

## CHAPTER 9: SPECIFICATIONS

**INTRODUCTION**

Specifications define the qualitative requirements for products, materials, and workmanship upon which the content is based. They are organized into **50** Divisions and **6** digit numbering system. Section titles have been closely coordinated with the numbering system established in CSI's *new* Masterformat **2004** Edition. In certain instances, section titles vary slightly from those recommended, but only where necessary to make them correspond more closely to text subject matter.

The specifications are no more than outlines compiled to establish minimum quality requirements. They do not cover all materials required for a complete Project and do not attempt to include every possible variable, particularly where doing so would require an almost unlimited number of choices. These specifications are not to be used as bid documents.

Specifying methods include both performance (a statement of required results with criteria for verifying compliance, but without unnecessary limitations on the methods for achieving the required results) and reference standard (requirements set by authority, custom, or general consensus and are established as accepted criteria). There was no attempt to establish these specifications based on proprietary specifications which identify the desired products by manufacturer's name, brand name, model numbers, type designation, or other unique characteristics.

Section format conforms to 3 part arrangement developed by CSI and accepted by the Design Professionals to achieve uniformity in locating and organizing specification content.

Streamlined language is used where possible to describe requirements for products, systems, and processes. In these instances a generic term is punctuated by a colon and then followed by a list of requirements without a linking verb such as "shall be" or "provide" which is implied by colon.

Spelling and punctuation conform as closely as possible to current standards of usage. If conflicts occur between spelling of words in the dictionary versus industry practices, the latter takes precedence.

Minimums and maximums are defined in text only where possibility of confusion exists. Otherwise, because of the nature of this document, it shall be assumed items indicated in documents are guidelines and shall be adhered to, unless discussed with state authority.

Abbreviations included in text are defined in Chapter 1.

Demolition: Although Chapter 9 does not include an outline specification on demolition, special emphasis should be placed on recycling. With a demolition project, a recommendation should stress the need to recycle ceiling tile, carpet, and other materials where recycling programs are available.

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# **01**

## **DIVISION**

### **GENERAL REQUIREMENTS**

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## SECTION 013100

## PROJECT MANAGEMENT AND COORDINATION

GENERAL GUIDELINES

## 1.1 SECTION INCLUDES

- A. Administrative guidelines for project management and coordination.

## 1.2 BUREAU OF BUILDING CODE COMPLIANCE MEETING

- A. Bureau of Building Code Compliance Meeting: CM will schedule a Building Code Compliance with Authorities with Jurisdiction, [Division of Industrial Compliance, 6606 Tussing Road, Reynoldsburg, Ohio 43068, (614)644-3334, [www.com.ohio.gov](http://www.com.ohio.gov).], at a time convenient to Owner, CM, and A/E, after execution of the Agreement and before beginning any on-site construction activities. Hold conference at Project Site or another convenient location. Conduct the meeting to review inspection responsibilities and personnel assignments.

- 1. Attendees: Authorized representatives of Owner, CM, A/E, and their consultants; Contractor and its superintendent; major subcontractors; testing agency; and other concerned parties shall attend the conference. All participants at conference shall be familiar with project testing and inspection requirements.

## 1.3 PRE-INSTALLATION CONFERENCES

- A. Pre-installation Conferences: A/E will schedule and conduct a pre-installation conference at Project Site before each construction activity that requires coordination with other construction and as indicated in the Contract Documents.

- 1. Attendees: Installer and representatives of manufacturers and fabricators involved in or affected by the installation and its coordination or integration with other materials and installations that have preceded or will follow, shall attend the meeting. Advise A/E and CM of possible meeting date a minimum of 72 hours in advance. A/E will schedule meeting.

LESSONS LEARNED

- 3.1 Modern technology has contributed to the development of many new building products. These new products and the creative use of existing materials by some architects have lead to many innovative construction procedures. As architects take advantage of the increasing availability of new materials, complicated installation details have become standard. Consequently, many building projects now include complex assemblies of materials that require more-than-normal care to execute.

- 3.2 Difficult material installations and complex assemblies usually demand considerable skill on the part of the Installer. When two or more trades are involved in an installation, close coordination is necessary to achieve satisfactory results. However, when assembly or installation is difficult or intricate, close coordination between the trades is *essential* to avoid problems or material failures. This is true of the mason and roofer for coordination of the thru-wall flashing at roof-wall intersections. It is recommended that special coordination meetings be required to address issues necessary to assure quality construction.

**GENERAL REQUIREMENTS****CHAPTER 9: SPECIFICATIONS**

- A. When a building project requires an unusual assembly of materials, a pre-installation conference is usually advisable to review installation procedures and establish responsibilities. Pre-installation conferences are also desirable for many routine construction operations such as built-up roofing and waterproofing. To avoid problems and material failures, many architects require pre-installation conferences to coordinate the installation of specific products or systems.
- 3.3 Pre-installation Conferences as Quality Assurance: Many architects have found that the pre-installation conference is their first opportunity to assess the Installer's understanding of the quality requirements in the specifications, and bring to their attention any special requirements or experience from past projects that may help avoid quality issues and rejected work. Through participation in pre-installation conferences and in reviewing of mockups, the Architect is able to assist the Owner in obtaining a better quality installation; consideration should be given those work results that would most benefit from a requirement for a pre-installation conference, as the conferences require a time and cost commitment from the Contractor and from the Architect.
- 3.4 Advantages: During a pre-installation conference, participants review conditions under which they will perform their work, resolve minor problems that may otherwise hinder or delay progress, and discuss procedures that require cooperation.
  - A. A pre-installation conference should not be held just to make the parties aware of each other's problems; these issues should be discussed at a regular progress meeting before installation begins.
- 3.5 Timing: A pre-installation conference should not be scheduled before preliminary work is complete. However, it should be held early enough to resolve potential problems; one week before installation begins is sufficient for many installations. For complex installation involving many trades and critical substrates, several sessions may be needed to clarify all issues.
- 3.6 Attendees: The Contractor's superintendent, the Architect's field representative or project manager, the Construction Manager, the subcontractors, and materials suppliers should attend pre-installation conferences. Often, representatives of various manufacturers, officials of testing agencies, and local building inspection officials also attend.
- 3.7 Location: A pre-installation conference is typically held at the jobsite to enable participants to review field conditions and evaluate critical substrates and other preparatory work, if necessary.
- 3.8 Agenda: The following issues are usually discussed at pre-installation conferences:
  - A. Procedures Review: Participants in a pre-installation conference review essential procedures the parties must follow, from initial preparation to protecting the completed installation. The conference gives participants an opportunity to review the sequence of operations. Some projects require special procedures for an installation, and this meeting gives the parties an opportunity to ensure that everyone understands these special procedures as well as their responsibilities regarding following them.
  - B. Conditions Review: Participants in a pre-installation conference should review pertinent conditions about installation, including timely access to the Work and environmental concerns. This conferences gives participants an opportunity to review the status of previously completed work before installation begins. If unsatisfactory conditions are

- discovered, the party responsible for the problem must take corrective action to remedy the situation without delaying progress.
- C. Schedules Check: A final review of all schedules for installation is a major agenda issue for pre-installation conferences. For large installations, staggered material delivery may help maintain progress without creating storage problems on-site. However, staggered material delivery must be carefully coordinated with work progress at all stages to avoid material storage at critical points in the installation process.
- D. Mockup Evaluation: On many projects, architects require the construction of mockups to establish the standard of performance of some critical construction operations. Pre-installation conferences give the participants an opportunity for a final review and evaluation of the mockups.

END OF SECTION

**GENERAL REQUIREMENTS****CHAPTER 9: SPECIFICATIONS****SECTION 014000****QUALITY REQUIREMENTS****GENERAL GUIDELINES****1.1 SECTION INCLUDES**

- A. Administrative guidelines for quality assurance and quality control.

**1.2 PRIME CONTRACTORS QUALITY CONTROL PLAN**

- A. Quality Control Plan, General: Each Prime Contractor shall submit quality-control plan not less than five days prior to preconstruction conference. Submit in format acceptable to Architect. Identify personnel, procedures, controls, instructions, tests, records, and forms to be used to carry out Contractor's quality-assurance and quality-control responsibilities. Coordinate with Contractor's construction schedule.
- B. Quality Control Personnel Qualifications: Engage qualified full-time personnel trained and experienced in managing and executing quality-assurance and quality-control procedures similar in nature and extent to those required for Project.
  - 1. Project quality control manager may also serve as Contractor superintendent or foreman.
- C. Submittal Procedure: Describe procedures for ensuring compliance with requirements through review and management of submittal process. Indicate qualifications of personnel responsible for submittal review.
- D. Testing and Inspection: Include in quality control plan a comprehensive schedule of Work requiring testing or inspection, including the following:
  - 1. Contractor-performed tests and inspections including subcontractor-performed tests and inspections. Include required tests and inspections and Contractor-elected tests and inspections.
  - 2. Special inspections required by authorities having jurisdiction and indicated on the "Statement of Special Inspections."
  - 3. Owner-performed tests and inspections indicated in the Contract Documents including test and inspections indicated to be performed by the Commissioning Authority.
- E. Continuous Inspection of Workmanship: Describe process for continuous inspection during construction to identify and correct deficiencies in workmanship in addition to testing and inspection specified. Indicate types of corrective actions to be required to bring work into compliance with standards of workmanship established by Contract requirements and approved mockups.
- F. Monitoring and Documentation: Maintain testing and inspection reports including log of approved and rejected results. Include work Architect has indicated as nonconforming or defective. Indicate corrective actions taken to bring nonconforming work into compliance with requirements. Comply with requirements of authorities having jurisdiction.



**1.3 QUALITY ASSURANCE**

- A. Mockups: Before installing portions of the Work requiring mockups, build mockups for each form of construction and finish required to comply with the following requirements, using material indicated for the completed Work:
1. Build mockups in locations and of size indicated or, if not indicated, as directed by Architect.
  2. Notify Architect and Construction Manager seven days in advance of dates and times when mockups will be constructed.
  3. Employ supervisory personnel who will oversee mockup construction. Employ workers that will be employed during the construction at the Project.
  4. Demonstrate the proposed range of aesthetic effects and workmanship.
  5. Obtain Architect's approval of mockups before starting work, fabrication, or construction.
    - a. Allow seven days for initial review and each re-review of each mockup.
  6. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.

**LESSONS LEARNED**

- 3.1 Mockups are full-size representations of the construction, materials, and finishes required by the Contract Documents. They can be used to verify selections made under Sample submittals, to demonstrate aesthetic effects, to provide coordination between elements, and to demonstrate the qualities of products and workmanship. Mockups are especially useful when quality of workmanship is a particular concern and is difficult to specify and enforce through reference to industry standards. For all but the simplest of mockups described in the specifications, Drawings delineating the extent and location of mockups are typically provided. The Architect may wish to observe the construction of mockups. The Contractor's construction schedule should indicate adequate time for construction and approval of mockups. Extensive mockups should also be included as a line item in the schedule of values.

- A. Mockups may simply be a portion of the Work completed for review prior to proceeding, or they may be extensive freestanding construction intended for demolition upon completion and acceptance of the Work. The individual specification sections indicate which type of mockup applies to which element of the Work.
- B. Freestanding masonry mockups can be excellent opportunities for "Quality Assurance" measures to verify flashing.
- C. Integrated exterior mockups incorporate mockup elements specified in several Specification Sections into a single, usually free-standing, assembly that also demonstrates successful interface between different materials and systems. Integrated mockups may be a valuable tool in enhanced building commissioning.
- D. Room mockups are full-size representative construction of one or several typical room types that may incorporate all specified materials, including fixtures and equipment. Room mockups are often used in projects to provide final verification of specified materials as well as to demonstrate an acceptable level of workmanship.

END OF SECTION

**GENERAL REQUIREMENTS****CHAPTER 9: SPECIFICATIONS****SECTION 015000****TEMPORARY FACILITIES AND CONTROLS****GENERAL GUIDELINES****1.1 SECTION INCLUDES**

- A. Administrative guidelines for temporary utilities, support facilities, and security and protection facilities.

**1.2 TEMPORARY UTILITY INSTALLATION**

- A. Heating and Cooling: Provide temporary heating and cooling required by construction activities for curing or drying of completed installations or for protecting installed construction from adverse effects of low temperatures or high humidity. Select equipment that will not have a harmful effect on completed installations or elements being installed.
- B. Isolation of Work Areas in Occupied Facilities: Prevent dust, fumes, and odors from entering occupied areas.
  - 1. Prior to commencing work, isolate the HVAC system in area where work is to be performed in accordance with approved coordination drawings.
    - a. Disconnect supply and return ductwork in work area from HVAC systems servicing occupied areas.
    - b. Maintain negative air pressure within work area using HEPA-equipped air filtration units, starting with commencement of temporary partition construction, and continuing until removal of temporary partitions is complete.
  - 2. Maintain dust partitions during the Work. Use vacuum collection attachments on dust-producing equipment. Isolate limited work within occupied areas using portable dust containment devices.
  - 3. Perform daily construction cleanup and final cleanup using approved, HEPA-filter-equipped vacuum equipment.
- C. Ventilation and Humidity Control: Provide temporary ventilation required by construction activities for curing or drying of completed installations or for protecting installed construction from adverse effects of high humidity. Select equipment that will not have a harmful effect on completed installations or elements being installed. Coordinate ventilations requirements to produce ambient condition required and minimize energy consumption.
  - 1. Provide dehumidification system when required to reduce substrate moisture levels to levels required to allow installation, application of finishes, and minimize the potential for mold growth.

**1.3 MOISTURE AND MOLD CONTROL**

- A. Contractor's Moisture-Protection Plan: Avoid trapping water in finished work. Document visible signs of mold that may appear during construction.

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**GENERAL REQUIREMENTS**

- B. Exposed Construction Phase: Before installation of weather barriers, when materials are subject to wetting and exposure and to airborne mold spores, protect as follows:
  - 1. Protect porous materials from water damage.
  - 2. Protect stored and installed material from flowing or standing water.
  - 3. Keep porous and organic materials from coming into prolonged contact with concrete.
  - 4. Remove standing water from decks.
  - 5. Keep deck openings covered or dammed.
  
- C. Partially Enclosed Construction Phase: After installation of weather barriers, but before full enclosure and conditioning of building, when installed materials are still subject to infiltration of moisture and ambient mold spores, protect as follows:
  - 1. Do not load or install drywall or other porous materials or components, or items with high organic content, into partially enclosed building.
  - 2. Keep interior spaces reasonably clean and protected from water damage.
  - 3. Periodically collect and remove waste containing cellulose or other organic matter.
  - 4. Discard or replace water-damaged material.
  - 5. Do not install material that is wet.
  - 6. Discard, replace, or clean stored or installed material that begins to grow mold.
  - 7. Perform work in a sequence that allows any wet materials adequate time to dry before enclosing the material in drywall or other interior finishes.
  
- D. Controlled Construction Phase of Construction: After completing and sealing of the building enclosure but prior to the full operation of permanent HVAC systems, maintain as follows:
  - 1. Control moisture and humidity inside building by maintaining effective dry-in conditions.
  - 2. Use permanent HVAC system to control humidity.
  - 3. Comply with manufacturer's written instructions for temperature, relative humidity, and exposure to water limits.
    - a. Hygroscopic materials that may support mold growth, including wood and gypsum-based products, that become wet during the course of construction and remain wet for 48 hours are considered defective.
    - b. Measure moisture content of materials that have been exposed to moisture during construction operations or after installation. Record daily readings over a forty-eight hour period. Identify materials containing moisture levels higher than allowed. Report findings in writing to Architect.
    - c. Remove materials that can not be completely restored to their manufactured moisture level within 48 hours.

**LESSONS LEARNED****3.1 Temporary Utilities**

- A. Temporary Heating and Cooling: Construction procedures require minimum temperatures for proper curing or drying. Architects should specify minimum temperatures for construction operations in the Sections for specific activities. Includes requirements for minimum temperatures in enclosed portions of the building to forestall the possibility of damage to the completed construction.

**GENERAL REQUIREMENTS****CHAPTER 9: SPECIFICATIONS****3.2 Security and Protection**

- A. Work in facilities may require special considerations for dust control and isolation of the building HVAC system. In addition to dust-tight temporary partitions, dust controls at openings to the work area, walk-off mats, negative pressurization, and independent temporary ventilation may be required.
- B. Temporary fire-protection provisions in the Section Text are essential but basic. Contractors must keep temporary fire protection operational until permanent fire protection is available. If permitted by the Owner, once permanent facilities are completed and placed in service, the Contractor may remove temporary facilities. Review provisions with the Owner's insurance carrier to see if additional provisions will result in lower premiums; also review NFPA 241, *Safeguarding Construction, Alteration, and Demolition Operations*, before editing these provisions.

**3.3 Environmental Considerations**

- A. **Mold and Moisture Protection:** In order to deliver a finished facility that is free of moisture damage and mold growth, the Contractor is responsible for taking appropriate steps during the construction to control the ingress of moisture, protect hygroscopic materials, and maintain a clean jobsite. Recommended procedures for controlling moisture during construction are well presented in the Associated General Contractors of America publication, *Managing Risk of Mold in the Construction of Buildings*.
- B. **Dust, Fume, and Odor Control:** Construction sites inherently product dust- and fume-producing environments. Work in occupied facilities poses special challenges with respect to protection of the occupants and maintenance of acceptable indoor air quality. Include general provisions for dust control, maintaining negative air pressure, and separating HVAC systems that are intended to protect occupants from pollutants generated by construction operations.

END OF SECTION

## SECTION 015800

## PROJECT IDENTIFICATION

GENERAL GUIDELINES

## 1.1 SECTION INCLUDES

- A. Signage identifying the construction and project team.

## 1.2 MATERIALS

- A. Lumber and Plywood
  - 1. For signs and directory boards, provide exterior marine plywood of sizes and thicknesses indicated.
  - 2. Treated lumber posts.
    - a. Preservative chemicals: Shall contain no arsenic or chromium.
- B. Paint
  - 1. For sign panels and applying graphics, provide exterior grade alkyd gloss enamel over exterior primer.

## 1.3 PROJECT IDENTIFICATION

- A. Project Identification and Temporary Signs: Prepare project identification and other signs of size indicated. Support on posts of framing of preservative treated wood or steel. Do not permit installation of unauthorized signs.
  - 1. Project Identification Signs: Engage an experienced sign painter to apply graphics. Comply with details indicated.
  - 2. Temporary Signs: Prepare signs to provide directional information to construction personnel and visitors.

LEED SUGGESTIONS

- 2.1 A. Credit EQ 4.4: For composite-wood products, consider using products containing no urea formaldehyde.
- B. Credit MR7: For wood products consider using materials obtained from forests certified by an **FSC**-accredited certification body to comply with FSC STD-01-001, "FSC Principles and Criteria for Forest Stewardship."

END OF SECTION

**GENERAL REQUIREMENTS****CHAPTER 9: SPECIFICATIONS**

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**PROJECT SIGN NOTES:**

1. (1) SIGNBOARD - 8'-0" X 8'-0" X 3/4" MARINE PLYWOOD
2. LETTERS - GREEN ON WHITE BACKGROUND/STRIP AND BORDER RED/ SIZES AS NOTED
3. (2) POSTS 10'-0" (4" X 4")/FIR TREATED AND PAINTED BROWN
4. CROSS BRACE 2" X 4" X 5'-0"/LET INTO POSTS
5. (4) CARRIAGE BOLTS 5/8" X 5" WITH WASHERS
6. LOCATION DETERMINED BY ARCHITECT IN FIELD
7. LETTER STYLE TO BE "HELVETICA MEDIUM"

## SECTION 017419

## CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL

GENERAL GUIDELINES

## 1.1 SECTION INCLUDES

- A. Salvaging nonhazardous demolition and construction waste.
- B. Recycling nonhazardous demolition and construction waste.
- C. Disposing of nonhazardous demolition and construction waste.

## 1.2 PERFORMANCE GOALS

- A. Salvage/Recycle Goals: As much demolition and construction waste as possible.

## 1.3 WASTE MANAGEMENT PLAN

- A. Types and quantities of demolition, site-clearing, and construction waste.
  - 1. Plan shall be approved by Construction Manager.
  - 2. Train workers, subcontractors, and suppliers on waste management plan.
  - 3. Distribute waste management plan to entities when they first begin work on-site.
- B. Type of waste and whether it will be salvaged, recycled, or disposed of in landfill or incinerator.

## 1.4 RECYCLING WASTE

- A. Recycling Incentives: Revenues and other incentives for recycling will accrue to Contractor.

LEED SUGGESTIONS

- 2.1 LEED for Schools includes credits for diverting materials from landfills. The project team is encouraged to work together to establish project goals for these credits.

LESSONS LEARNED

- 3.1 Everyone on the project team, including vendors, should be made aware of the project goals so materials are not disposed of that could have been salvaged. Signs should be posted at the waste collection areas indicating what should be done to accomplish project goals.

END OF SECTION

**GENERAL REQUIREMENTS****CHAPTER 9: SPECIFICATIONS****SECTION 017700****CLOSEOUT PROCEDURES****GENERAL GUIDELINES****1.1 TORNADO SHELTER AREAS**

- A. The 1999 “National Performance Criteria for Tornado Shelters” provided by FEMA recommends providing 5 SF per person standing (10 SF for wheelchair) for shelter area. The 1998 National Fire Code also has recommendations. The Design Professional for new school facilities should assist the school district in selecting the most obvious shelter areas. Shelter areas should be ADA accessible and could include toilet rooms, locker rooms, spaces below structural decks, smaller interior rooms, in spaces with short ceiling spans, and in the center of the building.
- B. It is not the intent of this section to require construction or improvement of a facility or area for use as a tornado shelter. Identified spaces should avoid walls of glass, windows, skylights, exterior walls, long open corridors, and modular classroom buildings.
- C. Prior to completion of required closeout items, the Design Professional shall submit, through the Construction Manager, to the school district, a floor plan indicating recommended tornado shelter areas for the building(s) involved. The floor plan shall be small scale and indicate spaces to provide 5 SF per occupant plus reasonable space for wheelchair occupants.
- D. OSFC and others involved in the development of this project closeout section do not make any representation, warranty, or covenant, expressed or implied, with respect to performance or results from recommendations herein.

**1.2 PROJECT RECORD DOCUMENTS**

- A. The Design Professional shall provide record documents to the School District prior to final completion. The record documents shall be in conformance with the requirements of A/E Contract Article 2.7.16, CM Contract Article 2.7.16 and 2.7.14, General Conditions Article GC 11.2.1, and other provisions of the closeout process as determined by the OSFC in accordance with the Policy and Procedure Memorandums.

END OF SECTION



## SECTION 018113

## SUSTAINABLE DESIGN REQUIREMENTS

GENERAL GUIDELINES

## 1.1 SECTION INCLUDES

- A. USGBC Leed for Schools: Silver certification based on LEED for Schools.
- B. A copy of the LEED project checklist is to be submitted by the Design Team to the OSFC at each phase submission and shall be attached to the this section for contractor's information only.

## 1.2 SUBMITTALS

- A. LEED Action Plans: The Design Team is encouraged to work with the Construction Team to develop an "Action Plan" within 30 days of date established for the Notice to Proceed:
  - 1. The "Action Plan" shall indicate contractor strategies for obtaining construction phase credits.
- B. LEED Progress Reports: Contractor shall, with each Application for Payment, compare construction and purchasing with LEED action plans.
- C. LEED Documentation Submittals: Contractor shall provide product data, receipts, certification letters, chain-of-custody certificates, and other documentation needed to show compliance with requirements.

LESSONS LEARNED

- 3.1 A LEED Action Plan can provide reassurance that the contractors understand the LEED requirements and can help to clear up misunderstandings before they become a larger problem.
- 3.2 It Owner authorizes use of permanent heating, cooling, and ventilating systems during construction period, verify installation of filter media having a MERV 8 according to ASHRAE 52.2 at each return-air inlet for air-handling system used during construction. Verify all filters are replaced prior to occupancy with MERV **rating indicated in the project specifications.**

END OF SECTION

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## SECTION 019100

## COMMISSIONING

Spec Writer Note: Development of this specification section requires coordination with the project CxA. The CxA will assist with developing this section to properly reflect the scope of work for the project.

GENERAL GUIDELINES

## 1.1 Referenced Standards

- A. LEED for Schools Credit EAp.1 and EAc3
- B. ASHRAE Guideline 0 - 2005
- C. ASHRAE Guideline 1.1 - 2007

## 1.2 Related Documents

- A. Owner Project Requirements (OPR), Basis of Design (BOD), Construction Drawings and Specifications, LEED documentation, Provisions of the Commissioning Services Contract, including General Conditions and Requirements, Supplementary Conditions, Revisions and other Specification sections, apply to work in this section.

## 1.3 Definitions

School District (SD or Owner)  
 Ohio School Facilities Commission (OSFC or Co-Owner)  
 Ohio School Design Manual (OSDM)  
 Architect/Engineering Firm (A/E)  
 Construction Manager (CM)  
 Commissioning (Cx)  
 Commissioning Authority (CxA)  
 Test and Balance (TAB)  
 Owner's Project Requirements (OPR)  
 Basis of Design (BoD)  
 United States Green Building Council (USGBC)  
 Design Team (A/E, CM)  
 Project Team (A/E, CM, Contractor, Owners)  
 LEED Accredited Professional (LEED-AP)  
 Commissioning Team (SD, OSFC, CxA, CM, HVAC contractor, ATC contractor, TAB contractor, electrical contractor, plumbing contractor, general contractor.)

## 1.4 General Work Included

- A. This section describes the process for commissioning of the various building systems, defines the responsibilities for the Project Team, and outlines the duties of parties involved.
- B. The commissioning process may be applied to all equipment, components, and systems to be commissioned as listed in Part 3 of this section, including specified interfaces to and from equipment and systems provided under the other Divisions of this Specification.

