solutions, Inc.	MasterEmaco T430 Rapid Strength Mortar

Bonding Agents:

Sika	Armatec 110 Bonding Agent
BASF Master Builders Solutions, Inc.	MasterEmaco P-24 Bonding Agent

Tile Grout (Thin set multipurpose for use in setting floor tiles in conjunction with Pedestrian Traffic Coating)

HB Fuller	TEC TA392 Gray Superflex Premium Latex Modified Grout or equivalent

Epoxy Mortar Grout (for floor tile joints)

HB Fuller	TEC Epoxy Mortar Grout or equivalent

Stone Patch Repair

Cathedral Stone Inc.	Jahn Stone Patch
Condroco Corp.	Mimic
Edison Coatings, Inc.	System 45

Fireproofing - Spray Applied:

W.R. Grace	Monokote MK-6
Isolatek International	CAFCO 400 - Medium Density

Roof Drains

Josem Manufacturing Co.	Model 21500
MIFAB	Series R1200-JD-STR

Through-Wall Flashings

(Through-Wall Flashing shall be 2 mil. Stainless steel, type 304 laminated with polymer or fiberglass on one side or 5 oz. sheet copper laminated with non-asphaltic polymer or fiberglass fabric on both sides)

York Manufacturing, Inc.	Multi- Flash SS
Prosco, Inc.	R-Guard SS ThruWall
STS Coating Inc.	Wall Guardian SS TWF
York Manufacturing, Inc.	Multi- Flash 500, 5 oz. Copper Fabric Flashing
Advanced Building Products, Inc.	Copper Sealtite 2000, 5 oz. Thru-wall Flashing

Brick Ties at Through-Wall Flashings and Air Barrier Sheet Membrane - Type 304 Stainless Steel

Hohmann & Barnard, Inc.	HB-213-2X
Wire-Bond	2401 RJ-711, Adjustable Veneer Anchor w/2402 pintle

Through-Wall Flashing Sealants

York Manufacturing, Inc.	Great Seal, LT-100
UniverSeal	US-100
BASF	MasterSeal NP150 *(formerly Sonneborn, Sonolastic 150)* (For use with York Mfg. Flashings)
Advanced Building Products Flashing;	Sealtite Sealant

Prosoco, Inc.	FastFlash

Termination Bar Fasteners

Powers Fasteners	Zamac Nailin, (Stainless Steel Anchors with alloy body, ¼" diameter)
Fastenal	Nail-in SS Anchor

Appendix 2 – Definitions

Addenda: Written or graphic documents, issued before the bid opening date that modify, clarify or interpret the Bid Documents.

Addition: A floor or floors, a room, wing, or other expansion to and exiting building. Any new construction which increases the height or floor area of the existing building or adds to it.

Architect or Engineer (A/E): Registered design professional or firm hired to design a project or represent the Minnesota State Colleges and Universities during construction.

Agreement: The written legal document that binds two or more parties to specific and implied obligations, a contract.

Alteration: Construction in an existing building which may change the structural parts, mechanical equipment, or location of openings, but does not increase the overall area or the building. (Remodeling)

Annealed Glass: Glass without internal stresses caused by heat treatment (ie by rapid cooling, or by toughening or heat strengthening). Glass becomes annealed if it is heated above a transition point then allowed to cool slowly, without being quenched. Float glass is annealed during the process of manufacture. However, most toughened glass is made from float glass that has been specially heat-treated. Annealed glass breaks into large, jagged shards that can cause serious injury, and thus annealed glass is considered a hazard in architectural applications.

Authority Having Jurisdiction (AHJ): A building code or similar government official who interprets code requirements relating to the design and or execution of the Project Work.

The **American Institute of Architects (AIA):** A professional organization of registered architects.

As-Built Drawings (Record Documents): Drawings prepared after construction that describe the actual as-installed construction of a project.

Architect's Supplemental Instruction (**ASI):**– a document written by the Architect that clarifies the Construction Documents. No additional cost or time should be associated with this document.

B3: Buildings, Benchmarks and Beyond – State of Minnesota Sustainable Building Guidelines.

BECxA: Building Enclosure Commissioning Authority

Bid: A written proposal prepared by the bidder to enter into a contract to provide the labor and/or materials required by the terms of the Bid Documents.