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- C. LEED for Schools EAp1 - Fundamental Cx- INTENT: Verify that the building's energy-related systems are installed, calibrated, and perform according to the Owner's Project Requirements, Basis of Design, and Construction Documents.
- D. LEED for Schools EAcr3 - Enhanced Cx - INTENT: Begin the Cx process early during the design process and execute additional activities after systems performance verification is completed.

**1.5 Commissioning Authority**

- A. The CxA shall confirm that major building systems in newly completed school facilities are good operational systems that are low on maintenance and operating costs and perform interactively according to the contract documents.
- B. Basic Services provided by the CxA are defined as services starting in the design phase through the warranty phase and include seasonal Cx. The CxA shall review design documents per LEED for Schools, develop a project specific Cx specification, develop and coordinate the execution of a testing plan, which includes observing and documenting system's performance to ensure that systems are functioning in accordance with the design intent of the contract documents and School District objectives.
- C. The CxA will conduct and document commissioning meetings.
- D. The CxA is not responsible for design or general construction scheduling, cost estimating, construction management, or performing corrective work, but shall assist with problem solving or addressing non conformance issues or deficiencies as identified by the CxA.
- E. (Spec Writer Note: Identify the CxA hired by the School District to act as the CxA for the project and insert into this paragraph.) The CxA is responsible to the owner and shall have the authority to recommend final acceptance of each system commissioned.

**1.6 Design Team (A/E and CM)**

- A. A/E will prepare the BoD and the construction documents per the OPR and the OSDM. This information must be submitted to the CxA for review.
- B. A/E is responsible for the LEED process for the project.
- C. A/E shall respond to the commissioning issues log.
- D. The CM shall attend the commissioning meeting.
- E. The CM shall prepare the Indoor Air Quality (IAQ) plan to be reviewed by the CxA per LEED for Schools EQc3.

**1.7 Contractors**

- A. The appropriate contractors shall be responsible for cooperating and coordinating their work during the commissioning process. They shall be responsible for performing all work required for the installation of the components and systems, and for operation during the commissioning process. They shall furnish all necessary resources to accomplish the installation and the commissioning.

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- B. Within 30 days of the award of Contract, the Contractor shall submit the names of all the trades people who will be part of the commissioning process. The Contractor, and all his sub-trades and suppliers, shall cooperate with the CxA in the commissioning process.
- C. At the initial commissioning scope meeting, to be held within 90 days of contract award, the contractor shall review the project schedule and identify the milestone commissioning activities. Milestone commissioning activities shall include, but are not limited to; equipment start-ups, system start-ups, testing activities performed by the contractor, readiness of each major system, and system functional testing as part of the commissioning process.
- D. Contractor shall attend commissioning meetings, and complete action items arising from them, as required to allow the commissioning process to proceed on schedule.
- E. Contractor shall complete and provide all system readiness documentation required by the commissioning process.
- F. Contractor shall provide a Start-up Plan for each piece of equipment and system that is identified to be commissioned. Notify the CxA a minimum of seven (7) calendar days before start-up of major equipment and systems.
- G. Contractors shall perform functional performance testing as specified in the CxA functional performance testing procedures.
- H. Contractor shall provide personnel and testing instrumentation required to operate and test equipment and systems as part of functional performance testing. Testing may include calibration verification of system devices. Testing shall take place under the direct supervision of the CxA. Contractor shall be responsible for reimbursing the Owner and CxA for costs associated with retesting of systems that fail initial testing.

## 1.8 Commissioning Documentation

- A. Commissioning Plan - Created by the CxA during the design phase of the project to identify scope of commissioning for the project and a preliminary schedule of activities for use during the project by members of the Commissioning Team.
- B. Commissioning Specification – Created by the CxA during the design phase of the project to be inserted into the construction documents. Specification shall include a sample test form for all major equipment.
- C. Meeting Minutes – Issued to members of the Commissioning Team after each commissioning progress meeting. Generated by the CxA.
- D. Commissioning Schedule – Produced by the CxA with the input from the CM and the Commissioning Team contractors.
- E. Design Phase documents – A/E will define the design intent for the Owner and for establishment of a basis for the Cx process. CxA will perform a design peer review report of the Owner's project requirements (OPR), Basis of Design (BoD), MEP Design Documents and the energy model. All documentation must be in compliance with LEED for Schools Credit EAc3 at each phased submission.

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- F. Start-up Plan – Submitted by the Contractor to identify methods to be used for equipment pre-checks, start-up procedures, start-up schedule, and sample reports to document completion. The Contractor shall document all equipment deficiencies and corrections made in the field as part of start-up report. Gather all appropriate utility information.
- G. Envelope Testing Plan – CxA shall develop a envelope testing plan, schedule and reports. Schedule shall be coordinated with the CM and contractors.
- H. Construction Phase documents – CxA shall provide a peer review and any comments on shop drawings to the designer of record. The CxA shall perform a peer review of the As-built documents at the end of the project.
- I. Test Reports – Reports generated by the Contractor to document system/equipment testing included in the contract that is not dictated by the CxA. (i.e. hydrostatic pipe test report, pipe flushing & disinfection report, air & water balance report, etc.) CxA shall provide a review of these test reports.
- J. Commissioning Issues Log – Identifies system deficiencies found through the commissioning process, updated and issued by the CxA.
- K. Functional Tests – Created by the CxA, reviewed by the Project Team and the Commissioning Team contractors, for use during functional testing of each system. Test shall incorporate the Engineers sequence of control.
- L. Training Plan – Submitted by the Contractor identifying personnel providing training and their qualifications, training supplemental materials and training session agendas for review by the CxA. Operation and maintenance manuals and as-builts shall be submitted to the CxA and the A/E to ensure completeness.
- M. Systems Manual – CxA shall compile the System Manual for the owner. System manual shall consist of the OPR, design narrative and BOD (by A/E), CxA narrative, performance metrics for pre design (by A/E), control drawings (ATC), table of setpoints (by A/E and ATC), energy saving strategies (by A/E), As-Built drawings (CM, A/E and contractor), re-commissioning plan and energy tracking recommendations.
- N. Final Commissioning Report – Provided by the CxA summarizing results, status of remaining operating deficiencies, and future actions and nonactions.
- O. Re-commissioning manual – Provide by the CxA to identify a re-commissioning plan in compliance with LEED Eac3.
- P. Commissioning Complete document– Formal Cx Project Complete document with sign-off to add finality to project.
- Q. Post-Acceptance Phase documents – CxA will provide a near-warranty-end review of commissioned equipment. CxA will participate in a project close-out meeting / walk-thru with the construction team near the end of the warranty period to review and provide updates of any remaining construction issues. CxA will provide a letter report, summarizing the status of any remaining construction issues after conducting this “End of Warranty Period” walk-thru.

**1.9 Testing Equipment & Instrumentation**

- A. The Contractor shall provide all industry standard test equipment required for performing the specified tests. Any proprietary vendor specific test equipment shall be provided by that vendor or manufacturer.
- B. Any portable or hand-held setup / calibration devices required to initialize the control system shall be made available by the control subcontractor at no cost to the CxA or Owner for use during functional testing or pre-check inspections.
- C. The Contractor's instrumentation shall be of sufficient quality and accuracy to test and/or measure system performance within the tolerances required. Instrumentation shall be calibrated at the manufacturer's recommendation intervals with calibration tags permanently affixed to the instrument. Instrumentation shall be maintained in good repair and operating condition throughout the duration of use on this project and shall be immediately re-calibrated or repaired if dropped and/or damaged in any way during use on the project.

**1.10 Direct Digital Control System Software & Hardware**

- A. The Automatic Temperature Control Contractor shall provide the CxA full access to the Direct Digital Control system at the start of the acceptance phase.
- B. System Software – The ATC Contractor shall provide the CxA with a copy of the system software and programming manual, including all diagnostic and trouble shooting features with license good for use during the project warrantee period. The ATC Sub-contractor shall provide the CxA training to allow navigation of the program. The security access should limit the CxAs ability to modify programming and only provide setpoint adjustment access, although does allow viewing of all system parameters and programming.

**1.11 Commissioning Process**

- A. General: The commissioning process depends upon proper coordination between all Commissioning Team members, strict adherence to schedule and completion of all required documentation. Responsibilities of each team member are described in this and other sections of the contract.
- B. Pre-Construction Phase
  - 1. Initial Input: CxA shall attend POR meeting with Design Team to review project scope. A/E shall have an eco-charrette meeting where the CxA, CM, and Owner provide input. No later than the Design Development Phase, the Design Engineer shall submit the BOD Design Intent, Energy Model, Sequence of Operation, and Design Drawings to the CxA for review and comment. The CxA design review will follow LEED for Schools.
  - 2. Preplanning: CxA will assist the A/E and CM in having the necessary commissioning language added to the bid documents and contractor requirements. CxA will work with the CM in adding the commissioning process into the project planning timeline and establish commissioning milestones.

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- C. Construction Phase
1. Commissioning Meetings: An initial Commissioning Scope Review/kick-off meeting will be held with all members of the Commissioning Team at the beginning of the project (generally within 90 days of award of contract). Periodic Commissioning Team progress meetings will be scheduled by the CxA to review progress of commissioning work and coordinate activities. (Commissioning progress meetings will be scheduled to coincide immediately before or after the regular weekly construction progress meeting.) Contractor shall anticipate at least one (1) commissioning meeting for every month of the construction phase (additional meetings as required will not be considered additional work to this contract).
  2. Commissioning Schedule: Contractor shall assist the CxA in the development of a written schedule that integrates the commissioning activities into the construction schedule specified in Division 1. Update of the commissioning schedule to reflect changes in the work will be done as necessary. The commissioning schedule shall include at least the following dates:
    - a. Submission of Operation & Maintenance information for systems to be commissioned.
    - b. Schedule for systems, subsystems, and equipment start-up, including services of manufacturers' authorized service representatives, and performance of pretest checks.
    - c. Schedule for functional performance testing, including seasonal testing.
    - d. Schedule for Building Envelope testing.
    - e. Schedule for Owner's operating personnel training.
  3. Equipment & System Start-Up: Before any equipment or system is started, the Start-up Plan, including all pre-start check documentation provided by the equipment manufacturer, must be submitted. A minimum of seven (7) days prior to the start-up, the contractor shall notify the CxA of the scheduled start-up and give the CA the opportunity to witness part or all of the start-up work, and conduct their own pre-check inspection. After start-up is completed, then contractor shall submit completed start up report for each piece of equipment.
  4. Prerequisite to Commissioning: Test and Balance report must be signed off by the Designer of record prior to final Cx of the respective systems. The CxA will observe, witness, and verify the TAB work in progress as necessary and correct. It is expected that all relevant and known punch-list items are addressed prior to that agenda Cx activity.
  5. Initial Operation: Once the Contractor completes the start-up, testing, balancing, and calibration of all components and systems, the Contractor shall operate all systems through the specified modes of operation, and test the system responses to specified abnormal or emergency conditions. It is the responsibility of the contractor to complete the system and perform this functional and performance pre-check before the commissioning team performs functional acceptance testing.
    - a. Functional acceptance testing included in the commissioning process is verification that the contractor has provided a complete and functioning system per the contract requirements. It is not, an opportunity for the contractor to determine deficiencies and work remaining.



- b. The contractor shall ensure that a qualified technician(s) is available and present during the agreed upon schedules and of sufficient duration to complete the necessary tasks, tests, adjustments, and/or problem resolution.
    - c. Functional testing of the system shall be terminated and re-scheduled if it is deemed by the CxA that the system is not ready for functional testing and that the contractor has not fully completed the required initial operation pre-check. Costs borne by the Owner, CxA, Construction Manager and Associates associated with the additional time and resources required to re-schedule and repeat testing due to a lack of system readiness by the contractor, shall be borne by the contractor.
  - D. Acceptance Phase
    - 1. Functional Acceptance Testing: Systems identified for commissioning shall be operated through the entire specified sequence of operations, as directed by the CxA for verifying acceptable operation. The contractor shall provide all testing instrumentation required and operate the system during the tests, and by this, the contractor shall ensure that the systems are not operated beyond their limits as installed.
    - 2. System Deficiencies: All system operational deficiencies identified during the functional acceptance testing will be recorded by the CxA for correction by the contractor. Work to correct the deficiencies will be under the direction of the Owner, the Owner's representative, or the Project CM. Final acceptance of the system shall not be granted until all deficiencies identified are corrected or accepted.
  - E. Post-Acceptance Phase
    - 1. CxA will provide a near-warranty-end review of commissioned equipment. CxA will participate in a project close-out meeting / walk-thru with the construction team near the end of the warranty period to review and provide updates of any remaining construction issues. CxA will provide a letter report, summarizing the status of any remaining construction issues after conducting this "End of Warranty Period" walk-thru.
- 1.12 System(s)/Equipment to be Commissioned
 

Spec Writer Note: Coordinate with the CxA and Owner which systems are to be commissioned for the project. HVAC systems and components listed are to be included in the basic project scope of work, although commissioning of additional building systems may also be added as an Owner's option.

  - A. The following systems shall be commissioned:
    - 1. HVAC Systems including:
      - a. Direct digital automatic temperature control system (building automation systems)
      - b. Air distribution systems (air handling units, VAV boxes, make-up air units, etc.)
      - c. Hot water heating system (including boiler(s), pumps)
      - d. Chilled water system (including chiller(s), pumps)
      - e. Exhaust systems
      - f. Unitary systems (heat pump units & unit heaters)
      - g. Variable frequency drives
      - h. Cooling towers
      - i. Hydronic systems

**GENERAL REQUIREMENTS****CHAPTER 9: SPECIFICATIONS**

- j. Electrical heating systems
- k. Utility service to HVAC systems
- l. Energy consumption
- M. HVAC Equipment Noise
- 2. Electrical Contractor Systems including:
  - a. Normal Power Distribution (Main to Sub-Panel)
  - b. Emergency Power System
  - c. Alternative Energy Systems
  - d. Lighting and lighting control
- 3. Plumbing Contractor Systems including:
  - a. Domestic Hot Water
- 4. General Contractor Systems including:
  - a. Classroom Acoustics per OSDM
  - b. Building Envelope
  - c. Kitchen Refrigerant Systems
- B. The following equipment shall be provided a formal start-up (refer to other sections of the project specification for additional start-up requirements):
  - 1. HVAC Equipment including:
    - a. Air Handling Units
    - b. Boilers
    - c. Pumps
    - d. Chillers
    - e. Fans
    - f. Unitary Equipment
    - g. Generator and Transfer Switches

END OF SECTION

**02**  
**DIVISION**  
**EXISTING CONDITIONS**

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024116	Structural Demolition
024119	Selective Structural Demolition
025000	Site Remediation

## SECTION 024116

## STRUCTURAL DEMOLITION

GENERAL GUIDELINES

## 1.1 SECTION INCLUDES

- A. Qualitative requirements for demolition and removal of buildings and site improvements.

## 1.2 QUALITY ASSURANCE

- A. Quality Standard: ANSI A10.6 and NFPA 241.

## 1.3 EXAMINATION

- A. Perform an engineering survey of condition of building.

## 1.4 DEMOLITION

- A. Use of explosives is not permitted.
- B. Below-Grade Construction: Demolish and completely remove materials within 5 feet of new building footprint.
  - 1. Remove to at least 12 inches below grade all material outside of building footprint.
- C. Existing Utilities: Demolish within 5 feet of new/existing building footprint and abandon outside footprint.

## 1.5 SITE RESTORATION

- A. Below-Grade Areas: Fill and rough grade.
  - 1. Fill with satisfactory soil materials, recycled pulverized concrete, or recycled pulverized masonry per Geotechnical Engineer's recommendation.

## 1.6 DISPOSAL OF DEMOLISHED MATERIAL

- A. Remove demolished material from site that cannot be salvaged or recycled and dispose of in an EPA-approved landfill.
- B. Burning: Not Permitted.

LEED SUGGESTIONS

- 2.1 Coordinate with goals for "Construction Waste Management" to divert demolition debris from landfills. Identify and document materials that can be recycled. Identify and document materials to be salvaged for reuse either on site or off site.

LESSONS LEARNED

- 3.1 If over one acre of site is disturbed outside of building footprint, the School District must apply for a Notice of Intent (NOI) for Coverage under Ohio Environmental Protection Agency General Permit. Comply with local authorities who have jurisdiction requirements.

END OF SECTION

**EXISTING CONDITIONS****CHAPTER 9: SPECIFICATIONS****SECTION 024119****SELECTIVE STRUCTURE DEMOLITION****GENERAL GUIDELINES****1.1 SECTION INCLUDES**

- A. Qualitative requirements for demolition and removal of portions of a building or structure and selected site elements.
  - 1. Salvage existing items that can be reused or recycled.

**1.2 EXECUTION**

- A. Professional engineer engaged to survey condition of building.

**1.3 DISPOSAL OF DEMOLISHED MATERIAL**

- A. Remove demolished material from site that cannot be salvaged or recycled and dispose of in an EPA-approved landfill.

**LEED SUGGESTIONS**

- 2.1 Large portions of existing structures that can be reused on a major renovation project may qualify for a LEED for Schools Materials and Resources, Building Reuse Credit. Design Professionals are encouraged to pursue these credits where possible.
- 2.2 Coordinate with Construction Waste Management Plan. Identify materials to be recycled. Identify materials to be salvaged for reuse either on site or off site.

**LESSONS LEARNED**

- 3.1 What is to be demolished and what is to remain should be clearly indicated on the Drawings. Distinguish between what is to be demolished and discarded, and what is to be reinstalled, salvaged, or protected.
- 3.2 ***If selective demolition involves the exterior walls or roof of a building, temporary enclosures need to be weather-tight and strong enough to withstand winds. Airborne particles and dust generated by selective demolition activities may also be of concern to occupants of other spaces in the building. The following requirements can also be added to the Section Text for selective demolition locations near occupied areas where dust and other possible pollutants may be an issue:***
  - A. ***Provide a vestibule enclosure at the entrance to the selective demolition area to create an airlock and suiting-up area.***
  - B. ***Specify access routes for equipment and personnel and removal routes for selective demolition debris to areas outside the building; use sealed transport containers in corridors.***
  - C. ***Provide exhaust systems to filter out and expel dust and airborne contaminants from the selective demolition enclosure directly to the outside. Design the system to provide negative air pressure in the selective demolition area relative to the adjacent spaces. The system can be designed and shown on the Drawings or the Contractor can be required to design the system to meet specific criteria.***
  - D. ***Provide replacement-air (makeup air) systems to condition and filter air to replace exhausted air.***
  - E. ***Clean and treat duct interiors with antifungal and antiviral agents after selective demolition is complete.***

END OF SECTION

## SECTION 025000

## SITE REMEDIATION

GENERAL GUIDELINES

## 1.1 SECTION INCLUDES

- A. *Qualitative requirements concerning remediation of typical environmental contaminants at school renovation/demolition sites.*

1.2 **ASBESTOS**

- A. *Under Environmental Protection Agency (EPA), National Emission Standards for Hazardous Air Pollutants (NESHAP), and inspection for asbestos-containing materials (ACM) must be completed prior to renovation or demolition of a facility. While some of the information in this report can be used, the Enhanced Environmental Assessment prepared for the Ohio School Facilities Commission does not satisfy this inspection requirement.*
1. *The inspection for asbestos-containing materials must be conducted by an Asbestos Hazard Evaluation Specialist (AHES) licensed by the Ohio Department of Health.*
  2. *To conduct this inspection, the AHES should be provided with the results of any previous sampling conducted for the District and will need to know whether or not the buildings or portions thereof will be demolished or renovated.*
  3. *If the building will be demolished, the AHES will need to know if the design for demolition will include requirements to recycle building materials or portion thereof.*
- B. *ACM is defined as those materials containing greater than 1% asbestos. Since OSHA still regulates the removal of materials containing less than or equal to 1% asbestos, OSFC policy is to treat all materials (even those containing less than 1% asbestos) as ACM.*
- C. *Prior to collecting bids for the removal of ACM found during the inspection, an asbestos hazard abatement design must be prepared by an individual licensed by the Ohio Department of Health as an Asbestos Hazard Abatement Project Designer.*
- D. *Generally, OSFC's policy is that all asbestos-containing materials be removed prior to renovation work. Materials allowed to remain in a facility during demolition under NESHAP regulations not be removed. Regulatory requirements regarding removal of asbestos-containing materials include, but are not limited to, the following:*
1. *Under NESHAP, EPA mandates the following:*
    - a. *Demolition Work: regulated Asbestos-Containing Materials (RACM) must be removed. RACM includes the following: friable ACM (e.g., fireproofing and mechanical insulation); Category I nonfriable ACMs that become friable or will be subjected to*

**EXISTING CONDITIONS****CHAPTER 9: SPECIFICATIONS**

sanding, grinding, cutting or abrading (e.g., non-intact/nonpliable resilient floor coverings and glazing compound); and Category II nonfriable ACMs (e.g., hard plaster, gypsum board and cement board) which have a high probability of becoming crumbled, pulverized, or reduced to powder during the course of demolition work. Typically, Category I nonfriable ACM and pliable Category II nonfriable ACMs need not be removed prior to demolition work where standard demolition procedures and equipment are utilized (i.e., wrecking ball and cranes, bulldozer wrecking, explosions/ implosions, heavy equipment loading and materials handling, etc.).

**1) Any Category I or Category II asbestos-containing material that becomes damaged from either deterioration or attempts at removal or abatement resulting in small fragments the size of four square inches or less shall also be considered friable or RACM.**

b. Renovation Work: if a variance to OSFC's policy regarding removal of all ACM is granted, NESHAP requires that ACM be removed prior to renovation if such work will disturb them.

2. In schools being renovated, abatement work shall also be conducted per EPA's Asbestos Hazard Emergency Response Act which includes, but is not limited to, procurement of air samples following asbestos hazard abatement work prior to dismantlement of work areas.

3. Occupational Safety and Health Administration (OSHA) Standards require implementation of appropriate engineering controls and work practices for renovation and demolition work where ACM is present. These controls and practices include specific methods for removal of each type of ACM, air monitoring, appropriate personal protective equipment, hygiene facilities, and proper containerization and disposal of asbestos waste.

OSHA also regulates disturbance of materials which contain trace amounts (one percent or less) of asbestos. For removal of materials containing trace amounts of asbestos, OSHA requires air monitoring of employee exposures, use of wet methods, and proper containerization of waste. Therefore, for purposes of this report, material containing trace amounts of asbestos have been treated as if they are ACM.

4. Ohio Department of Health (ODH) regulations require that credentialed and licensed personnel be used for asbestos-related work (survey, design, abatement work, etc.).

### 1.3 LEAD- AND CADMIUM-CONTAINING COATINGS

A. OSHA regulations apply to work that will disturb paint or any other coating that contains a detectable amount of lead utilizing a valid detection method. EPA regulations apply to work that will disturb coatings that contain lead in an amount equal to or greater than 1.0 mg/cm<sup>2</sup> or 0.5% by weight). Generally, since OSHA regulations will virtually always apply to renovation work, OSFC's policy is to assume that all coated surfaces contain lead and cadmium. However, in child-occupied facilities (any school built prior to 1978 where children under 6 years of age are present on a regular basis), one should consider having a full building or partial paint inspection completed in these types of facilities built between 1960 and 1978 to determine whether or not EPA's RRP regulations would apply (refer to paragraph 1.3.C below). Note that if a facility is inspected prior to renovation work, this inspection must be completed per Ohio Department of Health regulations using licensed lead inspectors or lead risk assessors.

B. In schools not defined as a child-occupied facility, the following language should be added to Bidding Documents: Contractors shall assume that painted and coated surfaces that may be disturbed during work contain lead and cadmium. Contractors shall follow applicable OSHA and EPA regulations.



**EXISTING CONDITIONS****CHAPTER 9: SPECIFICATIONS**

1. *OSHA requirements include, but are not limited to: air monitoring; engineering controls and respirator usage (based on results of air monitoring); designation of a competent person; certain housekeeping activities; handwashing facilities; hazard communication and safety training; and clean lunchroom facilities.*
  2. *EPA requirements include, but are not limited to sampling and/or disposal of lead waste.*
- C.** *In schools which are child-occupied facility (e.g., kindergarten classrooms, daycare facilities, etc.), the following language should be added to Bidding Documents: Contractors shall assume that painted and coated surfaces that may be disturbed during work contain lead and cadmium. Contractors shall follow applicable OSHA and EPA regulations, including EPA's Renovation, Repair and Painting Program Final Rule (RRP).*
1. *RRP requirements include, but are not limited to: use of certified firms, certified renovators, and trained workers; installation of job postings and demarcation signage; isolation of work areas; installation of polyethylene film over all flooring and objects; use of personal protective equipment; and prohibition of certain work activities.*
  2. *RRP also requires that, at a minimum, prior to opening a renovated area within a building to the public, that the work area pass a visual inspection and project cleaning verification process; this process includes the wiping of floors, countertops and sills with a cleaning cloth at least 3 times or until the cloth passes a visual cleaning standard.*

**1.1 MERCURY**

- A.** *Elemental mercury may be found in schools as follows:*
1. *Fluorescent and HID lamps contain mercury; EPA regulations require proper recycling and disposal of these lamps.*
  2. *HVAC and other mechanical components may utilize mercury switches and thermostats; EPA regulations require proper recycling and disposal of such devices.*
  3. *Elemental mercury is often found in school laboratories, occasionally in large quantities. Chemistry and physics labs may study its unusual properties, and labs may utilize mercury-containing devices such as thermometers and pressure gauges. EPA regulations require proper recycling and disposal of mercury from laboratories.*
  4. *Improper handling of elemental mercury from the above sources could result in mercury spills.*
  5. *Elemental mercury may contaminate building drainage systems, especially those drains serving laboratories. Often, plumbing traps and acid/neutralization tanks collect mercury that has been flushed down drains.*
- B.** *Polyurethane sport or recreational floor finishes may be present in schools, sometimes under newer floor finishes. Some polyurethane flooring was manufactured using mercury (and other heavy metals) salts as catalysts; as these floors age, they emit mercury vapor. Suspect polyurethane floors should be sampled to determine whether or not levels of mercury or other heavy metals used in their manufacture were in sufficient concentrations to trigger EPA Hazard Waste requirements. If mercury-containing floors will be left in place, mercury vapor sampling should be performed to determine that levels are safe for occupancy.*

**EXISTING CONDITIONS****CHAPTER 9: SPECIFICATIONS**

- C. Suspected mercury spills and mercury removal projects need to be evaluated by experienced consultants or health professionals. Remediation of mercury hazards should be performed by experienced and trained environmental contractors in accordance with EPA and OSHA regulations.**

**1.5 UNDERGROUND STORAGE TANKS (USTs)**

- A. USTs may be found on school sites. Active USTs should be evaluated to determine whether or not they meet current building and fire codes. Inactive USTs should be removed from the site during demolition or renovation work and proper site closure procedures and reports should be prepared.**
- B. In Ohio, BUSTR (Bureau of Underground Storage Tank Regulations, part of the State Fire Marshall's Office) regulates most gasoline and diesel USTs. BUSTR's mission is to effectively regulate the safe operation of underground storage tanks and to ensure appropriate investigation and cleanup of releases from USTs.**
- C. Heating oil USTs are not regulated by BUSTR, but BUSTR regulations are often followed for their design, maintenance and removal.**
- D. UST renovation/demolition work must be performed by BUSTR accredited firms and individuals.**

**1.6 POLYCHLORINATED BIPHEHYLS (PCBs)**

- A. Many schools in the U.S. have light ballasts containing PCBs. PCBs are contained within the ballast capacitors and potting materials.**
- B. In recent years, EPA has learned that caulk containing PCBs was used in some buildings, including schools, in the 1950s through the 1970s.**
- C. PCBs were widely used as an insulator and fire retardant in electrical transformers.**
- D. PCBs are regulated by the EPA under their Toxic Substances Control Act (TSCA). Materials containing PCBs must be disposed of properly.**

**END OF SECTION**

**03**  
**DIVISION**

**CONCRETE**

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### DIVISION 3: CONCRETE

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034100	Precast Structural Concrete
034500	Precast Architectural Concrete
035113	Cementitious Wood Fiber Decks
035216	Lightweight Insulating Concrete

## SECTION 031119

## INSULATING CONCRETE FORMING

GENERAL GUIDELINES

## 1.1 SECTION INCLUDES

- A. Qualitative requirements for an insulated concrete wall forming system. It is an expanded polystyrene concrete forming unit which is used to construct a monolithic reinforced concrete wall. The forms remain in place providing an energy efficient concrete wall and it is finished with conventional interior and exterior wall coverings.

## 1.2 MATERIALS

- A. Expanded Polystyrene: ASTM C 578.
- B. Cross Ties: Polypropylene.
- C. Concrete and Steel Reinforcement: Refer to Section 033000 – Cast-in-Place Concrete.
  - 1. Compressive Strength: 3000 psi minimum.
  - 2. Slump: 4 to 6 inches.

## 1.3 ACCESSORIES

- A. Bracing, wall alignment, and scaffolding.
- B. Window and door bucks.
- C. Bearing plates and rim joist brackets or anchors.
- D. Anchor bolts and plate anchors.
- E. Waterproofing for below grade applications. ***Refer to 071000 – Dampproofing and Waterproofing.***
- F. Exterior Finishes: Refer to Section 042000 – Unit Masonry.
- G. Interior Finishes: Must meet 15 minute thermal barrier requirements. Refer to Section 092116 – Gypsum Board Assemblies.

LESSONS LEARNED

- 2.1 Wall can achieve an R-value of greater than 20. Thermal comfort combined with thermal mass advantages yields potential energy savings.
- 2.2 Sound Attenuation can achieve an STC of 50 when a 6 inch core is used.
- 2.3 Fire Resistive Construction: Up to 4 hours can be obtained.
- 2.4 Storm Safe Occupancy: System can be reinforced to sustain wind loads in excess of 150 miles per hour.

END OF SECTION

## **CONCRETE**

## **CHAPTER 9: SPECIFICATIONS**

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## SECTION 033000

## CAST-IN-PLACE CONCRETE

GENERAL GUIDELINES

## 1.1 SECTION INCLUDES

- A. Qualitative requirements for curing, standard finishing, cements, aggregates, plasticizers and other chemical admixtures, additives, hardeners, and concrete reinforcement.

## 1.2 QUALITY ASSURANCE

- A. Quality Standard: ACI 301.

## 1.3 REINFORCEMENT MATERIALS

- A. Reinforcing Bars: Deformed.
- B. Welded Wire Fabric (WWF): Plain.
- C. Fibrous Reinforcement: (Optional) Fibrous reinforcement may be used in addition to welded wire fabric for concrete toppings and interior and exterior slabs on grade, whether exposed or covered with a floor covering. Use only fibrous reinforcement in precast concrete plank topping.
  - 1. Not to be used as a substitute for primary reinforcement for composite and non-composite elevated slabs or for interior or exterior slabs on grade.
- D. Carbon Steel Fibers:
  - 1. Carbon steel fibers may be used in concrete for slabs on grade in lieu of welded wire fabric and fibrous reinforcement, at a rate of 30 lbs/cu.yd. of concrete.
  - 2. Carbon steel fibers may not be used in concrete for elevated slabs on non-composite deck or steel centering in lieu of welded wire fabric and fibrous reinforcement.
  - 3. Carbon steel fibers may be used in concrete for elevated slabs on composite metal deck at a rate of 35 lbs. per cubic yard of concrete.
- E. Structural Macro Fibers:
  - 1. Structural macro fibers may be used in concrete for slabs on grade in lieu of welded wire fabric and fibrous reinforcement at a rate of 4 lbs. per cubic yard of concrete.
  - 2. Structural macro fibers may be used in concrete for elevated slabs on composite metal deck at a rate of 4.5 lbs. per cubic yard of concrete.
  - 3. Structural macro fibers may not be used in concrete for elevated slabs on non-composite metal deck.

**CONCRETE****CHAPTER 9: SPECIFICATION****1.4 CONCRETE MATERIALS**

- A. Portland Cement: ASTM C150, Type I, II, or III.
- B. Supplementary Cementitious Materials:
  - 1. Fly Ash: May be used up to a maximum of 25% of the total cementitious materials content in all concrete mixes.
  - 2. Ground Granulated Blast-Furnace Slag: May be used up to a maximum of 35% of the total cementitious material content in all concrete mixes.
- C. Aggregates
  - 1. ASTM C33, Class 3S, normal weight aggregates.
  - 2. ASTM C330, light weight aggregates.
- D. Water: Potable, ASTM C94.
- E. Concrete Admixtures: Containing less than 0.1 percent chloride ions.
  - 1. Water-Reducing Admixture: Type A.
  - 2. Retarding Admixture, Type B.
  - 3. High-Range Water-Reducing Admixture, Type F.
  - 4. Water-Reducing, Accelerating Admixture: Type E.
  - 5. Water-Reducing, Retarding Admixture, Type D.
  - 6. Accelerating Admixtures: Type C.
- F. Vapor Retarder:
  - 1. ASTM E-1745; meets or exceeds Class B, Water Vapor Permeance (ASTM E-96): 0.025 gr./ft<sup>2</sup>/hr. or lower.
- G. Concrete Curing Methods
  - 1. Keep concrete continuously wet.
  - 2. Covering concrete with mats.
  - 3. Covering concrete with impervious sheet.
  - 4. **Clear, waterborne dissipating liquid curing compound: to be used at all concrete floors scheduled to receive applied finish materials.**
  - 5. **Clear, waterborne membrane forming curing and sealing compound: to be used only at concrete floors not scheduled to receive applied finish materials.**
- H. Clear, Waterborne, Membrane-Forming Curing and Sealing Compound:
  - 1. Can be applied to floor not scheduled to receive a finish.

**1.5 PROPORTIONING AND DESIGN OF MIXES**

- A. Proportion mixes by either laboratory trial batch or field experience methods as specified in ACI 301, using materials to be employed on the project for each class of concrete required.
- B. Water/Cementitious Ratios: Concrete mixes shall be limited to the water/cementitious ratios specified in the Concrete Schedule.



**1.6 FLOOR AND SLAB FINISHES**

- A. Float Finish (Flt-Fn) - Noncritical Floors:
  - 1. Specified Overall Value: FF 20/FL 15.
  - 2. Minimum Local Value: FF 14/FL 10.
  - 3. Apply float finish to monolithic slab surfaces that are to receive trowel finish and subfloors under concrete toppings, thickset tile, sand bed terrazzo, and raised computer floors.
- B. Trowel Finish 1 (Tr-Fn1) – Carpeted Floors, unless otherwise noted.
  - 1. Specified Overall Value: FF 25/FL 20.
  - 2. Minimum Local Value: FF 17/FL 14.
  - 3. Apply trowel finish to monolithic slab surfaces that are to receive carpet and noncritical floors where slabs remain exposed, such as mechanical rooms, unless otherwise noted.
- C. Trowel Finish 2 (Tr-Fn2) – Floors with improved flatness/levelness requirements.
  - 1. Specified Overall Value: FF 35/FL 25.
  - 2. Minimum Local Value: FF 24/FL 17.
  - 3. Apply trowel finish to monolithic slab surfaces that are to receive thin-set flooring, resilient flooring, linoleum flooring, fluid-applied flooring, resinous flooring and other flooring types, unless otherwise indicated.
    - a. At thin-set tile floors, maximum permissible variation shall be ¼ inch to 10 feet from required plane. After surface is steel troweled, apply a fine broom finish.
- D. Trowel Finish 3 (Tr-Fn3) – Floors requiring better than average flatness/levelness.
  - 1. Specified Overall Value: FF 45/FL 35.
  - 2. Minimum Local Value: FF 30/FL 24.
  - 3. Apply trowel finish to monolithic slab surfaces that are scheduled to receive a polished concrete finish, unless otherwise noted.
- E. Trowel Finish 4 (Tr-Fn4) – Wood covered floors, and with other floor finishes as indicated in their technical sections and required by their manufacturers:
  - 1. The slab shall be steel troweled to a true level and finished smooth and straight to a tolerance of 1/8inch in any 10 foot radius.
- F. Nonslip Broom Finish (NsBrm-Fn): Apply nonslip broom finish to exterior concrete platforms, steps and ramps, and elsewhere as indicated.
  - 1. Immediately after float finishing, slightly roughen concrete surface by brooming with fiber bristle broom, perpendicular to main traffic route. Coordinate required final finish with the A/E before application.

**CONCRETE****CHAPTER 9: SPECIFICATIONS**

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**LEED SUGGESTIONS**

- 2.1 LEED for Schools includes credits for materials extracted/harvested and manufactured within a 500 mile radius from the project site. Concrete ready mix plants are so numerous that they are generally within 50 miles of most job sites. Supplementary cementitious materials, Portland cement, and the raw materials for cement are also generally extracted and manufactured within 500 miles of a job site as well.
- 2.2 Most reinforcing steel in the U.S. is manufactured from recycled steel. Steel from the Electric Arc Furnace (EAF) process contains a total of 100 percent recovered steel, of which 67 percent is post-consumer.
- 2.3 Supplementary cementitious material such as fly ash and slag cement are typically considered pre-consumer recycled material.

**LESSONS LEARNED**

- 3.1 Fly ash may improve workability, cohesiveness, and pumpability of fresh concrete and reduce concrete permeability with corresponding improvement in durability.
- 3.2 Fiber reinforcement may be used when plastic shrinkage reduction is sought.
- 3.3 Vapor Retarder is to be used directly below slab-on-grade.

(please see chart on next page)

**CONCRETE****CHAPTER 9: SPECIFICATIONS**

<b>CONCRETE SCHEDULE</b>		
(The following are minimum design values)		
ITEM OR STRUCTURE	FINISH	COMPRESSIVE STRENGTH AND OTHER REQUIREMENTS
Suspended slabs and concrete not otherwise indicated	RfFm-Fn SmFm-Fn, if exposed	3500 P.S.I. at 28 days Normal Weight Concrete: Minimum Cementitious Material Content: ACI minimum requirements Lightweight Concrete: Calculated Equilibrium Unit Weight: 110 lb/cu.ft, plus or minus 5 lb/cu.ft. per ASTM C567
Trench footings, footings, and interior foundations and retaining walls	RfFm-Fn SmFm-Fn, if exposed	3000 P.S.I. at 28 days
Foundation and retaining walls exposed to exterior	RfFm-Fn SmFm-Fn, if exposed, <b><i>UON A6-Fn, where noted.</i></b>	4000 P.S.I. at 28 days 4.5% - 7.5% air entrainment Max W/C Ratio = 0.45 Mid-Range Water Reducer Required
Interior formed concrete exposed to view	SmFm-Fn	4000 P.S.I. at 28 days <b><i>Max W/C Ratio = .055</i></b>
Interior floor slabs scheduled to receive mud-set mosaic and quarry tile	Flt-Fn	3500 P.S.I. at 28 days Max W/C Ratio = 0.45 Mid-Range Water Reducer Required
Exposed interior floor slabs and interior slabs scheduled to receive carpet	Tr-Fn1	3500 P.S.I. at 28 days Max W/C Ratio = 0.45 Mid-Range Water Reducer Required
Interior floor slabs scheduled to receive thin-set flooring, resilient flooring and other flooring types, unless otherwise noted	Tr-Fn2	3500 P.S.I. at 28 days Max W/C Ratio = 0.45 Mid-range water reducer
Interior floor slabs scheduled to receive a polished surface, and where indicated	Tr-Fn3	3500 P.S.I. at 28 days Max W/C Ratio = 0.45 Mid-range water reducer
Interior floor slabs scheduled to receive wood flooring, and where indicated	Tr-Fn4	3500 P.S.I. at 28 days Max W/C Ratio = 0.45 Mid-range water reducer
Exterior walks, stoops, steps, aprons, and curbs; exterior formed concrete exposed to view; exterior concrete not otherwise indicated	NsBrm-Fn Grt-Cl-Fn	<b><i>4500 P.S.I.</i></b> at 28 days 4.5% - 7.5% entrainment Max W/C Ratio = <b><i>0.45</i></b>
Metal stair pan fill, toppings over precast deck	--	2500 P.S.I. at 28 days #8 Aggregate (maximum)
Flowable fill – Type I Utility Trench Backfill	--	50-100 PSI at 28 days Unconfined compression strength per ASTM D4832
Flowable fill – Type II (option) Under Foundations	--	85 PSI at 28 days Unconfined compression strength per ASTM D4832
Lean concrete fill at soft soils or over excavations (option)	--	1500 P.S.I. at 28 days

END OF SECTION

**SECTION 033510**  
**POLISHED CONCRETE FINISHING**

**GENERAL GUIDELINES****1.1 SECTION INCLUDES**

- A. This Section covers the performance characteristics and application procedures for polishing of concrete. The process involves grinding and buffing concrete surface to provide a sheen. Application of a liquid densifier provides a non-dusting surface resistant to surface absorption of liquids.

**1.2 POLISHING MATERIALS**

- A. Liquid Densifier: Chemically reactive, waterborne solution of inorganic silicate or silicate materials; odorless; colorless which hardens and densifies concrete surfaces to protect against abrasion, dusting, and absorption of liquids.
- B. Joint Fillers: Two (2) component, 100 percent solids compound, with a minimum Shore D hardness of 50.
- C. Color (Optional): Ready to use, penetrating, dye or reactive stain that chemically combines with cured concrete to produce permanent, variegated or translucent color effects or a hydrolyzed, lithium quartz or silicate compound, that works by penetrating and reacting with mineral compounds and/or siliceous materials to create a translucent or marbled color effects.
- D. Polishing Equipment

**1.3 POLISHED CONCRETE APPLICATION**

- A. Grind the concrete floor to within 2 to 3 inches of walls or obstructions with 16, 25, 40, 60, 80, and/or 150 grit, removing construction debris.
- B. Apply material for color effects (optional).
- C. Apply liquid densifier.
- D. Polish the floor to desired sheen level.
- E. Edges may be painted, honed, or polished.

**LESSONS LEARNED**

**3.1 *Polished concrete is gaining popularity as a moderate-duty concrete floor that is low maintenance and environmentally-friendly. Diamond polishing technology adapted from the dimension stone industry is used to produce a concrete floor with moderate to high-gloss shine.***

- A. ***Polished concrete is considered an environmentally-friendly choice for hard-surfaced flooring, eliminating resilient floor coverings, adhesives, sealers, and waxes that contain VOCs. The low-maintenance finish requires only regular damp mopping and occasional light polishing to restore gloss, without the need for periodic waxing, stripping, or chemical cleaning. Furthermore, the high reflectivity of the surface can reduce the amount of artificial lighting required to achieve a given level of illumination.***
- B. ***Existing concrete flat work also can be polished following patching and crack repair as required to produce a sound surface.***

END OF SECTION

## SECTION 033519

## COLORED CONCRETE FINISHING

GENERAL GUIDELINES

## 1.1 SECTION INCLUDES

- A. Qualitative requirements for chemically staining and sealing **(or just sealing)** concrete flatwork.

## 1.2 POLISHING MATERIALS

- A. Liquid Densifier (optional): Chemically reactive, waterborne solution of inorganic silicate or silicate materials; odorless; colorless which hardens and densifies concrete surfaces to protect against abrasion, dusting, and absorption of liquids.
- B. Joint Fillers: Two (2) component, 100 percent solids compound, with a minimum Shore D hardness of 50.
- C. Color **(optional)**: Ready to use, penetrating, dye or reactive stain that chemically combines with cured concrete to produce permanent, variegated or translucent color effects or a hydrolyzed, lithium quartz or silicate compound, that works by penetrating and reacting with mineral compounds and/or siliceous materials to create a translucent or marbled color effects.
- D. Sealer: Water based acrylic for sealing concrete where regular maintenance is planned.  
***Designed to repel water, reduce scuffing and marring, allows substrate to breath, and produces a shine.***
  - 1. ***Sealer shall be compatible with stain where stain is used.***

END OF SECTION

**CONCRETE**

## CHAPTER 9: SPECIFICATIONS

## SECTION 034100

## PRECAST STRUCTURAL CONCRETE

**GENERAL GUIDELINES****1.1 SECTION INCLUDES**

- A. Qualitative requirements for precast reinforced concrete units.
  - 1. Plant-cast, load bearing, double-wythe, insulated, structural precast concrete units with an architectural finish for use as exterior building envelope and structural elements.
  - 2. Hollow-core slab and long-span plant-cast structural concrete units.

**1.2 QUALITY ASSURANCE**

- A. Design Standard: PCI MNL 120
- B. Quality-Control Standard: PCI MNL 116

**1.3 MATERIALS**

- A. **Form Liners (option)**
- B. Reinforcing Materials
  - 1. Reinforcing Bars: Deformed, deformed low-alloy, or galvanized steel.
  - 2. Steel Bar Mats: **Steel or low-alloy steel.**
  - 3. Welded Wire **Reinforcement:** Plain or deformed steel.
- C. Prestressing **Tendons**
- D. Concrete Materials
  - 1. Portland Cement: ASTM C **150**, Type I or III.
  - 2. Normal-Weight Aggregates: Except as modified by PCI MNL 116, ASTM C 33, with coarse aggregates complying with Class 4S.
  - 3. Admixtures: As recommended by **Design Professional**, unless otherwise noted.
  - 4. **Supplementary Cementitious Materials:**
    - a. Fly Ash may be substituted for up to 20 percent of the total cementitious materials.
    - b. **Ground granulated blast-furnace slag may be substituted for up to 50% of the total cementitious materials.**
- E. Steel Connections
  - 1. Finish: Painted, interior and galvanized for item in exterior wall or exposed to humidity above 50 percent.
- F. Bearing Pads: As selected by Design Professional.
- G. Rigid Insulation for Concrete Sandwich Panels: Extruded polystyrene rigid board.

**CONCRETE**

## CHAPTER 9: SPECIFICATIONS

- H.** Wythe Connectors for concrete sandwich panels: non-conductive, corrosion and alkali resistant, fiber composite wythe connectors, notched for retention.
- I.** Thin and half brick units and accessories.
- J.** ***Latex-portland cement pointing grout for thin-brick-unit joints.***

**1.4 CONCRETE MIX**

- A.** Compressive Strength (28 days): Normal-Weight Concrete: 5,000 psi

END OF SECTION

**CONCRETE****CHAPTER 9: SPECIFICATIONS****SECTION 034500****PRECAST ARCHITECTURAL CONCRETE****GENERAL GUIDELINES****1.1 SECTION INCLUDES**

- A. Qualitative requirements for architectural precast units.

**1.2 QUALITY ASSURANCE**

- A. Design Standard: PCI MNL 120.
- B. Quality-Control Standard: PCI MNL 117.

**1.3 MATERIALS**

- A. Reinforcing Materials
  - 1. Reinforcing Bars: Steel.
  - 2. Steel Bar Mats: Steel.
  - 3. Welded Wire Reinforcement: Plain steel.
- B. Prestressing Strands
- C. Concrete Materials
  - 1. Portland Cement: ASTM C 150, Type I or III.
  - 2. Supplementary Cementitious Materials: Fly ash and/or ground granulated blast-furnace slag.
  - 3. Aggregates: Normal weight or lightweight.
    - a) Face-Mixture Coarse Aggregates: Uniformly graded.
  - 4. Coloring Admixture, if required by Design Professional.
  - 5. Admixtures: As recommended by Design Professional.
- D. Steel Connections: Carbon-steel shapes and plates.
  - 1. Finish: Galvanized.
- E. Bearing Pads: As selected by Design Professional.
- F. Grout: Sand cement.

**1.4 CONCRETE MIXTURES**

- A. Compressive Strength (28 days):
  - 1. Normal-Weight Concrete Face and Backup Mixtures: 5000 psi

END OF SECTION



## SECTION 035113

## CEMENTITIOUS WOOD FIBER DECKS

**GENERAL GUIDELINES****1.1 SECTION INCLUDES**

- A. Qualitative requirements for monolithic cementitious wood-fiber units for roof deck installation and subpurlin tees for tile decks.

**1.2 MATERIALS**

- A. Cementitious Wood-Fiber Units
  - 1. Composition: Chemically processed long wood fibers mixed with Inorganic Hydraulic Cement, pressure bonded to produce units of thicknesses and sizes indicated.

**1.3 PRODUCTS**

- A. **Monolithic** Cementitious Wood-Fiber Units
  - 1. Tile: 2 inch minimum thickness.
  - 2. Plank: 2 inch minimum thickness.
  - 3. Channel-Reinforced Panels: 2 inch minimum thickness.
  - 4. Concealed Tee Plank: 3 inch minimum thickness
- B. **Composite Cementitious Wood-Fiber Units**
  - 1. **Composite Tile: 2 inch minimum thickness.**
  - 2. **Composite Plank: 2 inch minimum thickness.**
  - 3. **Composite Channel-Reinforcement Plank: 2 inch minimum thickness.**
- C. **Insulated Composite Cementitious Wood-Fiber Units**
  - 1. **Insulated Composite Tile:**
    - a) **Tile Base Thickness: 2 inch minimum.**
    - b) **Insulation Thickness: Total thickness shall be as required to meet value established by Energy Modeling.**
    - c) **Insulation: Extruded polystyrene.**
  - 2. **Insulated Composite Plank:**
    - a) **Base Thickness: 2 inch minimum thickness.**
    - b) **Insulation: Extruded polystyrene.**
    - c) **Insulation Thickness: Total thickness shall be as required to meet value established by Energy Modeling.**
  - 3. **Insulated Composite Channel-Reinforced Plank:**
    - a) **Base Thickness: 2 inch minimum thickness.**
    - b) **Insulation: Extruded polystyrene.**
    - c) **Insulation Thickness: Total thickness shall be as required to meet value established by Energy Modeling.**
- D. Subpurlins: Hot-rolled steel bulb tees
  - 1. Gypsum based grout should fill entire space between tile and bulb tee.

**LEED SUGGESTIONS**

- 2.1 **Construction Waste Management: Products are typically cut to 1'-0" length increments at factory reducing or eliminating field cuts and waste at site. Products can be shipped without packaging for minimum site waste.**
- 2.2 **Certified Wood: Products can be FSC and SFI certified.**
- 2.3 **Regional Materials: Products are manufactured in Ohio.**

END OF SECTION

## SECTION 035216

## LIGHTWEIGHT INSULATING CONCRETE

**GENERAL GUIDELINES****1.1 SECTION INCLUDES**

- A. Qualitative requirements for cast-in-place lightweight concrete roof insulation for roof decks.