Casework: The built-in cabinets, shelving, and counters that are part of the project construction. Usually, included in the construction cost as fixed equipment.

Chancellor: Chief Executive appointed by the Board of Trustees to administer the policies set forth by the Board of Trustees for the Minnesota State Colleges and Universities.

Change Order (CO): An amendment to the construction contract signed by the Contractor, the Architect, and the Owner that authorizes a change in the Work, an adjustment in the contract Sum, or the Contract Time, or both.

Concrete Masonry Unit (CMU): Concrete block used in construction typically used as a backer to clay brick veneer on Minnesota State buildings. Glazed or burnished CMU allowed for interior applications only.

Commissioning (Cx): The process at or near construction completion, when a facility is put into use to confirm that the building systems function as designed. The Commissioning Agent (CxA) may also be involved during the design phases of the Project.

Construction: Work done in building or altering structures, from land clearance through completion, including excavation, erection, and the assembly and installation of components and equipment. Includes alterations, repair or replacements, that involves skilled trades to perform work.

Construction Administrator (CA): A person, typically a representative from the A/E, that monitors the progress and quality of the Contractor's work through periodic site visits. The representative also responds to questions concerning the intent of the Contract Documents.

Construction Change Directive (CCD): A written authorization directing a change in the Work prior to or after agreement on adjustment, if any, in the Contract Sum, Contract Time, or both.

Construction Documents (CD): The phase of design where all elements necessary for the construction of the Project, including both graphics and written information are assembled.

Contingency: A line item and amount in a budget to cover unanticipated expenses that will occur during a Project. Project budgets often include contingencies to cover both construction and non-construction related items.

Construction Manager at Risk (CM@r): CM at-risk is a delivery method which entails a commitment by the construction manager to deliver the project within a Guaranteed Maximum Price (GMP). The construction manager acts as a consultant to the owner in the design phases (preconstruction services), and as a general contractor during construction.

Contract: The entire integrated agreement between two or more parties. In the context of this glossary, a Contract refers to the agreement between the Contractor and Owner, or between the A/E or their consultants, Owner's Representative and the Owner.

Contract Documents: The written agreement consisting of the Agreement between the Owner and the Contractor, the General Conditions of the Contract for Construction as amended by the Owner, Drawings, Specifications, Bidding Documents, Addenda issued prior to execution of the Contract, performance and payment bonds, insurance forms and modifications issued after execution of the Contract.

Contractor: The person or organization identified in the contract as the authorized representative to perform the construction work in accordance with the Contract Documents. The Contractor provides labor, materials, and equipment to accomplish the Work. Sometimes the Contractor is referred to as the Prime Contractor or General Contractor (GC).

Construction Specifications Institute (CSI) ~~()~~: A professional organization that developed a standard format to organize construction specifications by a list of numbers and subject titles providing information about construction work, requirements, products and activities into a standard sequence

College or University (**C/U)**: Community Colleges, Technical Colleges and State Universitiy Campuses that make up Minnesota State Colleges and Universities.

Date of Commencement of the Work: The date of the Owner's written Notice to Proceed.

Day: The term day, as used in the Bidding and Contract Documents, means calendar day, unless otherwise specified. **Deduct Alternate:** Project components that are desired by the Owner, but could be removed from the Project Work if the bids exceed the budget. Must be taken in numerical order.

Demolition: The systematic deconstruction of a building in whole or in part.

Design-Bid-Build (D/B/B): The traditional method of project delivery, in which the Owner commissions an Architect or Engineer (A/E) to prepare Drawings and Specifications under a design services contract, which are put out to bid, after which the Owner separately contracts with a General Contractor for construction.

Design Development (DD): The phase of design where the scheme selected during SD is developed and refined, materials selected, mechanical, electrical, structural, and other systems are defined and the size and character of the entire Project are established.

Drawings: The graphic or pictorial portions of the Contract Documents showing the design, location and dimensions of the Work, generally including plans, elevations, sections, details, schedules and diagrams.

Flashing: Material that is impervious to water that is used to redirect water out of a building wall cavity, and keep water from entering a building at the wall-to foundation transition or keep water from entering a wall cavity at roof-to-wall intersections or at the top of parapets.