**1.2 MATERIALS**

- A. General: Low density concrete, with an oven-dry unit weight not exceeding 50 lb./cu.ft., placed with or without embedded rigid insulation (EPS). Material shall be composed of a slurry of cement, water, and expansion material to produce an insulating concrete of a specific density range.
- B. Cement: Portland Cement.  
**1. Fly ash may be used up to 25 percent of Portland cement by weight.**
- C. Galvanized Plain-Steel Welded Wire Reinforcement.**
- D. Molded-Polystyrene Insulation Board.**

**1.3 PHYSICAL PROPERTIES**

	<u>Range II</u>	<u>Range III</u>
Cast Density	34-42 pcf	42-50 pcf
Compressive Strength	200 psi	250 psi
Roof Membrane Type	nailed base sheet	fully adhered system

END OF SECTION

# **04**

# **MASONRY**

# **DIVISION**

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DIVISION 04: MASONRY

<b>042000</b>	<b><i>Unit Masonry</i></b>
042250	Autoclaved Aerated Concrete (AAC) Masonry
042700	Glass Masonry Units
047200	Cast Stone

## SECTION 042000

## UNIT MASONRY

GENERAL GUIDELINES

## 1.1 SECTION INCLUDES

- A. Qualitative requirements for unit masonry assemblies.
  - 1. Masonry mortar and mixing masonry assemblies.
  - 2. Masonry grout and mixing masonry grout.
  - 3. Masonry anchorage and reinforcement devices.
  - 4. Masonry accessories.
  - 5. Manufactured concrete masonry units; both loadbearing and nonloadbearing and intended for use in unit masonry assemblies with mortar.
    - a. Concrete masonry units
    - b. Sound absorbing concrete masonry units
    - c. Sound diffusing concrete masonry units
    - d. Decorative concrete masonry units
  - 6. Manufactured clay masonry units; both loadbearing and non-loadbearing.
    - a. Brick
    - b. Structural-Clay Facing Tile

## 1.2 QUALITY ASSURANCE

- A. Masonry Standard: Comply with ACI 530.1 / ASCE 6 / TMS 602, unless otherwise noted.
  - a. Provide a 2-inch minimum clear air-space.
- B. Protection of Masonry: During erection, cover tops of walls, projections, and sills with waterproof sheeting at end of each day's work. Cover partially completed masonry when construction is not in progress.
  - 1. Extend cover a minimum of 24 inches down both sides and hold cover securely in place.
  - 2. Where one wythe of multiwythe masonry walls is completed in advance of other wythes, secure cover a minimum of 24 inches down face next to unconstructed wythe and hold cover in place.
- C. Mockups: Build mock-ups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials, execution, and aesthetic effect. Observation and evaluation of the mock-up shall be by the masonry installer, general trades contractor, A/E, CM, OSFC-PA, Commissioning Agent, window installer, **testing agency, and air barrier certifier**.
  - 1. Build mock-up of typical wall area(s) as shown on Drawings including Movement Control Joints (Sealant Filled) 1'4" (minimum length), Air Barrier, Blocking for Window, Horizontal and Vertical Reinforcing Shelf Angles and Supports, Bond Beams and Lintels, Brick Ties and Anchors Flashing, End Dams, Weeps and Vents, Cavity Drainage Material (if required), Window Head, Sill and Jamb Details.
    - a. Include a sealant-filled joint at least 16 inches long in each exterior wall mock-up.
    - b. Include lower corner of window opening at upper corner of exterior wall mock-up. Make opening approximately 12 inches wide by 16 inches high.
    - c. Include through-wall flashing installed for a 24-inch length in corner of exterior wall mock-up approximately 16 inches down from top of mockup, with a 12-inch length of flashing left exposed to view (omit masonry above half of flashing).

**MASONRY****CHAPTER 9: SPECIFICATIONS**

**d. Mock-up shall include a complete through-wall penetration by each trade contractor including fire protection, plumbing, mechanical and electrical.**

2. The window contractor shall provide and install in the mock-up wall a sample window of the type and profile used in the classrooms. (leaving portions of the perimeter exposed for inspection of the fasteners and air barrier transition to the masonry; some portions to receive final caulking inside and out)
3. Prior to starting general masonry cleaning, prepare mock-up for cleaning using the same cleaning materials and methods proposed for the Work.
4. Protect accepted mock-ups from the elements with weather-resistant membrane.
5. The construction of the mock-up shall be photographed or videotaped by the masonry contractor to be part of a presentation for groups of trades people as they join the project work force.

**6. Refer to OSDM page 9101-5 for additional information.**

**1.3 CONCRETE MASONRY UNITS**

- A. Concrete Masonry Units (CMU): Light weight, medium weight, or normal weight.
- B. Concrete Building Brick
- C. Sound Absorbing Concrete Masonry Unit (SACMU)
  1. Face sizes, unit weights, and finish textures shall match those of required regular concrete masonry units.
  2. Provide flared slots, metal septa, and incombustible fibrous cavity fillers of the following:
    - a. 8 inch (53 STC) and 12 inch (56 STC) thick walls.
- D. Sound Diffusing Concrete Masonry Units (SDCMU)
  1. Aggregate shall meet ASTM C90 and ASTM C129.
  2. Fiberglass inserts shall be installed at the block plant to ensure proper positioning.
- E. Decorative Concrete Masonry Units: Light weight, medium weight, or normal weight.
  1. Finish: Exposed faces of the following general description matching color, pattern, and texture of Architect's samples:
    - a. Normal-weight aggregate, ground finish (not acceptable if used as a comparison for LFI calculations)
    - b. Normal-weight aggregate, split-face finish
    - c. Normal-weight aggregate, split-ribbed finish
    - d. Normal-weight aggregate, standard finish, scored vertically so units laid in running bond appear as square units laid in stack bond
    - e. Normal-weight aggregate, standard finish, triple scored vertically so units laid in running bond appear as vertical units laid in stacked bond
- F. Prefaced Concrete Masonry Units: Light weight hollow or solid units with smooth resinous facing.
- G. Integral Water Repellent: Provide units made with liquid polymeric, integral water-repellent admixture that does not reduce flexural bond strength.

**1.4 BRICK**

- A. Face Brick: ASTM C 216
  1. Grade and Unit Compressive Strength: Provide units with grade indicated below:
    - a. Grade: SW., Type FBX or FBS

## CHAPTER 9: SPECIFICATIONS

**MASONRY**

- B. Building (Common) Brick: ASTM C 62 and as follows:
1. Grade and Unit Compressive Strength: Provide units with grade indicated below:
    - a. Grade: MW or SW.
  2. Application: Use where brick is indicated for concealed locations.
- 1.5 STRUCTURAL-CLAY FACING TILE
- A. Glazed Structural – Clay Facing Tile: ASTM C126, Grade S or SS.
  - B. Unglazed Structural – Clay Facing Tile: ASTM C212, Type FTX or FTS, Standard class.
- 1.6 STONE
- A. Stone Trim Units: Limestone.
- 1.7 MORTAR MATERIALS
- A. Portland Cement: ASTM C150, Type I or III, nonstaining, without air entrainment and of natural color or white, to produce the required color of mortar or grout.
  - B. Hydrated Lime: ASTM C207, Type S.
  - C. Portland Cement-Lime Mix: Packaged blend of portland cement complying with ASTM C150, Type I or III, and hydrated lime complying with ASTM C207.
  - D. Masonry Cement: ASTM C91. (optional)
  - E. Mortar Cement: ASTM C1329. (optional)
  - F. Aggregates: ASTM C144, except for joints less than 1/4 inch, use aggregate graded with 100 percent passing the No. 16 sieve.
  - G. Water: Potable.
  - H. Mortar Pigments: Natural and synthetic iron oxides and chromium oxides, compounded for use in mortar mixes.
  - I. Epoxy Pointing Mortar:
  - J. Integral Water Repellent Admixture (Exterior): An integral liquid polymeric admixture intended for use with concrete masonry units, containing integral water repellent.
- 1.8 MORTAR MIXES
- A. Do not use calcium chloride in mortar or grout.

TABLE A1 - Guide for the Selection of Masonry Mortars\* (Modified)

Location	Building Segment	Mortar Type
Exterior, above grade	loadbearing wall nonloadbearing wall, parapet wall, chimney and veneer wall	S N
Exterior, at or below grade	foundation wall, retaining wall, manholes, sewers, pavements, walks and patios	S
Interior	loadbearing wall nonloadbearing partitions	N N

\* This table does not provide for many specialized mortar uses, such as reinforced masonry, acid-resistant mortars and fire box mortar.

**MASONRY****CHAPTER 9: SPECIFICATIONS****1.9 GROUT MATERIALS**

- A. Portland Cement: ASTM C150, Type I.
- B. Fine Aggregates: ASTM C404, clean, sharp, natural sand.
- C. Coarse Aggregates: ASTM C404. Maximum aggregate size 3/4 inch.
- D. Water: Potable.
- E. Flyash: May be substituted for up to 20 percent of the total cementitious materials in the grout mix.

**1.10 GROUT MIXES**

- A. Grout mixes shall be plant mix or factory blended (dry mix with water added at the site).
- B. Do not lower the freezing point of grout by use of admixtures or anti-freeze agents.
  - 1. Do not use calcium chloride in grout.
- C. Grout for Unit Masonry: Comply with ASTM C476.
  - 1. Fine Grout: 2500 psi average compressive strength at 28 days for 6 inches and smaller hollow concrete masonry units and between 2 wythes of masonry where space is less than 2 inches in width.
  - 2. Coarse Grout: 2500 psi average compressive strength at 28 days for 8 inches and larger hollow concrete masonry units and between 2 wythes of masonry where space is 2 inches in width or wider.

**1.11 CONTINUOUS WIRE REINFORCING AND TIES FOR MASONRY**

- A. Masonry Joint Reinforcement.
- B. For single wythe and composite masonry, provide ladder type joint reinforcing.
- C. For multi-wythe masonry, provide as follows:
  - 1. When both wythes are to be constructed simultaneously:
    - a. Provide ladder type joint reinforcing.
  - 2. When each wythe is to be constructed separately:
    - a. Provide adjustable ladder type joint reinforcing fabricated with two steel side rods, cross rods, eyes and double legged pintles. Longitudinal rods shall be spaced for each face shell of CMU; eye sections shall extend into walls cavity, and pintles shall rest upon bed joints of face brick.

**1.12 ANCHORING DEVICES FOR MASONRY**

- A. Rigid Anchors: Where masonry is to be rigidly anchored to structural steel beams, provide galvanized steel straps, bars or rods welded to the steel beam and extending into the mortar joint.
- B. Flexible Anchors: Where masonry is to be laterally supported from structural steel, while permitting only vertical movement or both vertical and horizontal movement, provide adjustable anchors.



## CHAPTER 9: SPECIFICATIONS

## MASONRY

## 1.13 REINFORCING BARS

- A. Uncoated Steel Reinforcing Bars

## 1.14 FLASHING

- A. Embedded Flashing Materials
1. Provide one of the following types of flashing materials:
    - a. Copper-Fabric Laminate.
    - b. Rubber Asphalt Sheet Flashing.
    - c. Elastomeric Thermoplastic Flashing.
    - d. EPDM Flashing.
  2. Sheet Metal Drip Edge: Fabricated from stainless steel or copper with hemmed edge.
    - a. Application: Where drip edge is required per recommendations of NCMA-TEK 19-4, **and at all through wall flashings.**
    - b. Embedded flashing materials should not be used for drip edges.

## 1.15 INSULATION

- A. Insulation: Provide insulation as required to meet or exceed thermal performance required or modeled by ASHRAE Standard 90.1.
1. Primary insulation shall be one of the following:
    - a. Extruded-Polystyrene Board Insulation: ASTM C578, Type IV.
    - b. Closed-cell polyurethane foam insulation.
    - c. Closed-cell polyisocyanurate foam core insulation: ASTM C1289, Type I or II, Class 1 or 2, Grade 2 (20 psi).
    - d. **Foil faced closed cell rigid foam insulation.**
  2. Secondary, if required for thermal resistance:
    - a. Loose-Granular Fill Insulation.
    - b. Molded-Polystyrene Insulation Units.
    - c. Polyurethane Spray Foam (Foamed-in-Place Insulation).

## 1.16 RELATED MATERIALS

- A. Additional accessories, including compressible fillers, preformed control-joint gaskets, bond breaker strips, weep/vent products, cavity drainage material, reinforcing bar positioners and cleaners may be used at the discretion of the Project Designer to provide a complete weathertight masonry assembly.

## 1.17 CONTROL JOINTS – EMPIRICAL METHOD

- A. Concrete Masonry Units

TABLE 1  
CONTROL JOINT SPACING FOR RECOMMENDED ABOVE GRADE EXPOSED  
CONCRETE MASONRY WALLS (NCMA TEK-10-2B)

Distance between joints should not exceed the lesser of:	
Length to height ratio	or ft (m)
1-1/2	25 (7.62)

## Notes:

1. Table values are based on the use of horizontal reinforcement having an equivalent area of not less than 0.025 in.<sup>2</sup>/ft. (52.9 mm<sup>2</sup>/m) of height to keep unplanned cracks closed.

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2. Criteria apply to all concrete masonry units.
3. This criteria is based on experience over a wide geographical area. Control joint spacing should be adjusted up or down where local experience justifies but no farther than 25 ft. (7.62 m).
  - a. Where concrete masonry is used as backup of other materials:
    - 1) Extend control joints through facing if it is rigidly bonded (masonry bond).
    - 2) Control joint need not extend through facing when bond is flexible (metal ties).
  - b. Provide a horizontal slip plane where reinforced lintel beam terminates at a control joint. Provide horizontal slip plane at junction of roof and load-bearing masonry terminating at a control joint.
- B. Expansion Joints in Brick: Provide in accordance with BIA Technical Note No. 18B.

**1.18 FLASHING AND WEEP HOLES**

- A. General: Installed embedded flashing and weep holes in masonry at shelf angles, lintels, ledges, other obstructions to downward flow of water in wall, and where indicated.
  1. Install concealed through-wall flashing in accordance with SMACNA "Architectural Sheet Metal Manual" Chapter 4 Flashing and with NCMA TEK Bulletins 19-4 and 19-5 details to ensure water resistant masonry construction.
  2. Installed preformed corners and end dams, under flexible flashing membrane, bedded in sealant (as approved by manufacturer of preformed corner, end dams, and flexible flashing for compatibility) in appropriate locations along wall.

**1.19 SOURCE QUALITY CONTROL**

- A. Masonry Contractor shall water test cavity to verify all water is draining to the exterior through the weeps before continuing with exterior wythe before capping wall.
  1. Contractor shall perform tests in the presence of CM, A/E, testing lab representative, and General Contractor.
    - a. Do not proceed more than 3 veneer courses above flashing without testing, observation, and picture documentation by testing lab representative.
  2. Contractor shall hold water hose and with standard water pressure force water into the cavity at a cell vent so water can be observed coming out adjacent weeps for a period of at least 5 minutes. Contractor shall continue down the wall to the next cell vent where a weep did not indicate water wicking out and continue this process until the entire length of flashing is tested.
  3. Where water is observed inside the building or outside the building away from the weeps, masonry units shall be removed and flashing re-inspected and repaired.
  4. Water test shall be re-performed where flashing was repaired.

**LEED SUGGESTIONS**

- 2.1 Masonry normally generates large volumes of construction waste. However, masonry is clean waste and is, therefore, easily recycled as fill material.

## CHAPTER 9: SPECIFICATIONS

## MASONRY

LESSONS LEARNED

3.1 Flashing: Through-wall flashing and weep holes are detailed and installed in exterior masonry wall construction to collect and divert moisture to the outside of the wall that penetrates the exterior veneer. Through-wall flashing must be provided at the base of the wall, at roof and wall intersections, and at the top of parapets. Flashing is also needed over and under door and window openings, at shelf angles, and at other horizontal discontinuities in the cavity.

A. One non-ideal design issue that has surfaced is when the top of the roofing counter-flashing is not in the same joint as the bottom of the through-wall flashing. This causes some masonry to be unprotected. Since all masonry is permeable to water, water permeating this unprotected masonry can possibly enter the building. Ideally, the design would provide the through-wall flashing drip edge and the top of the roof counter-flashing in the same joint, thereby leaving no masonry wall area unprotected.

B. Flashing details that should be included to avoid construction deficiencies include:

1. Roof-wall flashing integration along sloped roofs.
2. Stepped counter-flashing along sloped roof-wall intersections.
3. Stepped roof-wall flashing and counter-flashing where the elevation of a flat roof changes.
4. Flashing integration where parapets intersect with walls.
5. End dams.

### 3.2 Weeps or Vents:

1. ***Weeps or vents installed at the top of walls, under window sills, etc. can aid in the venting of the cavity if properly installed and detailed and should be considered.***

### 3.3 Penetrations of joists, beams, etc:

1. ***Joists, beams and other items that penetrate the masonry wall should be sealed completely with grout on both sides of the wall to prevent rotation and to ensure that the cavity remains completely separated from the interior of the wall and building.***

Nominal Unit thickness, In.(mm) <sup>b</sup>	Density, pcf (kg/m <sup>3</sup> )	STC <sup>a</sup>			
Hollow unit	Grout-filled unit	Sand-filled unit	Solid unit		
4 (100)	85 (1,362)	43	46 <sup>c</sup>	45	45
	95 (1,522)	44	46 <sup>c</sup>	45	45
	105 (1,682)	44	46 <sup>c</sup>	46	46
	115 (1,842)	44	47 <sup>c</sup>	46	46
	125 (2,002)	45	47 <sup>c</sup>	46	47
	135 (2,162)	45	47 <sup>c</sup>	47	47
6 (150)	85 (1,362)	44	49	47	47
	95 (1,522)	44	50	48	48
	105 (1,682)	45	50	48	49
	115 (1,842)	45	51	49	50
	125 (2,002)	46	51	49	51
	135 (2,162)	46	52	50	51
8 (200)	85 (1,362)	45	53	50	50
	95 (1,522)	46	53	51	51
	105 (1,682)	46	54	51	52
	115 (1,842)	47	55	52	53
	125 (2,002)	47	55	52	54
	135 (2,162)	48	56	53	55
10 (250)	85 (1,362)	46	56	53	53
	95 (1,522)	47	57	53	54
	105 (1,682)	48	58	54	55
	115 (1,842)	48	58	55	57
	125 (2,002)	49	59	56	58
	135 (2,162)	50	60	56	59
12 (300)	85 (1,362)	47	60	55	55
	95 (1,522)	48	61	56	57
	105 (1,682)	49	62	57	59
	115 (1,842)	49	62	58	60
	125 (2,002)	50	63	59	62
	135 (2,162)	51	64	59	63

<sup>a</sup> Based on: grout density of 140 lb/ft<sup>3</sup> (2,243 kg/m<sup>3</sup>); sand density of 90 lb/ft<sup>3</sup> (1,442 kg/m<sup>3</sup>); unit percentage solid from mold manufacturer's literature for typical units (4-in.(100-mm) 73.8% solid, 6-in.(150-mm) 55.0% solid, 8-in.(200-mm) 53.0% solid, 10-in.(250-mm) 51.7% solid, 12-in. (300-mm) 48.7% solid). STC values for grout-filled and sand-filled units assume the fill materials completely occupy all voids in and around the units. STC values for solid units are based on all mortar joints solidly filled with mortar.

<sup>b</sup> Metric dimensions reflect equivalent metric unit sizes as opposed to direct SI conversions. Therefore, STC ratings of these hard metric units may be slightly different from the ratings listed here.

<sup>c</sup> Because of small core size and the resulting difficulty consolidating grout, these units are rarely grouted.

END OF SECTION

**MASONRY****CHAPTER 9: SPECIFICATIONS****SECTION 042250****AUTOCLAVED AERATED CONCRETE (AAC) MASONRY****GENERAL GUIDELINES****1.1 SECTION INCLUDES**

- A. Qualitative requirements for Autoclaved Aerated Concrete (ACC) Masonry Block

**1.2 AUTOCLAVED AERATED CONCRETE (ACC) BLOCKS**

- A. AAC Masonry Block: ASTM C1386 for tolerances, density, and compressive strength.

**1.3 ACCESSORIES**

- A. Mortar Materials: ASTM C 270.
- B. Reinforcement: Continuous wire reinforcing, horizontal wall reinforcing.
- C. Veneer Ties
  - 1. Anchors
  - 2. Fasteners
- D. Concealed Flashing Materials
  - 1. Copper-Fabric Laminate
  - 2. Rubber Asphalt Sheet Flashing
  - 3. EPDM Flashing

**LESSONS LEARNED**

- 2.1 *Autoclaved aerated concrete (AAC) is a type of lightweight precast concrete, prevalent in Europe, Asia, and in the Middle East and recently available through manufacturing facilities in the United States. It is made with portland cement, silica sand or fly ash, lime, water, and aluminum powder or paste. The aluminum reacts with the products of hydration to release millions of tiny hydrogen gas bubbles that expand the mix to approximately five times the normal volume. When set, the AAC is cut into blocks or slabs and steam-cured in an autoclave.***
- 2.2 *AAC is significantly lighter (about 1/5<sup>th</sup> the weight of traditional concrete) than normal concrete and can be formed into blocks or panels. Lighter weight concretes generally have greater fire and thermal resistance, but less strength than traditional normal weight concrete.***

END OF SECTION

## SECTION 042700

## GLASS MASONRY UNITS

**GENERAL GUIDELINES****1.1 SECTION INCLUDES**

- A. Qualitative requirements for glass block set in mortar.

**1.2 GLASS BLOCK**

- A. Hollow Glass Block: Hollow units made from transparent glass, with manufacturer's standard edge coating.
- B. Solid Glass Block: Colorless, transparent, solid glass block with smooth or stippled faces and manufacturer's standard edge coating.

**1.3 MORTAR MATERIALS**

- A. Portland Cement.
- B. Hydrated Lime.
- C. Portland Cement-Lime Mix.
- D. Aggregate.
- E. Water-Repellent Admixture: Provide at all exterior joints.

**1.4 ACCESSORIES**

- A. Panel Reinforcement: Ladder-type units, butt welded, not lapped and welded.
  - 1. Interior Walls: Hot-dip galvanized, carbon-steel wire.
  - 2. Exterior Walls: Hot-dip galvanized, carbon or stainless-steel wire.
- B. Panel Anchors: Hot-dip galvanized after fabrication.

END OF SECTION

**MASONRY****CHAPTER 9: SPECIFICATIONS****SECTION 047200****CAST STONE****GENERAL GUIDELINES****1.1 SECTION INCLUDES**

- A. Qualitative requirements for cast Stone Trim

**1.2 QUALITY ASSURANCE**

- A. Manufacturer Qualifications: Manufacturer is a producing member of the Cast Stone Institute, or has on file and follows a written quality-control plan that includes all elements of the Cast Stone Institute's "Quality Control Procedures Required for Plant Inspection."

**1.3 CAST STONE MATERIALS**

- A. General: Comply with ASTM C1364
  - 1. Portland Cement.
  - 2. Aggregates.
- B. Reinforcement: Use galvanized or epoxy-coated reinforcement when covered with less than 1½ inches of cast stone material.
- C. *Embedded Anchors: Hot-dip galvanized steel.***
- D. *Mortar: Portland cement and lime, masonry cement, or mortar cement.***

**1.4 FABRICATION**

- A. Provide units that are resistant to freezing and thawing.

**LESSONS LEARNED**

- 2.1 *The term 'cast stone' is defined by the Cast Stone Institute and in ASTM C 1364, Specification for Architectural Cast Stone, as architectural precast concrete building units intended to simulate natural cut stone. Cast stone is typically distinguished from other architectural precast concrete by its size (masonry- or stone-sized units rather than panels) and its finish, which is intended to simulate stone rather than look like concrete. Cast stone is usually made with more carefully graded aggregate and less water than most architectural precast concrete, giving it a higher compressive strength, lower water absorption, and a more void-free surface than most architectural precast concrete.***
- 2.2 *Cast stone is used, like limestone or sandstone, as a masonry material for architectural features and trim or as a facing for buildings or other structures. By carefully selecting aggregates, cement, and pigments and through controlled manufacturing techniques, cast stone can be made to resemble various varieties of limestone, sandstone, quartzite, granite, and other unpolished, cut building stones. This ability to simulate natural cut stone can be used to replace damaged natural stone in historic renovation work where the original stone is no longer available.***

- 2.3** *Cast stone units must be designed within the manufacturing and handling limitations of the production process. Keep units generally rectangular in cross section; avoid L or U shaped units. Avoid long thin units; length should not exceed 15 times the least dimension and should generally be no more than 96 inches. Thickness should never be less than 2 inches, and 3 inches, as a minimum, is even better. Curved sections should be limited to no more than 48 inches in length. Generally, size units so that their volume is about 1 ½ to 2 cu.ft. Bear in mind the casting process when designing with cast stone; the profiles of units must include adequate “draft”, which is the slope on surfaces that allows the cast stone unit to be removed from the mold. Also remember that repetition is the key to economy in any molded product; unless standard cast stone units are used, try to use as few types as feasible with as much repetition as possible.*

END OF SECTION

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# 05 METALS DIVISION

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## SECTION 051200

## STRUCTURAL STEEL FRAMING

GENERAL GUIDELINES

## 1.1 SECTION INCLUDES

- A. Qualitative requirements for structural steel, shop painting, grout, and related items necessary to complete the Work indicated.

## 1.2 QUALITY ASSURANCE

- A. Quality Standards: AISC 303 and 360.
- B. All load-bearing structural steel shall be fabricated and produced using only steel made in the United States in accordance with Sections 153.011 and 153.99 of the Ohio Revised Code (ORC).

## 1.3 MATERIALS

- A. Structural Steel Shapes: W-shapes, channels, angles, M-shapes, S-shapes, plate and bar, cold-formed hollow structural sections, and steel pipe.
  - 1. W-Shapes: ASTM A992.
  - 2. Channels, Angles, M- and S-Shapes: ASTM A36 or ASTM A572, Grade 50.
  - 3. Plate and Bar: ASTM A36 or ASTM A572, Grade 50.
- B. Steel Casings
- C. Steel Forgings
- D. Bolts, Nuts, and Washers: High strength and tension control, high strength
- E. Anchor Rods: Unheaded and headed rods, nuts, plate washers, and washers.
- F. Connectors: Shear connectors, threaded rods, clevises, turnbuckles, eye bolts and nuts and sleeve nuts.
- G. Structural Slide Bearings
- H. Primer: Zinc oxide, oil.
  - 1. Coordinate primers with topcoats, requirements for slip critical joints, and limitations of sprayed fire resistive materials.
- I. Grout: Metallic, shrinkage resistant and nonmetallic, shrinkage resistant.
- J. Bituminous Coating: Cold applied asphalt mastic.**

## 1.4 SHOP PRIMING

- A. Shop prime steel surfaces except the following:
  - 1. Surface embedded in concrete or mortar.
    - a. Apply a bituminous coating to steel embedded in concrete or mortar.**

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2. Surfaces to be field welded.
3. Surfaces to be high strength bolted with slip critical connections.
4. Surfaces to receive sprayed fire resistive materials (applied fireproofing).
5. Galvanized surfaces.

**1.5 GALVANIZING**

- A. Galvanize lintels, shelf angles, and welded door frames attached to structural steel frame and located in exterior walls.

**1.6 INSTALLATION**

- A. Erect structural steel in compliance with the AISC "Specifications and Code of Standard Practice."
  1. OSHA safety practices for steel erection per Federal Register 29 CFR 1926, Subpart R.

**LEED SUGGESTIONS**

- 2.1 LEED credits may be obtained under Materials and Resources for using materials with recycled content. The requirements are based on a cost-based formula for the total recycled content of all materials used on the project, excluding mechanical, electrical, and plumbing components and specialty items such as elevators, so that recycled content in high-cost items is significant. For steel-framed buildings, the recycled content of the steel goes a long way toward meeting the requirements for these credits.
- 2.2 The Steel Recycling Institute indicated that hollow structural shapes and steel plates are made by basic oxygen furnace method which typically has 23% post consumer recycled content and 1.5% preconsumer recycled content; rolled structural shapes are made by the electric arc furnace method, which typically has 57.5% postconsumer recycled content and 6.5% pre-consumer recycled content. The LEED Credit Interpretations allow the use of 25% for steel without any documentation, but for structural steel it is very worthwhile to obtain the required documentation because structural steel usually consists primarily of rolled structural shapes that have a much higher recycled content.
- 2.3 U.S.-EPA Comprehensive Procurement Guidelines (CPG) discusses steel manufactured in either a Basic Oxygen Furnace (BOF) or an Electric Arc Furnace (EAF). Steel from the BOF process contains 25-30% total recovered materials, of which 16% is post-consumer steel.

**LESSONS LEARNED**

- 3.1 A common coordination problem is the finishing of steel lintels and shelf (relieving) angles. Division 05, Section "Metal Fabrications" requires galvanizing of exterior loose-steel lintels or shelf angles; Division 05, Section "Structural Steel Framing" may require shop priming of structural steel members. If lintels or shelf angles are attached to the structural-steel frame, the steel fabricator may shop primer them unless the Contract states otherwise. If the Designer intends these lintels or shelf angles to be galvanized, retain this requirement in Division 5, Section "Structural Steel Framing".

END OF SECTION

## SECTION 052100

## STEEL JOISTS FRAMING

GENERAL GUIDELINES

## 1.1 SECTION INCLUDES

- A. Qualitative requirements for steel joists, accessories, and related items necessary to complete to the Work indicated.

## 1.2 QUALITY ASSURANCE

- A. Manufacturer Qualifications: A firm experienced in manufacturing joists similar to those indicated for this Project and with a record of successful in-service performance.
  - 1. Manufacturer must be certified by SJI to manufacture joists to those indicated for this Project and with a record of successful in-service performance.
  - 2. Assumes responsibility for engineering special joists to comply with performance requirements. This responsibility includes preparation of shop drawings and comprehensive engineering analysis by a qualified professional engineer.
  - 3. Professional Engineer Qualifications: A professional engineer who is legally authorized to practice in jurisdiction where Project is located and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for installation of joists that are similar to those indicated for this Project in material, storage, and extent.

## 1.3 MATERIALS

- A. Steel: Comply with SJI and AISC "Standard Specifications."
- B. Bolts: Carbon or high-strength carbon steel.
  - 1. Finish: Plain, uncoated.
- C. Primer: SSPC – Paint 15.
  - 1. Coordinate primer with topcoats and sprayed fire-resistive materials and primers.

LEED SUGGESTIONS

- 2.1 Refer to Division 5, Section "Structural Steel Framing".

LESSONS LEARNED

- 3.1 Low-sloped roofing requires a roofing slope of at least ¼ inch per 12 inches. Besides using tapered insulation (\$\$\$), measures to eliminate or reduce unwanted ponding of water on the roof include sloping joists to a low point or specifying joists with pitched top chords. Pitch may be one way where slope is in one direction or two ways where slope is in both directions.
  - A. Except for K-series joists that have top chords fabricated parallel or without pitch as standard, steel joists and joist girders may be fabricated with a top-chord pitch of 1/8 inch per 12 inches. This standard top-chord pitch will not be sufficient alone to meet the minimum ¼ inch per 12 inches (1:48) slope requirement.
- 3.2 Where shop priming is not permitted (were sprayed fire-resistive material is to be applied), distinguish locations of primed and unprimed joists on the drawings.

END OF SECTION

**METALS**

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## SECTION 053100

## STEEL DECKING

**GENERAL GUIDELINES****1.1 SECTION INCLUDES**

- A. Qualitative requirements for metal floor and roof deck of fluted, ribbed, and cellular configurations; composite decks of metal and acoustical insulation; anchors, closures, and related accessories.

**1.2 MATERIALS**

- A. Type: Steel for galvanized metal deck, ASTM A 653, structural quality Grade 33 or higher, G60 zinc coating, unless otherwise noted.
  - 1. Noncomposite steel form deck, when design of concrete slab meets all loading requirements without assistance from steel deck, engineer may reduce galvanized coating to G30.
  - 2. **Note: Prime-painted decking is not acceptable.**
- B. **Accessories: Flexible closure strips, pour stops, girder fillers, column closures, end closures, Z-closers, cover plates, and sump plate.**

**1.3 FABRICATION**

- A. Decking, General: Fabricate panels to comply with SDI Specifications and Commentary in SDI Publication No. 30.
- B. Acoustical Roof Deck Units: **NRC as determined by Designer.**

**LEED SUGGESTIONS****2.1 Refer to Division 05, Section “Structural Steel Framing”.**

END OF SECTION

## SECTION 054000

## COLD-FORMED METAL FRAMING

**GENERAL GUIDELINES****1.1 SECTION INCLUDES**

- A. Qualitative requirements for bracing, fasteners, and related accessories for light gauge, loadbearing metal elements.

**1.2 SYSTEM DESCRIPTION**

- A. Design Requirements: Calculate structural characteristics of cold-formed metal framing according to AISI's "Specification for The Design of Cold-Formed Steel Structural Members" **and its "Standard for Cold-Formed Steel Framing – General Provisions"**.
  - 1. Design exterior nonaxial load bearing framing to accommodate lateral deflection without regard to contribution of sheathing materials.
  - 2. Headers: Design according to AISI's "Standard for Cold-Formed Steel Framing – Header Design."
  - 3. Roof Trusses: Design according to AISI's "Standard for Cold-Formed Steel Framing – Truss Design."
    - a. Note: Prefabricated trusses that meet the qualitative requirements are acceptable.
- B. Performance Requirements: Engineer, fabricate, and erect cold-formed metal framing to withstand design loads within limits and under conditions required.
  - 1. Design framing systems to withstand design loads without deflections greater than the following:
    - a. Cold-Formed Metal Framing: Lateral deflection of 1/240 of the wall height, unless otherwise noted.
      - 1) Limit deflection to 1/600 when supporting masonry.
    - b. Floor Joists: Vertical deflection of 1/480 for live loads and 1/360 for total loads of span.
    - c. Ceiling Joists: Vertical deflection of 1/240 of the span.
    - d. Roof Trusses: Vertical deflection of 1/240 of the span.

**1.3 COLD-FORMED METAL FRAMING MATERIALS**

- A. Galvanized Steel Sheet: ASTM A 1003, Structural Grade, Type H, metallic coated of grade and coating, and as follows:
  - 1. Coating Designation: G 60 (Z 275), unless otherwise noted.
    - a. Provide G90 where studs backup masonry, and where indicated.
  - 2. Grade: As required for structural performance.
- B. System Components: With each type of metal framing required, provide manufacturer's standard steel runners (tracks), blocking, lintels, clip angles, shoes, reinforcements, fasteners, and accessories as recommended by manufacturer for applications indicated, as needed to provide complete metal framing system.
  - 1. Steel Sheet for Vertical Deflection and Drift Clips: ASTM A 653, structural steel, zinc coated, of grade and coating as follows:

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- a. Grade: As required by structural performance.
  - b. Coating: G60.
- C. *Framing Accessories: Supplementary framing, bracing, bridging, and solid blocking, web stiffeners, gusset plates, stud kickers, girts, joist hangers, and end closures.***
- D. *Insulation for Inaccessible Voids.***

END OF SECTION



## SECTION 055000

## METAL FABRICATIONS

GENERAL GUIDELINES

## 1.1 SECTION INCLUDES

- A. Qualitative requirements for metal items fabricated from standard metal shapes and plates that are not classified in other locations.

## 1.2 PRODUCTS

- A. Materials: Steel plates, shapes, and bars. Steel tubing, steel pipe, slotted channel framing, iron castings, and aluminum.
- B. Miscellaneous Framing and Supports: Galvanized where indicated.
  - 1. Steel framing and supports for ceiling-hung toilet compartments, operable partitions, overhead doors, overhead grilles, countertops, and mechanical and electrical equipment.
  - 2. Elevator machine beams, hoist beams.
  - 3. Steel shapes for supporting elevator door sills.
- C. Shelf Angles: Galvanized at exterior walls.
- D. Metal Ladders - Including Elevator Pit Ladders: Steel, unless otherwise noted.
  - 1. Exterior ladders: Galvanized or aluminum.
  - 2. ***Provide fixed, permanent ladders on wall(s) for access to all low-sloped roof areas.***
- E. Ladder Safety Cages: Match ladder.
- F. Alternating Tread Devices: Steel.
- G. Metals Ships' Ladders: Steel.
- H. Metal Floor Plate: Steel.
- I. Structural-Steel Door Frames:
  - 1. Exterior frames galvanized.
- J. Miscellaneous Steel Trim: Steel angle corner guards, steel edgings, and loading-dock edge angles.
  - 1. Exterior trim galvanized.
- K. Metal Bollards: Schedule 40 steel pipe.
- L. Pipe and Downspout Guards.
  - 1. Galvanized.
- M. Abrasive Metal, Nosings, Treads, and Thresholds: Cast iron, cast aluminum, or extruded aluminum.

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- N. Metal Downspout Boots: Cast iron or aluminum.***
- O. Loose Bearing and Leveling Plates, Galvanized.***
- P. Loose Steel Lintels, Galvanized at Exterior Walls.***
- Q. Steel Weld Plates and Angles not specified in other sections, for casting into concrete.***

LEED SUGGESTIONS

- 2.1 Refer to Division 05, Section "Structural Steel Framing".

END OF SECTION

## SECTION 055100

## METAL STAIRS

**GENERAL GUIDELINES****1.1 SECTION INCLUDES**

- A. Qualitative requirements for metal stairs.
  - 1. ***Railings attached to metal stairs or attached to walls adjacent to metal stairs may be added to this section.***

**1.2 MATERIALS**

- A. ***Abrasive Nosings: Extruded aluminum.***
- B. ***Stringers: Steel channels or tubes.***
  - 1. ***Plate strings are not acceptable.***
- C. ***Metal-Pan Stairs: Uncoated cold-rolled or uncoated hot-rolled.***
- D. ***Metal Bar-Grating Stairs: ½ inch maximum opening.***
  - 1. ***For service and exterior applications.***
- E. ***Metal Floor Plate Stairs: Rolled steel.***
  - 1. ***For service applications.***

**1.3 FINISHES**

- A. Hot-dip galvanize items exposed to exterior or greater than 75% relative humidity.

END OF SECTION

**METALS****CHAPTER 9: SPECIFICATIONS****SECTION 055213****PIPE AND TUBE RAILINGS****GENERAL GUIDELINES****1.1 SECTION INCLUDES**

- A. Qualitative requirements for pipe railings and guards.

**1.2 METALS**

- A. Steel and Iron
  - 1. Steel Pipe
    - a. Black finish, unless otherwise indicated.
    - b. Galvanized finish for exterior installations and where indicated.
  - 2. Steel Tubing: Cold-formed steel tubing.
  - 3. Steel Plates, Shapes, and Bars.
  - 4. Iron Castings.
  - 5. **Expanded Metal.**
  - 6. **Perforated Metal.**
  - 7. **Woven-Wire Mesh.**
- B. Aluminum
  - 1. Extruded Bars and Tubing.
  - 2. Extruded Structural Pipe and Round Tubing.
  - 3. Plate and Sheet.
  - 4. Castings.
  - 5. **Perforated Metal.**
  - 6. **Woven-Wire Mesh.**

**1.3 FABRICATION**

- A. ***Changes in Direction of Members: By bending or by inserting prefabricated fittings.***
- B. ***Connections: Either welded or non-welded.***
- C. ***Infill: Provide either vertical picket, expanded metal, perforated metal, or woven-wire mesh.***
- D. ***Toe Boards.***

**LEED SUGGESTIONS**

- 2.1 ***Refer to Division 5, Section "Structural Steel Framing".***

**LESSONS LEARNED**

- 3.1 ***Guard rail infill must be designed so a 4-inch sphere cannot pass through it, as to comply with code requirements. Horizontal rails as infill can be readily climbed by children and should be avoided. Economical options for infill include vertical pickets, expanded metal, perforated metal, or woven-wire mesh.***

END OF SECTION

**06**  
**DIVISION**

**WOODS, PLASTICS, AND COMPOSITES**

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## CHAPTER 9: SPECIFICATIONS

**WOODS, PLASTICS, AND COMPOSITES**

## SECTION 061000

## ROUGH CARPENTRY

GENERAL GUIDELINES

## 1.1 SECTION INCLUDES

- A. Qualitative requirements for miscellaneous wood framing, incidental rough carpentry required for support or attachment of other construction, pressure preservative treated and fire retardant treated wood.

## 1.2 PRODUCTS

- A. Lumber
  - 1. Maximum moisture content: 19 percent.
  - 2. Factory mark each piece of lumber with grade stamp.
- B. Boards
  - 1. Maximum moisture content: 19 percent.
- C. Fasteners: Hot-dip galvanized or stainless steel where exposed to weather, in ground contact, in contact with treated wood, or in area of high relative humidity.

## 1.3 WOOD PRESERVATIVE TREATED MATERIALS

- A. ***Preservative Treatment by Pressure Process: AWP A U1; Use Category UC2 for interior construction not in contact with the ground, Use Category UC3b for exterior construction not in contact with the ground, and Use Category UC4a for items in contact with the ground.***
  - 1. ***Preservative Chemicals: Acceptable to authorities having jurisdiction and containing no arsenic or chromium. Do not use inorganic boron (SBX) for sill plates.***

## 1.4 FIRE RETARDANT TREATED MATERIALS

- A. ***Fire-Retardant-Treated Lumber and Plywood by Pressure Process: Products with a flame spread index of 25 or less when tested according to ASTM E 84, and with no evidence of significant progressive combustion when the test is extended an additional 20 minutes, and with the flame front not extending more than 10.5 feet beyond the centerline of the burners at any time during the test.***
  - 1. ***Use treatment that does not promote corrosion of metal fasteners.***
  - 2. ***Exterior Type: Treated materials shall comply with requirements specified above for fire-retardant-treated lumber and plywood by pressure process after being subjected to accelerated weathering according to ASTM D 2898. Use for exterior locations and where indicated.***
  - 3. ***Interior Type A: Treated materials shall have a moisture content of 28 percent or less when testing according to ASTM D 3201 at 92 percent relative humidity. Use where exterior type is not indicated.***

**WOODS, PLASTICS, AND COMPOSITES****CHAPTER 9: SPECIFICATIONS****LESSONS LEARNED**

3.1 Increased corrosion of steel fasteners is a concern with preservative treatments, especially those containing ammonia and higher concentrations of copper (which will generally replace those containing arsenic). For this reason, hot-dip galvanized steel or stainless steel fasteners should be used with pressure-preservative-treated lumber.

**3.2 WOOD PRESERVATIVE TREATMENT**

- A. Where carpentry may be subject to deterioration by moisture or insect attack, consider using pressure-preservative-treated material. Provide provisions for preservative-treated wood in locations required by building codes and in certain locations where wood should always be treated, such as wood used with roofing and flashing, on the damp side of vapor **retarders** and waterproofing, and items such as sills, sleepers, furring, blocking, and stripping if in contact with masonry or concrete located below grade. Provisions for treating wood in other locations should be added as required on a project-by-project basis. If the additional locations for the use of treated wood are too complex to describe in the specifications, identify them by notes on the Drawings.
- B. Arsenic has been used in most of the treatment chemicals used for treating wood used in building construction since the 1970's, when the use of pentachlorophenol was largely eliminated. Some of the treatment chemicals that contain arsenic also contain chromium. The wood treatment industry has voluntarily phased out the use of the most common arsenic-based treatment (chromated copper arsenate, also called CCA) for treated wood intended for residential and similar uses, although the EPA has not declared pressure-treated wood that contains arsenic to be hazardous. The phase out required that wood treated after 2003 not contain CCA. Because the phase-out applied to residential use, CCA has generally been eliminated from use with all dimension lumber, its use being largely restricted to utility poles and piling. The phase-out does not apply to ACZA (ammoniacal copper zinc arsenate), which also contains arsenic, and which is often used to treat Douglas fir and other species that are difficult to treat, due to their high density and resultant poor absorption of treatment chemicals.
- C. Boron is effective for controlling fungi, molds, and insects such as termites that use these wood-destroying organisms to break down and digest wood fibers. Boron is also relatively safe for human beings and animals and is inexpensive. The one problem with boron is that its compounds are very water soluble. It is easy and inexpensive to treat wood with boron, but the wood must be protected from getting wet. For most of the building framing, which will be enclosed in the finished building, boron treatment is ideal, for protection against termites, but care must be exercised to ensure that the treatment is not washed out by rain before the framing can be covered. If boron treatment is used, provisions should be included for spray treatment by an exterminator of wood that has become wet.

END OF SECTION



## CHAPTER 9: SPECIFICATIONS

**WOODS, PLASTICS, AND COMPOSITES**

## SECTION 061600

## SHEATHING

GENERAL GUIDELINES

## 1.1 SECTION INCLUDES

- A. Qualitative requirements for wall sheathing, roof sheathing, building wrap, sheathing joint and penetration treatment and flexible flashing at openings in sheathing.

## 1.2 WOOD PANEL PRODUCTS, GENERAL

- A. Plywood: Either DOC PS 1 or DOC PS 2, unless otherwise indicated.

## 1.3 PRESERVATIVE-TREATED PLYWOOD

- A. Preservative Treatment by Pressure Process: AWPA U1; Use Category UC2 for interior construction not in contact with the ground, Use Category UC3b for exterior construction not in contact with the ground, and Use Category UC4a for items in contact with the ground.
  - 1. Preservative Chemicals: Acceptable to authorities having jurisdiction and containing no arsenic or chromium.

## 1.4 FIRE-RETARDANT-TREATED PLYWOOD

- A. Fire-Retardant-Treated Plywood by Pressure Process: Products with a flame spread index of 25 or less when tested according to ASTM E 84, and with no evidence of significant progressive combustion when the test is extended an additional 20 minutes, and with the flame front not extending more than 10.5 feet beyond the centerline of the burners at any time during the test.
  - 1. Exterior Type: Treated materials shall comply with requirements specified above for fire-retardant-treated plywood by pressure process after being subjected to accelerated weathering according to ASTM D 2898. Use for exterior locations and where indicated.
  - 2. Interior Type A: Treated materials shall have a moisture content of 28 percent or less when testing according to ASTM D 3201 at 92 percent relative humidity. Use where exterior type is not indicated.

## 1.5 WALL SHEATHING

- A. Plywood Wall Sheathing.
- B. Glass-Mat Gypsum Wall Sheathing.
- C. Cellulose Fiber-Reinforced Gypsum Sheathing.
- D. Extruded-Polystyrene-Foam Wall Sheathing.
- E. Foil Faced Closed Cell Rigid Foam Wall Sheathing.**

## 1.6 ROOF SHEATHING

- A. Plywood Roof Sheathing: Exterior, Structural I sheathing.
  - 1. Provide 5/8 inch nominal thickness for 24 inch rafter spacing.
- B. Oriented-Strand-Board Roof Sheathing: Exposure 1, Structural 1 sheathing.
  - 1. Provide 5/8 inch nominal thickness for 24 inch rafter spacing.

**WOODS, PLASTICS, AND COMPOSITES****CHAPTER 9: SPECIFICATIONS****1.7 FASTENERS**

- A. Fasteners: Hot-dip galvanized or stainless steel where exposed to weather, in ground contact, in contact with treated wood, or in area of high relative humidity.

**1.8 WEATHER-RESISTANT SHEATHING PAPER**

- A. Building Wrap: ASTM E 1677, Type I air retarder; with flame-spread and smoke-developed indexes of less than 25 and 450, respectively, when tested according to ASTM E 84; UV stabilized.
- B. Building-Wrap Tape: Pressure-sensitive plastic tape recommended for sealing joints and penetrations in building wrap.

**1.9 SHEATHING JOINT-AND-PENETRATION TREATMENT MATERIALS**

- A. Sealant for Glass-Mat Gypsum Sheathing Board: Silicone emulsion sealant, compatible with sheathing tape and sheathing, and recommended for use with glass-fiber sheathing tape and for covering exposed fasteners.
- B. Sheathing Tape for Glass-Mat Gypsum Sheathing Board: Self-adhering glass-fiber tape, for use with silicone emulsion sealant in sealing joints in glass-mat gypsum sheathing board.
- C. Sheathing Tape for Foam-Plastic Sheathing: Pressure-sensitive plastic tape for sealing joints and penetrations in sheathing.

**1.10 MISCELLANEOUS MATERIALS**

- A. Flexible Flashing: Composite, self-adhesive, flashing product consisting of a pliable, rubberized-asphalt compound, bonded to a high-density, cross-laminated polyethylene film to produce an overall thickness of not less than 0.025 inch.

**LEED SUGGESTIONS**

- 2.1 Emissions: Products shall meet the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

END OF SECTION

## SECTION 062000

## FINISH CARPENTRY

GENERAL GUIDELINES

## 1.1 SECTION INCLUDES

- A. Qualitative requirements for wood construction that can be purchased ready made and installed by a finish carpenter, not requiring the specialized skills of architectural woodwork fabrication.

## 1.2 QUALITY ASSURANCE

- A. Quality Standards: Architectural Woodwork Institute (AWI) "Quality Standards."
  - 1. Custom grade.

## 1.3 INTERIOR MATERIALS

- A. General: Provide materials that comply with requirements of the AWI Woodworking Standard for each type of woodwork and quality grade indicated and, where the following products are part of woodwork, with requirements of the referenced product standards, that apply to product characteristics indicated:
  - 1. Hardboard: AHA A135.4
  - 2. High Pressure Laminate: NEMA LD3.
  - 3. Medium Density Fiberboard: ANSI A208.2, made with binder containing no urea-formaldehyde resin.
  - 4. Particleboard: ANSI A208.1, Grade M-2, made with binder containing no urea-formaldehyde resin.
  - 5. Straw-based particleboard: ANSI A208.1, Grade M-2, except for density.
  - 6. Softwood Plywood: PS 1.
  - 7. Hardwood Plywood and Face Veneers: HPVA HP-1, made with binder containing no urea-formaldehyde resin.

## 1.4 EXTERIOR MATERIALS

- A. Exterior Standing and Running Trim and Rails
  - 1. Dimensional lumber of rot resistance species.
    - a. Redwood, South American ipe, bald cypress, cedar, black locust, and black walnut.

## 1.5 STANDING AND RUNNING, TRIM AND RAILS FOR TRANSPARENT FINISH

- A. Standing and running trim shall be custom grade hardwood, conforming to AWI Section 300.

## 1.6 FACTORY FINISHING OF INTERIOR WOODWORK

- A. Quality standard complies with AWI Section 1500.

**WOODS, PLASTICS, AND COMPOSITES****CHAPTER 9: SPECIFICATIONS**

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- B. General: The prefinishing of interior architectural woodwork is required to be preformed at factory as specified in this section.
- C. Transparent Finish: Comply with requirements indicated below for grade, finish system, staining, effect, and sheen.
  - 5. Grade: Custom
  - 6. AWI Finish System TR-6 - Catalyzed Polyurethane
  - 7. Staining: As determined by Designer.
  - 8. Effect: Open grain
  - 9. Sheen: As determined by Designer.

END OF SECTION

## CHAPTER 9: SPECIFICATIONS

**WOODS, PLASTICS, AND COMPOSITES**SECTION 064023  
INTERIOR ARCHITECTURAL WOODWORKGENERAL GUIDELINES

## 1.1 SECTION INCLUDES

- A. Qualitative requirements for shop-fabricated wood and laminate-clad fabrications.
  - 1. Section includes custom-fabricated cabinets and countertops.

## 1.2 QUALITY ASSURANCE

- A. Quality Standards: Architectural Woodwork Institute (AWI) "Quality Standards."
  - 1. Custom grade.

## 1.3 MATERIALS

- A. Wood Products
  - 1. Hardboard: AHA A135.4
  - 2. Medium Density Fiberboard: ANSI A208.2, made with binder containing no urea-formaldehyde resin.
  - 3. Particleboard: ANSI A208.1, Grade M-2-Exterior Glue.
  - 4. Straw-based Particleboard: ANSI A208.1, Grade M-2, except for density.
- B. Thermoset Decorative Panels
- C. High-Pressure Decorative Laminate: NEMA LD3, grades as required by woodwork quality standard.