Through-wall Flashing (TWF) is used to direct water out of a wall cavity and is typically 5 oz copper sheet laminated with nonasphalt ~~h~~ polymer or fiberglass on both sides. Base flashings, counter flashings and cap flashings are used in roofing applications at wall intersection or to wrap a parapet to keep water from getting under the roof system or from entering the wall. Base flashings are typically an EPDM type material, while counter flashing and cap flashings are typically sheet metal.

Furniture, Fixtures and Equipment (FF&E):, generally accessories included in a completed project to facilitate use of the spaces. FF&E items are typically separate from construction and are usually provided by specialty firms separate from construction contractors, and are movable or portable.

Final Completion: The stage in the progress of the Work when the Contractor has completed all of the Work for the Project, has fulfilled all requirements of the contract, has corrected all punch-list items, and the A/E has approved the final application for payment for the entire balance due the Contractor.

General Conditions (of the Contract for Construction): The part of the contract that prescribes the rights, responsibilities, and relationships of the parties signing the agreement and outlines the administration of the contract for construction, e.g., American Institute of Architects (AIA) Document A201.

Gross Square Feet (GSF): All of the floor space inside a building, measured from the outside surfaces of exterior walls.

Heat Strengthen Glass: Annealed glass that has been heat treated to induce surface compression, but not to the extent of causing it to break into small pieces like tempered glass.

Heating, Ventilation and Air Conditioning (HVAC): building interior mechanical systems which create and control environmental conditions within the Project spaces.

Higher Education Asset Preservation and Replacement (HEAPR): General Obligation bond funding used for removal of life safety hazards, building code violations, or structural defects and repair and replacement or building equipment or components that have reached the end of their life cycle. Referred to as Deferred Maintenance.

IAQ: Indoor Air Quality, measures taken to ensure a high level of air systems environmental conditions within the Project spaces.

Laminated Glass: A type of safety glass that holds together when shattered. Laminated glass is comprised of an interlayer, typically of PVC, between two or more layers of glass. Normally used when a possibility of human impact exists or where the glass could fall if shattered and where safety is a concern.

LEED: Leadership in Energy and Environmental Design – A voluntary, consensus based, market driven building measurement system designed for rating new and existing commercial, institutional and high-rise residential buildings. It is based on accepted energy and environmental principles and strikes a balance between established practices and emerging concepts. Provides a definitive standard for what constitutes a "green building".

Liquidated Damages (LD): A fixed sum as specified in the Agreement and which the Contractor is assessed as a measure of damages the C/U will have for each day the Work remains incomplete beyond the expiration of the contract time.

M&E: Mechanical and Electrical: Building environmental and power/lighting systems.

MERV: Minimum Efficiency Reporting Value – A filter efficiency rating based on a test method established by ASHRAE (American Society of Heating, Refrigerating and Air Conditioning Engineers). Efficiency categories range from 1 (very low) to 16 (very high).

Net Assignable Square Feet (NASF): The net square feet that can be specifically assigned to users.

Net Square Feet (NSF): The net floor space in a building measured from the inside surfaces of exterior walls and excluding interior walls, partitions, mechanical equipment rooms, restrooms/toilets, janitor closets, elevators, stairwells, corridors, hallways and lobbies.

Notice to Proceed (NTP): The official written notification by the Owner to a consultant or contractor that Work on the Project can begin.

Owner: The Minnesota State Colleges & Universities' Board of Trustees on behalf of the State of Minnesota. The College or University where the Project is located, or the System Office (SO) are the "user" or "client".

Owner's Budget: That portion of a Project Budget directly managed by the Owner (College/University), also referred to as "soft costs", comprising all overhead expenses related to the delivery of the Project except the construction budget. Overhead expenses include, but are not limited to, A/E fees, land costs, other consultant fees, FFE, and contingencies

Owner's Representative (OR): A person or firm contracted by the Owner to perform project management duties to assist the C/U Project Manager.

Pre-Bid Meeting: A meeting held prior to receipt of bids to give prospective bidders an overview of the Project and allow them to visit the site and observe the existing conditions.

Pre-Construction Conference: A meeting held prior to the start of construction to discuss the routing of communications, the construction schedule, use of premises, special requirements and procedures.

Predesign: The stage in the development of a project during which the purpose, scope, cost, and schedule of the complete project are defined and described.

Pre-Installation Conference: A meeting held prior to start of installation of critical items of the Work, to demonstrate understanding of workmanship quality and conformance with the specifications. Typically these meeting are required for waterproofing, masonry and flashings, curtain wall/windows, roofs and sealants.