## 1.4 HARDWARE

- A. Butt Hinges.
- B. Wire Pulls: Back-mounted, metal.
- C. Catches, Adjustable Shelf Standards and Supports, and Shelf Rests.
- D. Drawer Slides: Builders Hardware Manufacturers Association (BHMA): Minimum standards of BHMA A156.9.
  - 1. Heavy Duty (Grade 1 HD-100).
  - 2. Box Drawer Slides: Grade 1 HD-100.
  - 3. File Drawer Slides: Grade 1 HD-200.
  - 4. Pencil Drawer Slides: Grade 1.
  - 5. Keyboard Slides: Grade 1 HD-100.
- E. Locks: Door and drawer.
- F. Grommets, Casters, Leveling Guides, and Articulating Keyboard Assemblies.

## 1.5 FABRICATION

- A. Comply with requirements of AWI for Custom Grade, unless otherwise noted.

LEED SUGGESTIONS

- 2.1 ***Emissions: Products shall meet the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."***

END OF SECTION

## **WOODS, PLASTICS, AND COMPOSITES**

## **CHAPTER 9: SPECIFICATIONS**

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**07**  
**DIVISION**

**THERMAL AND MOISTURE PROTECTION**

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## SECTION 071000

## DAMPPROOFING AND WATERPROOFING

LESSONS LEARNED

- 3.1 While damp proofing and waterproofing qualitative requirements are not included in the Design Manual, ***their correct implementation is critical*** to a successful project.
- 3.2 ***Damp proofing is used on the exterior face of below grade walls to reduce migration of moisture into interior spaces. Waterproofing is resistive to migration of water into interior spaces through below grade walls where it is under hydrostatic pressure. Waterproofing is required on walls that retain earth and enclose interior spaces where groundwater is within 6 inches of the floor.***
- 3.3 The Design Team should review the Geotechnical report for recommendations on damp proofing and waterproofing. ***Good rainwater and storm run-off management and foundation drainage, and proper grading of soil or paving away from building walls and foundations is also critical.***

END OF SECTION

**THERMAL AND MOISTURE PROTECTION****CHAPTER 9: SPECIFICATIONS****SECTION 072100****THERMAL INSULATION****GENERAL GUIDELINES****1.1 SECTION INCLUDES**

- A. Qualitative requirements for organic and inorganic insulation applied for thermal protection in walls, ceilings, attics, and crawl spaces; under concrete slabs on grade; and at perimeter of foundations.

**1.2 PERFORMANCE REQUIREMENTS**

- A. Plenum Rating: Glass and slag-wool-fiber / rock-wool-fiber insulation rated for resistance against erosion and mold growth per UL 181.
- B. NFPA: Foam plastics left exposed to the interior occupied space must be covered by a thermal barrier, show compliance to NFPA 286 for flame spread classifications for specific materials or assemblies, **or qualify for an exemption under the Ohio Building Code.**

**1.3 MATERIALS**

- A. Extruded Polystyrene Board Insulation
  - 1. Type IV, 25 p.s.i. minimum density.
- B. Unfaced Mineral Fiber Blanket Insulation
  - 1. Mineral Fiber Type: Fibers manufactured from glass, slag wool, or rock wool.
- C. Faced Mineral Fiber Blanket Insulation
  - 1. Mineral Fiber Type: Fibers manufactured from glass, slag wool, or rock wool.
- D. Foil-Faced, Glass-Fiber Board Insulation: Nominal density of 6 lb/cu.ft.
- E. Glass-Mat-Faced, Glass-Fiber Board Insulation: Nominal density of 6 lb/cu.ft.
- F. Unfaced, Slag-Wool-Fiber / Rock-Wool- Fiber Board Insulation: Nominal density of 6 lb/cu.ft.
- G. Foil Faced Closed Cell Rigid Foam Board Insulation.**
- H. Glass-Fiber Loose Fill.
- I. Foamed-in-Place Insulation
  - 1. Silicate foam.
  - 2. Open-cell polyurethane: Water-based polyurethane, low-density, no VOC emissions after 30 days; foaming agent: carbon dioxide and water.
- J. Closed-cell polyurethane Foam Insulation: ASTM C 1029, Type II, 1.5 lb/cu.ft.
  - 1. Foam insulation required between all windows and doors at head, jamb, and sill.
  - 2. Foam interior junction of the roof to wall intersection, the underside of the roof deck at the ridge and valley(s) and at all roof penetrations (roof drains, conduit, roof hatch, etc.) per detail on Chapter 8: Systems and Materials – Exterior Walls, Exterior Wall/Roof Closure. **Provide thermal barrier per building code.**
    - a. Class A Foam that meets the requirements of NFPA 286 Room Corner Fire Test does not require a thermal barrier.**
- K. Auxiliary Insulating Materials
  - 1. Vapor-retarder tape
  - 2. Adhesive for bonding insulation
  - 3. Insulation fasteners
  - 4. Tape or foam for sealing joints in insulation board.**
- L. Self-Supported, Spray-Applied Cellulosic Insulation.
- M. Vapor Retarders.
- N. Spray-Polyurethane Foam Sealant: 1 or 2 component, 1.5 to 2.0 lb/cu.ft. density; flame

## CHAPTER 9: SPECIFICATIONS

**THERMAL AND MOISTURE PROTECTION**

spread index of 25 or less according to ASTM E 162 or E 84.

1. Single-component sealant low expansion design for sealing perimeter of openings.
2. Two-component foam sealant for gaps over 2 inches.

**LEED SUGGESTIONS**

- 2.1 Qualifying for a credit under the LEED Rating System requires a reduction in design energy cost compared to the energy cost budget for regulated energy components described in the requirements in ASHRAE 90.1. Insulation plays a major role in determining the extent of design energy-cost reductions. To obtain the maximum number of points under the “Energy and Atmosphere – Optimize Energy Performance”, an ‘integrated design’ approach with the Mechanical Engineer is important.
- 2.2 Product Data for Credit EQ 4: Indicate products meet the testing and product requirements of the California Department of Health Services Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers, including 2004 Addenda.
- 2.3 Sustainability Requirements: Provide glass-fiber insulation as follows:
  - A. Low Emitting: Insulation tested according to ASTM D 5116 and shown to emit less than 27-ppb formaldehyde.
- 2.4 Sustainability Requirements: Provide spray-applied cellulosic insulation as follows:
  - A. Low Emitting: Insulation tested according to ASTM D 5116 and shown to emit less than 27-ppb formaldehyde.

**LESSONS LEARNED**

- 3.1 Thermal Resistance and Thermal Resistivity
  - A. Thermal resistance (R-value) is a measure of resistance to heat flow of the “total thickness” of an insulating material or construction. Thermal resistivity (r-value) is a measure of resistance to heat flow of a “unit thickness” of a homogeneous insulating material. The performance of non-homogenous materials such as fibrous blanket insulation is always reported using total thermal resistance, not unit thermal resistivity. For insulation in board form, which is homogeneous, the performance is reported in unit thermal resistivity. Where thermal resistivity is used, the total thermal resistance can be calculated by multiplying the unit thermal resistivity by the actual thickness in inches, or in SI (metric) units, by fractions of a meter.
  - B. For thermal blanket insulation, the location and thermal resistance are properly shown on the Drawings rather than indicated in the Specifications. For thermal insulation in board form, the location and thickness are shown on the Drawings and the thermal resistivity is indicated in the Specifications.
  - C. Because the performance of acoustical blanket insulation is not related to heat flow, neither thermal resistance nor thermal resistivity is used, even though thermal and acoustical blanket insulation may be identical. The location and thickness of acoustical blanket is shown on the Drawings.
- 3.2 Placement and Anchorage
  - A. Difficult spaces to insulate include floor-to-window wall junctures and partition-to-exterior wall junctures. Gaps in insulation at such locations can be successfully insulated by using spray polyurethane foam insulation.

END OF SECTION

**THERMAL AND MOISTURE PROTECTION****CHAPTER 9: SPECIFICATIONS****SECTION 072700****AIR BARRIERS****GENERAL GUIDELINES****1.1 SECTION INCLUDES**

- A. Qualitative requirements for air barrier system. The entire building envelope shall be designed and constructed with a continuous air barrier.
  - 1. Provide transition taping and foam products for masonry mockup in early construction phase.
- B. Building Airtightness Requirement: The basic airtightness requirements and processes for OSFC projects is the following:
  - 1. Design and construct the building envelopes of **all instructional facilities** with a continuous air barrier to control air leakage into (or out of) the conditioned space. Clearly identify the boundary limits of the building air barriers and of the portion or portions of the building to be tested for building airtightness on the construction documents. Clearly identify all air barrier components of each envelope assembly on construction documents and detail the joints, interconnections and penetrations of the air barrier components.
  - 2. Join and seal the air barrier materials of each assembly to the air barrier materials of adjacent assemblies, allowing for the relative movement of these assemblies and components. Clearly identify air barrier system continuity on the plan and section construction drawings.
  - 3. There shall be a continuous thermal, moisture and air barrier system surrounding the interior of the building to the top of the footings. **There shall be no direct contact or thermal bridge between the exterior and the interior of the building** such that the thermal, moisture and air barrier becomes discontinuous. Provide details to seal all penetrations, including but not limited to electrical, plumbing and HVAC components; windows and doors; compatibility of materials with one another.
  - 4. Support the air barrier so that it shall withstand the maximum positive and negative air pressures that will be placed on the building without displacement, or damage, and transfer the load to the structure. The air barrier assembly must be durable to last the anticipated service life of the envelope.
  - 5. Provide a motorized damper in the closed position and connect it to the fire alarm system to open on call and fail in the open position for any fixed open louvers such as at elevator shafts. Dampers and controls shall close all ventilation or make-up air intakes and exhausts, atrium smoke exhausts and intakes, etc. where leakage can occur during inactive periods. Provide air-tight vestibules at building entrances with high traffic.
  - 6. Compartmentalize spaces under negative pressures such as boiler rooms and provide make-up air for combustion.

## CHAPTER 9: SPECIFICATIONS

**THERMAL AND MOISTURE PROTECTION**

- C. Air Barrier Design: The air barrier shall be designed and noted in the following manner:
1. All air barrier components of each building envelope assembly shall be clearly identified or otherwise noted on construction documents.
  2. The joints, interconnections, and penetrations of the air barrier components including lighting fixtures shall be detailed or otherwise noted.
  3. The continuous air barrier shall extend over all surfaces of the building envelope (at the lowest floor, exterior wall, and ceiling or roof).
  4. The continuous air barrier shall be designed to resist positive and negative pressures from wind, stack effect, and mechanical ventilation.
- D. Air Barrier Installation: The following areas of the continuous air barrier in the building envelope shall be wrapped, sealed, caulked, gasketed, or taped in an approved manner to minimize air leakage:
1. Installer shall be certified by the Air Barrier Association of America (ABAA) Quality Assurance Program.
  2. Joints around fenestration and door frames (both manufactured and site-built).
  3. Junctions between walls and floors, between walls at building corners, between walls and roofs or ceilings.
  4. Penetrations through the air barrier in building envelope roofs, walls, and floors.
  5. Building assemblies used as ducts or plenums.
  6. Joints, seams, connections between planes, and other changes in air barrier materials.
  7. **All steel support members at openings in exterior walls shall be isolated from direct thermal transfer.**
  8. **Install an air barrier transition from window to air barrier.**
- E. Quality Control: Provide for site inspections by ABAA to verify conformance with manufacturer's instructions and ABAA's Quality Assurance Program. Inspections at 5, 50, and 95 percent completion with written report.

## 1.2 MATERIALS AND ASSEMBLIES

- A. Continuous air barrier materials and assemblies for the opaque building envelope shall comply with one of the following requirements.
1. Materials that have an air permeance not exceeding 0.004 cfm/ft<sup>2</sup> under a pressure differential of 0.3 in w.g. (1.57 psf) when tested in accordance with ASTM E 2178. The following materials meet the requirements of 5.4.3.1.3.a:
    - a. Plywood – minimum 3/8 in.
    - b. Oriented strand board – minimum 3/8 in.
    - c. Extruded polystyrene insulation board – minimum 1/2 in.
    - d. **Foil-faced rigid foam insulation board – minimum 1/2 in.**
    - e. Exterior gypsum sheathing or interior gypsum board – min. 1/2 in.
    - f. Cement board – minimum 1/2 in.
    - g. Built up roofing membrane
    - h. Modified bituminous roof membrane
    - i. Fully adhered single-ply roof membrane
    - j. A Portland cement/sand parge, stucco, or gypsum plaster – minimum 1/2 in. thick.
    - k. Cast-in-place and precast concrete.
    - l. Sheet metal.
    - m. Closed cell 2lb/ft<sup>3</sup> nominal density spray polyurethane foam – minimum 1 in.

## THERMAL AND MOISTURE PROTECTION

## CHAPTER 9: SPECIFICATIONS

2. Assemblies of materials and components (sealants, tapes, etc.) that have an average air leakage not to exceed 0.04 cfm/ft<sup>2</sup> under a pressure differential of 0.3 in w.g. (1.57 psf) when tested in accordance with ASTM E 2357 ASTM E 1677, ASTM E 1680 or ASTM E283; the following assemblies meet the requirements of 5.4.3.1.3 b.
  - a. Concrete masonry walls that are:
    - 1) Fully grouted, or
    - 2) Painted to fill the pores.
- 1.3 Pre-Installation conferences shall be used to establish standards of workmanship for installation and for coordination among contractors.

### LESSONS LEARNED

- 2.1 Air barrier and vapor **retarder** are two distinct functions. Two functions may be provided by one material which has both characteristics or the functions may be satisfied by two separate materials occurring in different planes of the building envelope.
  - A. ***Air barriers serve a different role in a building envelope than vapor retarders. Air barriers restrict the movement of airborne moisture into building cavities. Vapor retarders control the diffusion of moisture vapor into and out of building envelopes. Many air barrier materials also function as vapor retarders; others are vapor permeable. The location within the wall of combined air barriers/vapor retarders and of separate vapor retarders and air barriers is governed by the difference between interior and exterior environmental conditions.***
- 2.2 A vapor **retarder, if used**, should occur on the interior side of the thermal insulation.
- 2.3 An air barrier/ retarder can be provided and satisfactorily serve its purpose in a variety of locations in the plane of the wall and roof.
  - A. ***Improper location or coordination of air barriers and vapor retarders can prevent the escape of moisture from the wall; moisture-laden air condensing in walls and the roof can lead to mold growth, metal framing corrosion, building materials deterioration, and wet insulation losing its insulating characteristics.***
- 2.4 Air movement can carry exponentially more moisture into and through the building envelope than vapor diffusion alone, which can lead to mold and fungal growth, the corrosion and premature deterioration of building components, and the staining of interior and exterior facades.
- 2.5 The Department of Energy has concluded that up to 40% of the energy consumed to heat and cool a building can be attributed to air leakage into and out of buildings. The effort to conserve energy and minimize losses from the interior environments of buildings has resulted in the need for tighter building envelopes. To control air leakage through building envelopes, air barriers as an air-impermeable component within the wall or roof have been incorporated into some building codes.
- 2.6 Air barriers are a component of the building envelope that control the movement of air into (infiltration) and out of (exfiltration) building walls and roofs due to differences in wind pressure, stack pressure, and HVAC fan pressure.
  - A. Wind: Produces positive air pressure on the windward façade of a building and negative air pressures on the leeward and side facades and on the roof. The magnitude of negative wind forces has been widely documented for roofing applications where substantial uplift loads must be resisted by roof assembly.

- B. Stack Effect: The effect of air rising or falling within a building due to temperature differences between air in the building and air outside the building. Stack effect in heating seasons in cold climates can cause air infiltration at the lower levels of a building and air exfiltration in the upper levels. The reverse occurs in warm climates with air conditioning cooling the inside air causing it to fall. Air infiltrates the upper levels of a building and exfiltrates in the lower levels. Stack effect forces can be significant and sustained for several months. The air barrier must be capable of resisting these forces.
  - C. Fan Pressure: HVAC system pressurization that maintains a building interior with a positive pressure. Air under pressure attempts to infiltrate through the building envelope. Positive HVAC pressurization is usually intended to reduce infiltration and pollutants and to counter stack effect air pressure.
- 2.7 The resultant air pressures about the entire building envelope will influence the HVAC design pressures as well as indicate the magnitude of forces that the air barrier will be required to sustain.
- 2.8 Air exfiltration from a heated or air-conditioned interior space through the building envelope increases energy consumption as the building's HVAC system produces more conditioned air than would be required in a building with a properly functioning air barrier.
- 2.9 Air infiltration into a heated or air-conditioned building also increases energy consumption as the building's HVAC system corrects the interior temperature and humidity to the desired levels.
- A. Air barriers restrict the movement of moisture into building cavities. Moisture-laden air condensing in walls and the roof can lead to mold growth, metal framing corrosion, building materials deterioration, and wet insulation losing its insulating characteristics.
  - B. Air barriers serve a different role in a building envelope than vapor retarders, which control the diffusion of moisture vapor into and out of building envelopes. Many air barrier materials also function as vapor retarders; others are vapor permeable. The location within the wall of combined air barriers/vapor retarders and of separate vapor retarders and air barriers is governed by the difference between interior and exterior environmental conditions.

END OF SECTION

## CHAPTER 9: SPECIFICATIONS

**THERMAL AND MOISTURE PROTECTION**

## SECTION 073113

## ASPHALT SHINGLES

GENERAL GUIDELINES

## 1.1 SECTION INCLUDES

- A. Qualitative requirements for roof shingles, underlayment, and fastening products and methods.

## 1.2 QUALITY ASSURANCE

- A. All products used must be approved by shingle manufacturer prior to use.
- B. Exterior Fire-Text Exposure: Class A; ASTM E108 or UL 790, for application and roof slopes indicated.

## 1.3 WARRANTY

- A. Special Warranty
  - 1. Material Warranty Period: 40 years from date of contract completion, prorated, with first 5 years nonprorated.
  - 2. Wind-Speed Warranty Period: Resist blow-off or damage caused by wind speeds up to 80 m.p.h. for a minimum 5 years from date of contract completion.

## 1.4 SHINGLES

- A. Laminated-Strip Asphalt Shingles: ASTM D3462, laminated, multi-ply overlay construction, glass-fiber reinforced, mineral-granule surfaced, and self-sealing.
- B. Hip roofs require special consideration.

## 1.5 ROOFING ACCESSORIES

- A. Felt Underlayment.
- B. Self-Adhering Sheet Underlayment.

## 1.6 METAL TRIM AND FLASHING

- A. Perimeter Edge Metal: Provide one of the following metal types and thickness:
  - 1. 26 gauge (0.019 inch thick), prefinished galvanized steel
  - 2. 0.032 inch thick, prefinished aluminum
- B. Penetration Flashings: Provide one of the following metal types and thickness:
  - 1. 26 gauge (0.019 inch thick), prefinished galvanized steel or stainless steel.
  - 2. 0.032 inch thick, prefinished aluminum.
  - 3. 16 ounce (0.022 inch thick), copper.
- C. Valley Construction (Open Valleys): Provide one of the following metal types and thickness:
  - 1. 26 gauge (0.019 inch thick), prefinished galvanized steel or stainless steel.
  - 2. 0.032 inch thick, prefinished aluminum.
  - 3. 16 ounce (0.022 inch thick), copper.
- D. Apron, Step, Cricket, or Backer Flashings: Provide one of the following:
  - 1. 26 gauge (0.019 inch thick), prefinished galvanized steel or stainless steel.
  - 2. 0.032 inch thick, prefinished aluminum.
  - 3. 16 ounce (0.022 inch thick), copper

## 1.7 INSTALLATION

- A. General: Comply with manufacturer's instructions and recommendations but not less than those recommended by ARMA's "Residential Asphalt Roofing Manual" or "The NRCA Steep Roofing Manual."
  - 1. Fasten asphalt shingles to roof sheathing with **galvanized roofing** nails.



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## CHAPTER 9: SPECIFICATIONS

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## SECTION 074113

## METAL ROOF PANELS

GENERAL GUIDELINES

## 1.1 SECTION INCLUDES

- A. Qualitative requirements for vertical-rib, seamed-joint, standing-seam metal roof panels.

## 1.2 WARRANTY

- A. Special Warranty on Panel Finishes: 20 years.
- B. Special Weathertightness Warranty for Standing-Seam Metal Roof Panels: 20 years.

## 1.3 PRODUCTS

- A. Standing-Seam Metal Roof Panels:
  - 1. Profile: Vertical rib, seamed joint.
  - 2. Material: Aluminum-zinc alloy-coated steel.
  - 3. Exterior Finish: 2-coat fluoropolymer, 70 percent PDVF resin.
- B. Accessories:
  - 1. Vapor retarder, if required by Design Team.
  - 2. Thermal insulation: Faced polyisocyanurate board or extruded-polystyrene board.
  - 3. Self-adhering, high-temperature sheet underlayment (optional over entire roof).
  - 4. Slip sheet.
  - 5. Substrate boards.
  - 6. Miscellaneous metal framing.
  - 7. Flashing and trim.
  - 8. Gutters.
  - 9. Downspouts.
  - 10. Roof curbs.
  - 11. Snow guards: Seam-mounted, stop or bar types. Surface mounted is not acceptable.
  - 12. Pipe flashing.
  - 13. Soffit panels.

LEED SUGGESTIONS

- 2.1 Buildings seeking LEED accreditation can receive a point for Sustainable Sites – Heat Island Effect for steep-sloped roofs having a Solar Reflectance Index (SRI) of 29 or more.

END OF SECTION

**THERMAL AND MOISTURE PROTECTION****CHAPTER 9: SPECIFICATIONS****SECTION 074213****METAL WALL PANELS****GENERAL GUIDELINES****1.1 SECTION INCLUDES**

- A. Qualitative requirements for factory-formed and field-assembled, exposed or concealed fastener, lap-seam metal wall panels.

**1.2 MATERIALS**

- A. Thermal Insulation for Field-Assembled Metal Wall Panels: Extruded polystyrene board.
- B. Substrate Board.
- C. Miscellaneous Metal Framing.
- D. Panel Material
  - 1. Metallic-Coated Steel Sheet Prepainted with Coil Coating.
    - a. Zinc-Coated (galvanized) Steel Sheet.
    - b. Aluminum-Zinc Alloy-Coated Steel Sheet.

**1.3 PRODUCTS**

- A. Exposed/Concealed-Fastener, Lap-Seam Metal Wall Panels
  - 1. Profile: As selected by A/E.
  - 2. Material: Zinc-coated (galvanized) steel or aluminum-zinc alloy-coated steel sheet. No aluminum.
  - 3. Exterior Finish: 2-coat Fluoropolymer.
- B. Accessories
  - 1. Flashing and trim.
  - 2. Metal soffit panels.

END OF SECTION

## SECTION 074216

## INSULATED-CORE METAL WALL PANELS

GENERAL GUIDELINES

## 1.1 SECTION INCLUDES

- A. Qualitative requirements for foamed-insulation-core metal wall panels and laminated-insulation-core metal wall panels.

## 1.2 PANEL MATERIALS

- A. Metallic-Coated Steel Sheet
  - 1. Zinc-Coated (Galvanized) Steel Sheet.
  - 2. Aluminum-Zinc Alloy-Coated Steel Sheet.
- B. Aluminum Sheet.

## 1.3 PANEL CORES

- A. Polyisocyanurate Insulation: Closed cell, modified polyisocyanurate foam using a non-CFC blowing agent, foamed-in-place or board type, with flame-spread index of 75 or less and smoke-developed index of 450.

## 1.4 FOAMED-INSULATION-CORE METAL WALL PANELS

- A. Concealed-Fastener, Foamed-Insulation-Core Metal Wall Panels: Formed with tongue-and-groove panel edges; designed for sequential installation by interlocking panel edges and mechanically attaching panels to supports using concealed clips or fasteners.

## 1.5 LAMINATED-INSULATION-CORE METAL WALL PANELS

- A. Shiplap-Edge, Laminated-Insulation-Core Metal Wall Panels: Formed with flush exterior panel facing and with shiplap edges; designed for sequential installation by mechanically attached panels to supports using concealed clips and fasteners; with factory-applied sealant or gaskets in side laps.

## 1.6 ACCESSORIES

- A. Miscellaneous Metal Framing.
- B. Flashing and Trim.

END OF SECTION

**THERMAL AND MOISTURE PROTECTION****CHAPTER 9: SPECIFICATIONS****SECTION 074219****METAL PLATE WALL PANELS****GENERAL GUIDELINES****1.1 SECTION INCLUDES**

- A. Qualitative requirements for factory-formed and field-assembled metal plate wall panels.

**1.2 PERFORMANCE REQUIREMENTS**

- A. Air Infiltration: ASTM E 283.
- B. Water Penetration under Static Pressure: ASTM E 331.
- C. Structural Performance: ASTM E 330.
  - 1. Deflection Limits: 1/180.

**1.3 WARRANTY**

- A. Materials and Workmanship: Two years.
- B. Finishes: 20 years.

**1.4 MATERIALS**

- A. Miscellaneous Metal Framing: Subgirts, base or sill angles or channels, hat-shaped rigid furring channels, and cold-rolled furring channels.

**1.5 PRODUCTS**

- A. Metal Plate Wall Panels
  - 1. Material: Aluminum or steel sheet.
  - 2. Thickness: 0.120 inch minimum
  - 3. Exterior Finish: 2-coat fluoropolymer (70% PVDF resin), clear anodized or color anodized.

**1.6 INSTALLATION**

- A. Installation Method: Flange attachment, clip, subgirt and spline, track support, rail support, or rainscreen principle.