Proposal Request (PR): - A written request prepared by the A/E and submitted to the Contractor, requesting costs to furnish all labor, materials, equipment and/or services for a possible change in the Work.

Project Budget: The total budget required to design, build and occupy a facility, composed of all Project related costs.

Project Manager (PM): The C/U representative who has delegated authority to manage construction and renovation of the Project at their campus. This person is involved in the A/E selection, reviews design documentation, hires consultants, prepares contracts, has approval authority for pay applications and change orders, and oversees the construction work through project close-out. The AE and the Contractor may also have team members with the title of Project Manager.

Program Manager: A representative from the Minnesota State System Office, Facilities Division that provides oversight and technical assistance to the C/U for design and construction projects.

The Project: The total design and construction of which the Work performed under the Contract Documents may be the whole or a part and which may include construction by the Owner or by separate contractors.

The Project Manual: A volume assembled by the A/E for the Work which may include the bidding requirements, sample forms, Conditions of the Contract and Specifications.

Punchlist: A list of incomplete items (usually minor) to be corrected by the Contractor after Substantial Completion and before Final Completion.

Quality Assurance (QA): All those planned and systematic actions necessary to provide verification and adequate confidence that a product or service will conform with specified requirements for quality. Specifications, testing and inspections used to ensure conformance with the intent of the Construction Documents.

Quality Control (QC): The assessment of the Work product compliance with specified and/or contract requirements. Quality Control is the responsibility of the Contractor during construction. QC is a system of procedures and standards by which the Contractor monitors compliance with the stated requirements of the Work. The Contactor is responsible for the finished product.

Renewal: The replacing or repair of something that is worn out, run-down, or broken. Replacement or the covering of existing materials (finishes), elements, equipment, or fixtures using new materials, elements, equipment, or fixtures that serve the same purpose.

Renovation: The process of improving a broken, damaged, or outdated structure. (also called remodeling)

Repair: Includes the patching, restoration, or (partial) replacement of worn of damaged materials, elements, equipment, or fixtures for the purpose of maintaining such components in good or sound condition with respect to existing loads or performance requirements.

Replacement: The complete removal and installation of a new building systems, equipment, or components that serve the same purpose.

Request for Information (RFI): – A written request from the Contractor to the A/E for clarification of either the Drawings or Specifications.

Request for Proposal (RFP): – A formal document detailing requirements for professional technical services and requesting written proposals which may be qualification based or monetary.

Schematic Design (SD): The phase of project design which defines the overall design intent, site location, general floor layout, description of infrastructure, selection of primary building systems and materials and how the C/U's program is to be satisfied within the budgeted construction cost.

Skylight: is a light transmitting fenestration (elements filling building envelope openings) forming all, or a portion of, the building's roof for daylighting purposes.

Specifications: A part of the Construction Documents contained in the Project Manual consisting of written requirements for materials, equipment, construction systems, standards and workmanship, usually prepared in a standard 49 part CSI format.

Subcontractor: A firm that has an agreement to perform Work for or supply materials to the Contractor. There is no contractual relationship between the Subcontractor and the Owner.

Submittals: Items that the Contractor must submit to the Architect for review and approval including, but not limited to such items as shop drawings, product data, samples, mock-ups, test results, warranties, operation and maintenance manuals.

Substantial Completion: The stage in the progress of the Work when all or a portion of the Work is sufficiently complete in accordance with the Contract Documents so that the Owner can occupy or utilize the Work, or a portion thereof for its intended use. Typically based on receipt of an Occupancy Certificate from the building code official or authority having jurisdiction over the Project.

System Office (SO): Minnesota State Colleges and Universities system offices located in St. Paul.

Tempered Glass: A type of safety glass (also known as toughened glass) that has increased strength and will shatter in small square pieces when broken.

USGBC: United States Green Building Council – Leader of a national consensus to produce new and existing building that deliver high performance inside and out.

The Work: The Construction and services required by the Contract Documents, whether completed or partially completed, and includes all other labor and materials, equipment and services provided or to be provided by the Contractor to fulfill the Contractor's contract obligations. The Work may constitute the whole or a part of a Project.

Upgrade: A replacement that significantly improves performance, appearance, or extended life use.