END OF SECTION

## SECTION 074243

## COMPOSITE WALL PANELS

GENERAL GUIDELINES

## 1.1 SECTION INCLUDES

- A. Qualitative requirements for factory-formed, metal-faced composite wall panels with thin thermoplastic cores.

## 1.2 PERFORMANCE REQUIREMENTS

- A. Air Infiltration: ASTM E 283.
- B. Water Penetration under Static Pressure: ASTM E 331.
- C. Structural Performance: ASTM E 330.

## 1.3 WARRANTY

- A. Materials and Workmanship: Two years.
- B. Finishes: 20 years.

## 1.3 MATERIALS

- A. Miscellaneous Metal Framing: Subgirts, base or sill angles or channels, hat-shaped rigid furring channels, and cold-rolled furring channels.

## 1.4 PRODUCTS

- A. Metal-Faced Composite Wall Panels:
  - 1. Material: Aluminum faced.
  - 2. Thickness: 0.157 inch (4mm) minimum.
  - 3. Exterior Finish: 2-coat fluoropolymer (70% PVDF resin), 3-coat fluoropolymer, 4-coat fluoropolymer, mica fluoropolymer, metallic fluoropolymer, FEVE fluoropolymer, clear anodized, color anodized, mill, acrylic finish for maintaining an “aged” finish, acrylic finish for maintaining a “penny-bright” finish, or pre-patinated.

## 1.5 INSTALLATION

- A. Installation Method: Clip, track support, subgirt and spline, or rainscreen principle.

END OF SECTION

**THERMAL AND MOISTURE PROTECTION****CHAPTER 9: SPECIFICATIONS****SECTION 075000****MEMBRANE ROOFING****GENERAL GUIDELINES****1.1 SECTION INCLUDES**

- A. General qualitative requirements for roofing system applied to the structural substrate, over insulation, or protected with insulation (protected membrane) as appropriate to the particular assembly.
  - 1. Built-up bituminous roofing
  - 2. Elastomeric membrane roofing
  - 3. Thermoplastic membrane roofing
  - 4. Modified bituminous membrane roofing

**1.2 SYSTEM DESCRIPTION**

- A. General: Provide installed roofing membrane and base flashings that remain watertight, do not permit the passage of water, and resist uplift pressure calculated according to ASCE 7, thermally induced movement, and exposure to weather without failure.
- B. Design Requirements
  - 1. All roofs shall be designed and built to ensure positive drainage.
    - a. Positive Drainage: The drainage condition in which consideration has been made during design for all loading deflections of the deck, and additional roof slope has been provided to ensure drainage of the roof area within 48 hours of rainfall, during ambient drying conditions.
  - 2. **Roofs shall be "solar ready" in accordance with O.R.C. 3318.112.**

**1.3 QUALITY ASSURANCE**

- A. Exterior Fire Test Exposure: Class A, comply with ASTM E108.

**1.4 SEQUENCING**

- A. Work shall begin only after opening and penetrations are in place and adjacent work required for complete tie-in are in place. This includes flashing in masonry walls with special attention given to roof to wall transitions.
  - 1. Work shall not begin before the "Preinstallation Conference" and conditions exist necessary for a successful completion of roofing have occurred.
  - 2. Work shall not begin without the presence of manufacturer's representative, A/E and Testing Laboratory, if required.
- B. Arrange work sequence to avoid use of newly constructed roofing as a walking surface or for equipment movement and storage. Where such access is absolutely required, the Applicator shall provide all necessary protection and barriers to segregate the work area and to prevent damage to adjacent areas.
- C. After work on roof is started, no traffic will be permitted on the roof other than necessary for the roofing application and inspection. Materials shall not be piled on the roof to the extent that design live loads are exceeded. Roofing materials shall not be transported over unfinished or finished roofing or existing roofs unless adequate protection is provided.

**1.5 WARRANTY**

- A. Roofing Warranty: Minimum manufacturer's 20 year total system warranty.

## CHAPTER 9: SPECIFICATIONS

**THERMAL AND MOISTURE PROTECTION**

- 1.6 BUILT-UP ASPHALT ROOFING
  - A. Refer to Section 075113.
- 1.7 MODIFIED BITUMINOUS MEMBRANE ROOFING
  - A. Refer to Section 075200.
- 1.8 EPDM ROOFING
  - A. Refer to Section 075323.
- 1.9 THERMOPLASTIC MEMBRANE ROOFING
  - A. Refer to Section 075400.
- 2.0 INSTALLATION
  - A. Install roofing membrane systems according to roofing system manufacturer's written instructions and applicable recommendations of NRCA's "Quality Control Guidelines".

LEED SUGGESTIONS

- 2.1 Buildings seeking LEED accreditation can receive a point for Sustainable Sites – Heat Island Effect for low-sloped roofs having a Solar Reflectance Index (SRI) of 78 or greater.
- 2.2 Qualifying for a credit under the LEED Rating System requires a reduction in design energy cost compared to the energy cost budget for regulated energy components described in the requirements in ASHRAE 90.1. Insulation plays a major role in determining the extent of design energy-cost reductions. To obtain the maximum number of points under the Energy and Atmosphere – Optimize Energy Performance, an "integrated design" approach with the Mechanical Engineer is important.

LESSONS LEARNED

- 3.1 Roof System: The term "roof system" is defined by these documents as "a system of interacting roof components, generally consisting of a membrane or primary roof covering, roof insulation and flashings designed to waterproof and improve the building's thermal resistance."
- 3.2 Warranties: Two types of comprehensive materials-and-workmanship warranties are commonly offered. Known as no-dollar-limit warranties and total-system warranties, these warranties usually bind the roofing installer to the manufacturer to make repairs during the first two years of the warranty period; thereafter, the system manufacturer agrees to provide labor and materials to repair leaks.
  - A. Total-system warranties are required by the Ohio School Design Manual to offer the Owner a single entity to resolve roofing leaks that are traceable to the roofing membrane and other roofing components. Therefore the specification prepared by the Design Team should provide provisions for a total-system approach.
- 3.3 ***Insulation: Joints between insulation boards need to avoid gaps. Insulation must be installed in a minimum of two layers with joints offset in each direction, which reduces thermal bridging and makes the roofing system more energy efficient.***
- 3.4 Additional items to be considered for a successful roof (one without leaks) includes:
  - A. Possible inspections by a Registered Roof Observer or Registered Roof Consultant from the Roofing Consultants Institute.
  - B. Thermographic scans by Owner for finished systems at job completion. This maybe included as part of the Enhanced Building Commissioning work.
  - C. Hold trades other than the roofing contractor accountable for work on finished roof.

END OF SECTION



**THERMAL AND MOISTURE PROTECTION****CHAPTER 9: SPECIFICATIONS****SECTION 075113****BUILT-UP ASPHALT ROOFING****GENERAL GUIDELINES****1.1 SECTION INCLUDES**

- A. Qualitative requirements for roofing systems composed of alternating layers of bituminous sheets and viscous bituminous coatings over an insulated deck.

**1.2 SYSTEM DESCRIPTION**

- A. Provide one of the following built-up roofing membrane systems for insulated substrates:
  - 1. BU-I-A-G (4)-A (Built-Up Roof Membrane Over Insulated Deck Using Asphalt with Glass Fiber Ply Sheets and Aggregate Surfacing)
  - 2. BU-I-L-G2(coated base) (4)-A (Built-Up Roof Membrane Over Insulated Deck Using, Cold Liquid-Applied Asphalt with Ply Sheets and Aggregate Surfacing)

**1.3 MATERIALS**

- A. Base Sheet: As recommended by manufacturer.
- B. Ply Felt: Asphalt impregnated, glass fiber felt, complying with ASTM D 2178, Type VI or 28 lb. coated based sheets as required by manufacturer to meet warranty requirements.

**1.4 FLASHING MATERIALS**

- A. Flashing Sheet
  - 1. Provide one of the following:
    - a. SBS modified asphalt sheet, mineral granule surfaced, ASTM 6162 (composite sheet) or ASTM 6164 (polyester).
    - b. APP modified asphalt sheet, mineral granule surfaced, ASTM 6223 (composite).

**1.5 ASPHALT MATERIALS**

- A. Roofing Asphalt: As recommended by built-up roofing membrane manufacturer.
- B. Cold Applied Adhesive.

**1.6 AUXILIARY MEMBRANE MATERIALS**

- A. Aggregate Surfacing.
- B. Substrate Board: If required by the Design Team or roof system manufacturer by project conditions.
- C. Vapor Retarder: If required by the Design Team by project conditions.
- D. Roof Coating: If required by the Design Team by project conditions.
- E. Walkways: Provide at roof access points and recommended by system manufacturer.

**1.7 POLYISOCYANURATE BOARD INSULATION**

- A. Insulation shall have a minimum compressive strength of 20 psi and be faced on both top and bottom.

## CHAPTER 9: SPECIFICATIONS

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- B. Provide tapered insulation, preformed saddles, crickets, tapered edge strips, and other insulation shapes as required for “positive drainage”.
- 1.8 INSULATION ACCESSORIES
- A. General: Roof insulation accessories recommended by insulation manufacturer for intended use and compatible with membrane roofing.
  - B. Fasteners.
  - C. Cold Fluid-Applied Adhesive.
  - D. Wood Nailer Strips.
  - E. Cover Board
    - 1. Perlite insulation board.
    - 2. Cellulosic-fiber insulation board.
- 1.9 GENERAL INSTALLATION REQUIREMENTS
- A. Install built-up roofing membrane system according to roofing system manufacturer's written instructions and applicable recommendations of ARMA/NRCA's “Quality Control Guidelines for the Application of Built-Up Roofing”.
    - 1. Install roofing system according to applicable specification plates of NRCA's “The NRCA Roofing and Waterproofing Manual”.

LEED SUGGESTIONS

- 2.1 Credit EQ 4.1 relates to indoor air quality within the building and sets limits for the VOC content of adhesives and sealants that may emit this VOCs into the interior space of the building. Because many adhesives and sealants used in roofing are used beneath the roof membrane, the volatile materials in them cannot be vented to the exterior and end up in the occupied space. For this reason, the requirements of this credit apply to roofing sealants and adhesives unless they are used exclusively on the exterior side of the roof membrane.

LESSONS LEARNED

- 3.1 If permanent roofing membrane is installed before roof-top work by other contractors is completed, a common scenario, the roofing membrane can be damaged. Although obvious damage can be remedied, long-term problems may still develop that may not be covered by a warranty. Confining rooftop construction operations to specific areas and enforcing protection requirements will also offer a measure of protection to the permanent roofing membrane.
- 3.2 The cost of temporary roofing, installed for the Contractor's convenience or to minimize the risk of incurring a penalty for delaying the overall Project completion, is the Contractor's responsibility.
- 3.3 Temporary roofing SHALL NOT be permitted to be retained as part of a final roofing membrane. It is easily damaged during the construction period. Moisture may enter the temporary roofing membrane and the dangers associated with phased construction of a BUR system may also be introduced. Ply slippage may occur between the temporary roof surface and the succeeding plies of the BUR roofing system. Interrupted or phased construction of the BUR roofing system is not recommended by roofing system manufacturers or NRCA.

END OF SECTION

**THERMAL AND MOISTURE PROTECTION****CHAPTER 9: SPECIFICATIONS****SECTION 075200****MODIFIED BITUMINOUS MEMBRANE ROOFING****GENERAL GUIDELINES****1.1 SECTION INCLUDES**

- A. Qualitative requirements for roofing systems formed with modified bituminous membranes over an insulated deck.
  - 1. Provide one of the following systems:
    - a. MBA (1)-I-(T, M or L)-G(2)-M or A (Modified Bitumen APP Roofing Membrane Over Insulated Deck, Mopped or Set In Cold, Liquid-Applied Adhesive, with Glass Fiber Ply Sheet and Mineral or Aggregate Surfacing)
    - b. MBS (1)-I-(T, M or L)-G(2)-M or A (Modified Bitumen SBS Roof Membrane Over Insulated Deck, Mopped or Set In Cold, Liquid-Applied Adhesive, with Glass Fiber Ply Sheet and Mineral or Aggregate Surfacing)

**1.2 MATERIALS**

- A. Cap Sheet: Provide one of the following:
  - 1. SBS-Modified Bituminous Cap Sheet: SBS-modified asphalt sheet, smooth surfaced, dusted with fine parting agent on both sides or granular surfaced; suitable for application method specified; manufacturer's standard thickness and weight; for use and of reinforcing type as follows:
    - a. Use: Roof membrane and base flashing.
    - b. Reinforcing: Composite woven (ASTM 6162) and glass fiber mat.
  - 2. APP-Modified Bituminous Cap Sheet, Smooth Surfaced: Atactic polypropylene modified asphalt sheet, smooth surfaced; suitable for application method specified; manufacturer's standard thickness and weight; for use and of reinforcing type as follows:
    - a. Use: Roof membrane and base flashing.
    - b. Reinforcing: Composite woven (ASTM 6162) and glass fiber mat.

**1.3 AUXILIARY MEMBRANE MATERIALS**

- A. Protective Surfacing
  - 1. Aggregate Surfacing.
  - 2. Roof Granules.
- B. Roofing Asphalt: As recommended by modified bituminous membrane manufacturer.
- C. Cold-Applied Adhesive.
- D. Substrate Board: If required by Design Team or roof system manufacturer by project conditions.
- E. Vapor Retarder: If required by Design Team or roof system manufacturer by project conditions.

## CHAPTER 9: SPECIFICATIONS

**THERMAL AND MOISTURE PROTECTION**

- F. Walkways: Provide at roof access points and recommended by system manufacturer.

## 1.4 BASE SHEET MATERIALS

- A. Base Sheet: Unperforated, asphalt impregnated and coated, glass fiber sheet, dusted with fine mineral surfacing on both sides.

## 1.5 BASE-PLY FELTS

- A. Base-Ply Felt: Asphalt coated, glass fiber felt, complying with ASTM D 2178, Type VI or 28 lb. coated base sheets as required by manufacturer to meet warranty requirements.

## 1.6 POLYISOCYANURATE BOARD INSULATION

- A. Insulation shall have a minimum compressive strength of 20 psi and be faced on both top and bottom.
- B. Provide tapered insulation, preformed saddles, crickets, tapered edge strips, and other insulation shapes as required for "positive drainage".

## 1.7 INSULATION ACCESSORIES

- A. General: Roof insulation accessories recommended by insulation manufacturer for intended use and compatible with membrane roofing.
- B. Fasteners.
- C. Cold Fluid-Applied Adhesive.
- D. Wood Nailer Strips.
- E. Cover Board
  - 1. Perlite insulation board.
  - 2. Cellulosic-fiber insulation board.

## 1.8 INSTALLATION

- A. Install modified bituminous membrane roofing system according to roofing system manufacturer's written instructions and applicable recommendations of NRCA/ARMA's "Quality Control Recommendations for Polymer Modified Bitumen Roofing".
  - 1. Install roofing system according to applicable specification plates of NRCA's "The NRCA Roofing and Waterproofing Manual".

END OF SECTION

**THERMAL AND MOISTURE PROTECTION****CHAPTER 9: SPECIFICATIONS****SECTION 075323****EPDM ROOFING****GENERAL GUIDELINES****1.1 SECTION INCLUDES**

- A. Qualitative requirements for roofing systems formed with nonvulcanized and vulcanized elastomeric membranes over an insulated deck.
  - 1. Fully-Adhered Thermoset Membrane Roofing.

**1.2 EPDM SHEET**

- A. Uniform, flexible sheet formed from a terpolymer of ethylene-propylene-diene (EPDM), complying with ASTM D 4637, of the following grade, class, thickness, backing, and exposed face color:
  - 1. Thickness: 60 mils, nominal.
    - a. Type II, scrim or fabric internal reinforced.
    - b. Backing: Unbacked.
    - c. Black
  - 2. Thickness: 60 mils, nominal.
    - a. Type I, non-reinforced
    - b. Backing: Unbacked.
    - c. White on black.
- B. Sheet Flashing: 60 mil thick EPDM.

**1.3 AUXILIARY MATERIALS**

- A. General: Furnish auxiliary materials recommended by roofing system manufacturer for intended use and compatible with EPDM membrane roofing.
- B. Protection Sheet: Epichlorohydrin or neoprene non-reinforced flexible sheet.
- C. Seaming Material: Manufacturer's standard splice tape.
- D. Slip Sheet: Manufacturer's recommended slip sheet, of type required for application.
- E. Fasteners, lap sealant, bonding adhesive, and water cutoff mastic.
- F. Miscellaneous Accessories: Provide pourable sealers, preformed cone and vent sheet flashings, preformed inside and outside corner sheet flashings, T-joint covers, termination reglets, cover strips, and other accessories.

**1.4 SUBSTRATE BOARDS**

- A. Substrate Board
  - 1. Glass-mat, water-resistant gypsum substrate.
  - 2. Gypsum wood fiber composite/fiber-reinforced gypsum.
  - 3. Perlite board.

## CHAPTER 9: SPECIFICATIONS

**THERMAL AND MOISTURE PROTECTION**

## 1.5 ROOF INSULATION

- A. General: Provide one of the following preformed roof insulation boards that comply with roofing system requirements and referenced standards:
  - 1. Extruded-Polystyrene Board Insulation: ASTM C 578, Type IV, 1.6 lb./cu.ft. minimum density, square edged.
  - 2. Polyisocyanurate Board Insulation: 20 psi compressive strength, minimum, and faced on both top and bottom.
- B. Provide tapered insulation, preformed saddles, crickets, tapered edge strips, and other insulation shapes as required for “positive drainage”.

## 1.6 INSULATION ACCESSORIES

- A. General: Roof insulation accessories recommended by insulation manufacturer for intended use and compatible with membrane roofing.
- B. Fasteners.
- C. Cold Fluid-Applied Adhesive.
- D. Cover Board – must be included in the assembly.

## 1.7 MEMBRANE INSTALLATION

- A. Membrane must be fully adhered.

LESSONS LEARNED

- 3.1 Substrate Boards may be used as thermal barriers, as support for vapor **retarders**, and as part of a fire-resistance-rated roofing system. Substrate boards used as part of a fire-resistance rated roofing system can reduce the amount spray-on fireproofing needed. Value engineering a substrate board out of a rated roof assembly may in turn add cost to the project. ***Careful choice of roofing insulation can eliminate the need for a thermal barrier.***
- 3.2 Cover Boards
  - A. Elastomeric roofing systems using molded- or extruded-polystyrene insulation or polyisocyanurate insulation may also benefit from cover boards. NRCA has identified conditions where a cover board might be considered for ballasted, fully-adhered, and mechanically-fastened roofing systems.
  - B. Cover boards are beneficial if the compressive strength of the foam insulation is less than 23 lb/sq.ft. (158 kPa). Foam insulation in roofing systems that will be ballasted or subject to foot traffic may crush, reducing the thermal-insulation value. Extruded-polystyrene insulation in a fully-adhered membrane roofing may be attacked by solvent-based adhesives. Polyisocyanurate felt facers may separate from the foam if subject to long-term roof traffic. Creep under pressure from fastener plates or bars, causing a reduction in clamping pressure, has been reported with molded polystyrene in mechanically-fastened roofing systems. The damage from these situations can be minimized with the use of cover boards.

END OF SECTION

**THERMAL AND MOISTURE PROTECTION****CHAPTER 9: SPECIFICATIONS****SECTION 075400****THERMOPLASTIC MEMBRANE ROOFING****GENERAL GUIDELINES****1.1 SECTION INCLUDES**

- A. Qualitative requirements for roofing systems formed with reinforced and unreinforced thermoplastic membranes over an insulated deck.
  - 1. Provide any of the following products:
    - a. Thermoplastic Polyolefin Sheet (TPO)
    - b. Polyvinyl-Chloride Sheet (PVC)
    - c. Ketone Ethylene Ester Sheet (KEE)

**1.2 THERMOPLASTIC POLYOLEFIN SHEET (TPO)**

- A. Reinforced Thermoplastic Polyolefin Sheet: ASTM D 6878-**11a**, reinforced, ***fabric backing is optional.***
  - 1. Thickness: 60 mils, minimum.

**1.3 Polyvinyl-Chloride SHEET (PVC)**

- A. PVC Sheet: ASTM D4434, Type III, fabric reinforced, ***fabric backing is optional.***
  - 1. Thickness: 60 mils, minimum.

**1.4 KETONE ETHYLENE ESTER SHEET (KEE)**

- A. Ketone Ethylene Based Sheet Roofing (KEE): ASTM D6754, reinforced internally with a fabric, ***fabric backing is optional.***
  - 1. Thickness: 45 mils, minimum.

**1.5 AUXILIARY MATERIALS**

- A. General: Finish auxiliary materials recommended by roofing system manufacturer for intended use and compatible with membrane roofing material.
- B. Sheet Flashing: As recommended by membrane manufacturer.
- C. Slip Sheet.
- D. Vapor Retarder: If required for assembly as determined by Design Team.
- E. Fasteners.
- F. Walkways.
- G. Miscellaneous Accessories: Provide pourable sealers, preformed cone and vent sheet flashings, preformed inside and outside corner sheet flashings, T-joint covers, termination reglets, cover strips, and other accessories.

## CHAPTER 9: SPECIFICATIONS

**THERMAL AND MOISTURE PROTECTION**

## 1.6 SUBSTRATE BOARDS

- A. Substrate Board, provide one of the following:
  - 1. Glass-mat, water-resistant gypsum substrate.
  - 2. Gypsum wood fiber composite/fiber-reinforced gypsum.
  - 3. Perlite board.

## 1.7 ROOF INSULATION

- A. General: Provide one of the following preformed roof insulation boards that comply with roofing system requirements and referenced standards.
  - 1. Extruded-Polystyrene Board Insulation: ASTM C 578, Type IV, 1.6 lb./cu.ft. minimum density, square edged.
  - 2. Polyisocyanurate Board Insulation: ASTM C 1289, Type II, Grade 2, felt or glass-fiber met facer on both major surfaces.
- B. Provide tapered insulation, preformed saddles, crickets, tapered edge strips, and other insulation shapes as required for "positive drainage".

## 1.8 INSULATION ACCESSORIES

- A. General: Roof insulation accessories recommended by insulation manufacturer for intended use and compatible with membrane roofing.
- B. Fasteners.
- C. Cold Fluid-Applied Adhesive.
- D. Cover Board – must be included in the assembly.

## 1.9 INSTALLATION

- A. Membrane shall be adhered.

END OF SECTION



**THERMAL AND MOISTURE PROTECTION****CHAPTER 9: SPECIFICATIONS****SECTION 075700****COATED FOAMED ROOFING****GENERAL GUIDELINES****1.1 SECTION INCLUDES**

- A. Qualitative requirements for low-slope roofing assemblies consisting of spray-applied materials which expand through chemical reaction and an elastomeric coating.

**1.2 PERFORMANCE REQUIREMENTS**

- A. Uplift pressure calculated according to SEI / ASCE 7.

**1.3 QUALITY ASSURANCE**

- A. Installer Qualifications: SPFA accreditation for company.
- B. Fire-Test-Response Characteristics
  - 1. Surface-Burning Characteristics: Maximum flame-spread and smoke-developed indexes of 75 and 450, respectively.
  - 2. Exterior Fire-Test Exposure: Class A.

**1.4 WARRANTY**

- A. Coated Formed Roofing Manufacturer's Warranty: 20 years.

**1.5 MATERIALS**

- A. Polyurethane Foam: ASTM C 1029, Type III; with in-place density of 2.8 to 3.0 lb/cu.ft. and flame-spread index of 75 or less.
- B. Silicone Coatings: One- or two-component silicone.
- C. Thermal Barrier: If required for roof assembly as determined by Design Team.
- D. Vapor Retarder: As recommended by coated foamed roofing manufacturer and Design Team.
- E. Mineral Granules: Ceramic-coated roofing granules.
- F. Walkway Pads: Formed of nonwoven PVC strands.

**1.6 INSTALLATION**

- A. Install thermal barrier to resist uplift pressures according to roofing system manufacturer's written instructions.
- B. Apply base coat and topcoat at thickness recommended by coated foamed roofing manufacturer.
- C. Apply mineral granules over coated polyurethane foam.

**END OF SECTION**

## CHAPTER 9: SPECIFICATIONS

**THERMAL AND MOISTURE PROTECTION**

## SECTION 076200

## SHEET METAL FLASHING AND TRIM

GENERAL GUIDELINES

## 1.1 SECTION INCLUDES

- A. Qualitative requirements for shop- and field-formed accessories trim.

## 1.2 QUALITY ASSURANCE

- A. Quality Standard: SMACNA's "Architectural Sheet Metal Manual".

## 1.3 WARRANTY

- A. Fluoropolymer Finishes: 10 years.

## 1.4 MATERIALS

- A. Sheet Metals, Exposed
  - 1. Copper sheet
  - 2. Aluminum sheet with smooth, flat or embossed surface.
    - a. Class I clear anodic finish.
    - b. Class I color anodic finish.
    - c. Coil-Coated Finish: two-coat fluoropolymer.
  - 3. Stainless-Steel Sheet: Polished directional satin finish with smooth, flat surface.
  - 4. Metallic-Coated Steel Sheet: Zinc-coated (galvanized) steel or Aluminum-zinc alloy-coated steel sheet with smooth, flat or embossed surface.
    - a. Coil-Coated Finish: Two-coat fluoropolymer.
- B. Underlayment

## 1.5 PRODUCTS

- A. Formed Flashing and Trim
  - 1. Reglets and Counterflashing: Stainless steel or galvanized steel.
    - a. Type: Stucco, concrete, or masonry.
      - 1) Surface-mounted type should be avoided.
    - b. Materials
      - 1) Copper: 16 ounce.
      - 2) Stainless Steel: 0.0187 inch thick.
      - 3) Prepainted, Metallic-Coated Steel: 0.028 inch thick.
- B. Formed Roof Drainage Fabrications: Including hanging gutters, downspouts, parapet scuppers, conductor heads, and splash pans.
  - 1. Gutters
    - a. Girth up to 15 inches
      - 1) Aluminum: 0.032 inch thick.
      - 2) Prepainted, metallic-coated steel: 0.0217 inch thick.
    - b. Girth 16 to 20 inches
      - 1) Aluminum: 0.040 inch thick.
      - 2) Prepainted, metallic-coated steel: 0.0276 inch thick.

**THERMAL AND MOISTURE PROTECTION****CHAPTER 9: SPECIFICATIONS**

- c. Girth 21 to 25 inches
      - 1) Aluminum: 0.050 inch thick.
      - 2) Prepainted, metallic-coated steel: 0.0336 inch thick.
    - d. Girth 26 to 30 inches
      - 1) Aluminum: 0.063 inch thick.
      - 2) Prepainted, metallic-coated steel: 0.040 inch thick.
    - e. Girth 31 to 35 inches
      - 1) Prepainted, metallic-coated steel: 0.0516 inch thick.
  - 2. Downspouts
    - a. Aluminum: 0.024 inch thick.
    - b. Prepainted, metallic-coated steel: 0.0217 inch thick.
  - 3. Parapet Scupper
    - a. Copper: 15 oz./sq.ft.
    - b. Aluminum: 0.032 inch thick.
    - c. Prepainted, metallic-coated steel: 0.0276 inch thick.
  - 4. Conductor Heads
    - a. Aluminum: 0.032 inch thick.
    - b. Prepainted, metallic-coated steel: 0.0276 inch thick.
  - 5. Splash Pans
    - a. Aluminum: 0.040 inch thick.
    - b. Stainless steel: 0.0187 inch thick.
- C. Formed Low-Slope Roof Fabrications: Including roof-penetration flashing and roof-drain flashing.
  - 1. Roof-Penetration Flashing
    - a. Stainless steel: 0.0187 inch thick.
    - b. Prepainted, metallic-coated steel: 0.0276 inch thick.
  - 2. Roof Drain Flashing
    - a. Stainless steel: 0.0187 inch thick.
  - 3. Refer to Section "Roof Specialties" for roof edge flashing and copings.
- D. Miscellaneous Formed Fabrications: Including equipment support flashing and overhead-piping safety pans.
  - 1. Equipment Support Flashing
    - a. Stainless steel: 0.0187 inch thick.
    - b. Prepainted, metallic-coated steel: 0.0276 inch thick.
  - 2. Overhead-Piping Safety Pans
    - a. Stainless steel: 0.0250 inch thick.
    - b. Prepainted, metallic-coated steel: 0.0276 inch thick.

**LESSONS LEARNED****3.1 Metal Considerations**

- A. Compatibility of sheet metal flashing and trim with other materials on the building must be considered. Sustained wash from certain materials onto sheet metal flashing and trim may cause deterioration of metals or finishes. Contact manufacturers to verify whether metals and coatings under consideration are compatible with runoff from adjoining stonework, concrete, or masonry.

- B. Metal-to-metal compatibility should also be considered. Avoid contact between metals that are farthest apart in the galvanic scale. See Appendix C in SMACNA's Architectural Sheet Metal Manual for more recommendations for reducing galvanic corrosion.
  - C. Galvanic corrosion results when two metals are in contact with each other in the presence of an electrolyte such as rainwater or sea water. The less noble, or more anodic, metal will corrode. A galvanic scale, or galvanic series, arranges metals according to their relative electrolytic behavior in a specific electrolyte, which is why the exact order of metals may differ in different galvanic scales. The greater the separation on the scale, the greater the corrosion potential.
- 3.2 Sheet Metal Thickness and Gages – The sheet metal flashing and trim industry continues to use the term gage to indicate sheet metal thickness for steel and stainless steel, although, according to ASTM standards, sheets metals are only produced in decimal or fractional thicknesses. ASTM A 480/A 480M, Specification for General Requirements for Flat-Rolled Stainless and Heat-Resisting Steel Plate, Sheet, and Strip, includes the following statement in Section 4, "Ordering Information": "Thickness shall be ordered to decimal or fractional thickness. The use of the gage number is discouraged as being an archaic term of limited usefulness not having a general agreement on meaning." It would be difficult to compare metal thicknesses among manufacturers if the use of gages were retained.
- 3.3 Wind-Uplift Resistance – Wind-uplift resistance and how sheet metal roof edge flashing and copings are attached at the roof perimeter are issues that have grown in prominence. Perimeter flashing failures are frequently cited as initiating roofing membrane failures during windstorms. FM Global (FMG) reports: "The majority of (low-slope) roof covering failures involve improperly designed or constructed perimeter flashings."

END OF SECTION

**THERMAL AND MOISTURE PROTECTION****CHAPTER 9: SPECIFICATIONS****SECTION 077100****ROOF SPECIALTIES****GENERAL GUIDELINES****1.1 SECTION INCLUDES**

- A. Qualitative requirements for standard manufactured components, both formed and extruded, serving as roofing perimeter facing, drainage, and expansion control.

**1.2 PERFORMANCE REQUIREMENTS**

- A. Low-slope membrane roof systems metal edge securement, except gutters, shall be designed in accordance with ANSI/SPRI ES-1, except wind speed shall be determined by ASCE 7.

**1.3 WARRANTY**

- A. Painted Finishes: 10 years.

**1.4 COPINGS**

- A. Copings: Manufactured coping system consisting of formed-metal coping cap, concealed anchorage, concealed splice plates with same finish as coping caps, mitered corner units, and end caps.
  - 1. Coping Caps: Fabricated from one of the following exposed metals.
    - a. Aluminum: 0.063 inch thick, minimum
    - b. Prepainted, Metallic-Coated Steel Sheet: 0.034 inch thick, minimum.
  - 2. Corners: Continuously welded or mechanically clinched and sealed watertight.

**1.5 ROOF EDGE FLASHINGS**

- A. Provide one of the following types compatible with roofing system selected, performance and wind-load requirements.
  - 1. Canted Roof Edge Fascia: Manufactured, two-piece, roof edge fascia consisting of snap-on or compression-clamped metal fascia cover and a continuous formed galvanized steel sheet cant dam, 0.028 inch thick, minimum, with integral drip edge cleat.
    - a. Fascia Cover: Fabricated from one of the following metals:
      - 1) Formed or extruded aluminum or painted, metallic-coated steel sheet in thickness as recommended by NRCA in "Guide for Sheet Metal Fascia Edges".
  - 2. Roof Edge Fascia: Manufactured, two-piece, roof edge fascia consisting of snap-on metal fascia cover and a continuous formed- or extruded-aluminum anchor bar with integral drip edge cleat to engage fascia cover.
    - a. Fascia Cover: Fabricated from one of the following metals:
      - 1) Formed or extruded aluminum or painted, metallic-coated steel sheet in thickness as recommended by NRCA in "Guide for Sheet Metal Fascia Edges".

## CHAPTER 9: SPECIFICATIONS

**THERMAL AND MOISTURE PROTECTION**

3. Gravel Stops: Manufactured, one-piece, formed-metal gravel stop with a horizontal flange and vertical leg fascia terminating in a drip edge, continuous hold-down cleat, and concealed splice plates of same material, finish, and shape as gravel stop.
  - a. Fabricate from one of the following metals:
    - 1) Aluminum sheet or painted, metallic-coated steel sheet in thickness as recommended by NRCA in "Guide for Sheet Metal Fascia Edges".

## 1.6 GUTTERS AND DOWNSPOUTS

- A. Gutters and Downspouts: Manufacture or fabricate gutter complete with end pieces, outlet tubes, and other accessories as required. Furnish flat-stock gutter spacers and gutter brackets from same material as gutters, of size recommended by SMACNA, but not less than twice the gutter thickness. Fabricate expansion joints, expansion-joint covers, and gutter accessories from same metal as gutters.
  1. Fabricate from one of the following metals:
    - a. Aluminum sheet or painted, metallic-coated steel sheet in thickness as recommended in the Architectural Sheet Metal Manual, Table 1-5 "Recommended Minimum Gages for Gutter."

## 1.7 REGLETS AND COUNTER FLASHINGS

- A. General: Provide reglets of type, material, and profile indicated, compatible with flashing. Form to securely interlock with counterflashing.
- B. Counterflashing Wind Resistant Clips: Provide clips to be installed before counterflashing to prevent wind uplift of the counterflashing's lower edge.
- C. Material: Fabricate reglets from the following metal in thickness indicated:
  1. Aluminum Sheet: 0.050 inch thick, minimum.
  2. Painted, metallic-coated steel sheet: 0.028 inch, minimum
- D. Provide counterflashing fabricated from the same metal as reglets and compatible with reglet system installed.
- E. Provide counterflashing fabricated from the following metal in thickness indicated:
  1. Aluminum Sheet: 0.024 inch thick.
  2. Painted, metallic-coated steel sheet:: 0.028 inch.

(continued on next page)

**THERMAL AND MOISTURE PROTECTION****CHAPTER 9: SPECIFICATIONS****Guide for Sheet Metal Fascia Edges**

(Reprinted from the NRCA Roofing and Waterproofing Manual – Fourth Edition)

<b>Recommended Minimum Gauges for Fascia and Cleat<sup>2</sup></b>					
<b>Exposed Face Without Brakes “A” Dimension</b>	<b>Aluminum Alloy (30003-H14)</b>	<b>Cold Rolled Copper</b>	<b>Galvanized or Coated Steel (G60 &amp; G90)</b>	<b>Stainless Steel (302 &amp; 304)</b>	<b>Cleat<sup>2</sup></b>
Up to 3” Face	.032”	16 oz.	24 ga.	24 ga.	Same gauge as fascia metal
3” to 6” Face	.040”	16 oz.	24 ga.	24 ga.	One gauge heavier than fascia metal
6” to 8” Face	.050”	20 oz.	24 ga.	24 ga.	One gauge heavier than fascia metal
8” to 15” Face	Add brakes to stiffen or use two-piece face	Add brakes to stiffen or use two-piece face	Add brakes to stiffen or use two-piece face	Add brakes to stiffen or use two-piece face	One gauge heavier than fascia metal

Reprinted from SMACNA “Architectural Sheet Metal Manual”

<b>Girth</b>		<b>Galvanized Steel</b>		<b>Copper</b>		<b>Aluminum</b>		<b>Stainless Steel</b>	
<b>in.</b>	<b>mm</b>	<b>gage</b>	<b>mm</b>	<b>oz.</b>	<b>mm</b>	<b>in.</b>	<b>mm</b>	<b>gage</b>	<b>mm</b>
Up to 15	Up to 380	26	0.5512	16	0.55	0.032	0.812	28	0.396
16-20	410-510	24	0.7010	16	0.55	0.040	1.016	26	0.477
21-25	530-640	22	0.8534	20	0.69	0.051	1.295	24	0.635
26-30	660-760	20	1.006	24	0.82	0.063	1.295	22	0.795
31-35	790-890	18	1.311	24	0.82			20	0.952
Over 35	Over 890	16	1.613					18	1.270

**Table 1-5 Recommended Minimum Gages for Gutter**

END OF SECTION

## SECTION 077200

## ROOF ACCESSORIES

GENERAL GUIDELINES

## 1.1 SECTION INCLUDES

- A. Qualitative requirements for accessories installed on or in roofing other than mechanical or structural items.

## 1.2 QUALITY ASSURANCE

- A. Sheet Metal Standard: SMACNA's "Architectural Sheet Metal Manual".

## 1.3 PRODUCTS

- A. Roof Curbs: Galvanized steel, aluminum-zinc alloy-coated steel, prepainted metallic-coated steel, aluminum, or stainless steel.
- B. Equipment Supports: Galvanized steel, aluminum-zinc alloy-coated steel, prepainted metallic-coated steel, aluminum, or stainless steel.
- C. Roof Hatches: Galvanized steel, aluminum-zinc alloy-coated steel, prepainted metallic-coated steel, aluminum, or stainless steel.
- D. Gravity Ventilators: Galvanized steel or aluminum.
- E. Ridge Vents: Galvanized steel or aluminum.**

LESSONS LEARNED

- 3.1 Special attention to insulating curbs and ensuring that seams and joints of roof accessories are sealed to prevent air or water infiltration can have a significant effect on the energy efficiency of roof accessories.

END OF SECTION



**THERMAL AND MOISTURE PROTECTION****CHAPTER 9: SPECIFICATIONS****SECTION 078100****APPLIED FIREPROOFING****GENERAL GUIDELINES****1.1 SECTION INCLUDES**

- A. Qualitative requirements for specialized coatings, mineral fiber, and cementitious coverings to provide the resistance to building components.

**1.2 QUALITY ASSURANCE**

- A. Fire-Test-Response Characteristics: Provide SFRM with the fire-test-response characteristics as determined by testing identical products per test method indicated by UL or another testing and inspecting agency acceptable to authorities having jurisdiction.
- B. Product shall contain no detectable asbestos.

**1.3 MATERIALS**

- A. Concealed SFRM: Cementitious or sprayed-fiber.
- B. Exposed SFRM
  - 1. Cementitious Type: Dry density not less than 22 lb/cu.ft.
  - 2. Sprayed-Fiber Type: Dry density not less than 22 lb/cu.ft.
  - 3. Water-based intumescent mastic.
  - 4. Non-water-based intumescent mastic.
- C. Auxiliary Fire-Resistive Materials:
  - 1. Substrate primers.
  - 2. Bonding adhesive.
  - 3. Expanded metal lath.
  - 4. Reinforcing fabric.
  - 5. Reinforcing mesh.
  - 6. Sealer.
  - 7. Topcoat.

**LESSONS LEARNED:**

- 2.1 If primers and lockdown encapsulants are neither listed nor prohibited in the specified fire-resistance design, UL allows the application of SFRM over unknown, primed, and similarly painted wide-flange steel shapes under certain conditions but only after bond tests are performed to compare the bond strength of the SFRM that has been applied over coated steel to that applied over uncoated steel. UL's Fire Resistance Directory, "Coating Materials" Article, which is applicable to wide-flange steel shapes, specifies the bond tests and the conditions where mechanically attaching the SFRM is required. These conditions include wide-flange-beam flange widths exceeding 12 inches, column-flange widths exceeding 16 inches, beam and column web depths exceeding 16 inches, and bond strengths over primed steel falling below the minimum acceptable values. Typically, SFRMs for direct application are tested on galvanized steel deck with a phosphate coating. If other coatings are present, mechanical attachment may be required unless the deck and coating have been UL tested and listed as a painted deck for a specific UL design. Verify, with manufacturers, the chemical compatibility of primers or encapsulants with the SFRM.

- 2.2 Careful consideration of fire-protection requirements by the entire design team early in the design process can result in integrated designs that may avoid common complaints about and problems with costs, value engineering, substitutions, workmanship, durability, indoor air quality, and failures related to applications of SFRM.
- 2.3 Several methods, both active (sprinklers) and passive, are possible for protecting steel structures from fire. Designing for fire protection might include dividing a building into isolated modules with a limited number of penetrations for fire-rated doorways, electrical conduits, and ducts. Modules could be protected with SFRM, sprinklers, or both, depending on use, occupancy, potential exposure to abusive environments and individuals, and requirements of authorities having jurisdiction. Costs of sprinkling may be offset by savings from less-restrictive requirements for construction and finishes. Avoiding fire-rated doorways reduces costs for doors, hardware, and signs. Avoiding penetrations for electrical and mechanical work reduces the need for and expense of through-penetration firestop systems, fire-safing insulation, and fire dampers.
- 2.4 The design of other construction may be dictated by the selection of specific fire-resistance designs in ways that are sometimes unanticipated. For example, selecting assemblies for floor-ceiling designs that are allowed, with restrictions, for roof-ceiling designs, may limit the choice of roofing materials and thickness of the roof insulation.
- 2.5 Certain surfaces, such as the underside of metal floors and roof decks, may undergo continuous changes in loading or vibration from heavy traffic that could damage SFRM. Excessive deflection and impact forces on steel deck from construction activities and traffic have been identified by manufacturers of SFRM as the leading causes of lack of cohesion/adhesion and bond failure when SFRMs are applied to steel deck. Problems with roof decks surpass problems with floor decks because floor decks are often concrete filled, usually stiffer than roof decks, and less susceptible to impact loads. Manufacturers of SFRM recommend that roofing be completed, penthouse construction be completed, HVAC roof equipment be placed, and construction roof traffic be stopped before applying SFRM. ASTM E 1513 "Practice for Application of Sprayed Fire-Resistive Materials" (SFRMs) states that "SFRM shall be applied after all roof construction, installation of roof-top HVAC equipment, and other related work is completed" and "No SFRM shall be applied to steel deck prior to completion of concrete work on steel deck." AWCI's Recommended Sprayed Fireproofing Industry Standards suggests prohibiting traffic on completed roofing until SFRMs are completely dry and cured. ASTM E 1513 requires that "No roof traffic shall be allowed during application or during the curing period of the SFRM applied to the roof." Excessive construction loads on roof decks can dent and distort the decks and cause damage to applied SFRM. Refer to manufacturers' written recommendations for other guidelines that might influence the choice of above-deck roofing components.

END OF SECTION

**THERMAL AND MOISTURE PROTECTION****CHAPTER 9: SPECIFICATIONS****SECTION 078400****FIRESTOPPING****GENERAL GUIDELINES****1.1 SECTION INCLUDES**

- A. Qualitative requirements for materials installed in cavities, around penetrations, and openings in floors, walls, partitions, and other building components to prevent spread of fire and smoke.

**1.2 QUALITY ASSURANCE**

- A. Installer Qualifications: An FM Global-approved firestop contractor or a UL-qualified firestop contractor.
- B. Fire-Test-Response Characteristics: UL, Intertek ETL SEMKO, or FM Global.

**1.3 PENETRATION FIRESTOPPING**

- A. Penetrations in Fire-Resistance-Rated Walls: F-ratings per ASTM E 814 or UL 1479.
- B. Penetrations in Horizontal Assemblies: F- and T-ratings per ASTM E 814 or UL 1479.
- C. Penetrations in Smoke Barriers: L-ratings per UL 1479.
- D. W-Ratings: Per UL 1479.

**1.4 FIRE-RESISTIVE JOINT SYSTEMS**

- A. Joints in or between Fire-Resistance-Rated Construction: ASTM E 1966 or UL 2079.
- B. Joints at Exterior Curtain-Wall / Floor Intersections: ASTM E 119 or ASTM E 2307.

**END OF SECTION**

## SECTION 079200

## JOINT SEALANTS

**GENERAL GUIDELINES****1.1 Sealants are required for masonry mockup in early construction phase.****LEED SUGGESTIONS**

- 2.1 LEED Rating: The U.S. Green Building Council's Green Building Rating System for Leed for Schools requires low-emitting materials within the weatherproofing system for Credit EQ 4.1. VOC limits are those listed for Bay Area Air Quality Management District Regulation 8, Rule 51. Although most elastomeric sealants fall easily within VOC limits, special attention should be paid to solvent-release sealants such as acrylic-based and butyl-rubber based products. Primers must also be considered because they typically have a higher VOC rating than the sealants themselves. Exterior sealants are not covered in LEED Credit EQ 4.1.

**LESSONS LEARNED**

- 3.1 While joint sealant qualitative requirements are beyond the scope of the Design Manual, they are none the less very important. Joint sealants provide continuity and weathertightness across small gaps in construction and at junctures between dissimilar materials.
- A. Exterior Exposure: For exterior applications sealants must resist the effects of exposure to ultraviolet (UV) light, ozone, heat, water, temperature extremes, air pollution, and cleaning chemicals.
    - 1. Silicone joint sealants are generally regarded as having the highest performance and best durability of the elastomeric joint sealants for exterior use.
  - B. Interior Applications: For interior applications, sealants must resist the effects of exposure to mildew, paint, cleaning agents, and for special applications - certain chemicals.
    - 1. Silicone, urethane, or latex sealants may be used for interior applications based on application.
      - a. Silicones are recommended for mildew resistance and where contact with food is possible.
      - b. Urethanes are good general purpose sealants.
      - c. Latex sealants are paintable and good for filling gaps where little movement is expected.
  - C. Traffic Applications: If exposed to foot and vehicular traffic, sealants must resist the abrasion, tearing, puncturing, and other forms of damage caused by sharp objects such as spike heels, pebbles, and debris.
    - 1. Urethanes are generally chosen for traffic joints because of their greater hardness and better tear resistance.
- 3.2 Evaluating joint-sealant performance requires understanding not only sealant properties but also their various modes of failure. These include the following:

- A. **Adhesive Failure:** The sealant loses bond with joint substrates. Sealants must tenaciously grip both sides of a joint, but may require a bond breaker or backer rod to prevent the sealant from adhering to the backing substrate. Adhesion testing prior to construction is recommended. Nonporous, and even some porous substrates, may require priming to improve adhesion. Adhesive failure is caused by the following:
1. Selecting a sealant that is not designed to adhere to the types of joint substrates existing in a project.
  2. Improperly formulating or mixing a sealant so that its bonding capacity is not developed.
  3. Improper preparation of joint substrates so that the sealant is not allowed to contact and wet sound surfaces. Substrates must be free of moisture, frost, dirt, sealers, paints, form release agents, contamination, corrosion, and degradation. Primer saturation could also prevent the sealant from bonding to substrates.
  4. Tensile strength of the sealant exceeds its adhesive strength in the extension cycle. This condition can result from joint widths that are too narrow relative to sealant movement capabilities.
  5. Hardening of sealant and loss of elasticity due to age or other causes. This condition can be caused by improper mixing of sealant components. It may occur in joints where initial adhesion is good but deteriorates after one or two years to the point where adhesive failure occurs.
  6. Compression set occurs, which refers to a sealant's resistance to return to its former shape during extension after deformation under compression. Because adhesive failures typically do not occur when sealants are compressed but generally occur during extension, the cause is often attributed to poor joint preparation or poor adhesion characteristics of the sealant rather than to the actual cause, compression set. Failure of preformed foamed sealants generally is caused by loss of compression pressure against joint substrates.
- B. **Cohesive Failure:** The sealant fails by tearing within itself while the edges remain adhered to both sides of the joint. The primary reason for cohesive failure is joint movement greater than the joint can accommodate.
- C. **Spalling Failure:** A portion of the joint substrate pulls away with the sealant attached. This may not be the result of a failure of the sealant, but may result if the substrate material is weak or friable. Such failures may occur if the sealant lacks adequate movement capability; the higher the modulus of a sealant, the greater the stress on the bond line.
- D. **Intrusion Failure:** Solid foreign matter intrudes into the sealant after it has necked down during extension and then, during a subsequent compression cycle, abrades the sealant in a manner that causes cohesive failure in a later tension cycle.
- E. **Reversion:** A sealant softens and loses its elasticity, thereby simulating a return to its uncured state. This form of failure is primarily associated with urethane sealants and is defined in ASTM C 717 as "a loss of elastomeric properties and a decrease in durometer hardness of a seal or cured sealant following environmental exposure." The sealant industry is not currently in agreement as to the cause of reversion or how prevalent the problem is.
- F. **Crazing:** Also called "alligatoring". This form of failure may be induced by normal deterioration due to weather and can eventually lead to cohesive failure.

- G. Bubbling: This condition is caused by gas escaping from the sealant, backer rods, or substrates, and can destroy the sealant's integrity when bubbles rupture. Moisture in the substrate is a primary cause of bubbling, but it is also often caused by air entrainment during mixing of liquid sealants.
- H. Appearance-Related Failures: These failures include bloom, organic growth, color change, and chalking. Bloom is where fluids within the sealant migrate to the sealant's surface. Organic growth is where algae, mildew, or other microorganisms grow on the sealant's surface and produce roots, which not only penetrate the sealant but also consume it. Color change results from unstable pigments or an adverse chemical reaction with another chemical in contact with the sealant. Chalking is where powder forms on the sealant's surface and can indicate disintegration of the base polymer as a result of weathering.

END OF SECTION

**08**  
**DIVISION**  
**OPENINGS**

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## SECTION 081113

## HOLLOW METAL DOORS AND FRAMES

**GENERAL GUIDELINES****1.1 SECTION INCLUDES**

- A. Qualitative requirements for hinged doors, fixed panels, and frames manufactured from carbon steel.

**1.2 QUALITY ASSURANCE**

- A. Steel Door and Frame Standard: Comply with ANSI A250.8.

**1.3 MATERIALS**

- A. Cold-Rolled Steel Sheet: ASTM A1008, Commercial Steel, Type B; suitable for exposed applications.
  - 1. Application: Interior, unless otherwise noted.
- B. Metallic-Coated Steel Sheets: ASTM A653, Commercial Steel, Type B, with an A60 zinc-iron-alloy (galvannealed) coating; stretcher-leveled standard of flatness.
  - 1. Application: Exterior openings.

**1.4 DOORS**

- A. Interior Doors: Provide doors complying with requirements indicated below by referencing ANSI 250.8 for level and model and ANSI A250.4 for physical endurance level:
  - 1. Level 3 and Physical Performance Level A (Extra Heavy Duty), Model 2 (Seamless) or Model 3 (Stile and Rail).
- B. Exterior Doors: Provide doors complying with requirements indicated below by referencing ANSI 250.8 for level and model and ANSI A250.4 for physical endurance level:
  - 1. Level 3 and Physical Performance Level A (Extra Heavy Duty), Model 2 (Seamless) or Model 3 (Stile and Rail).

**1.5 FRAMES**

- A. Frames for Interior Openings: 0.053 inch thick steel (16 gauge).
- B. Frames for Exterior Openings: 0.053 inch thick steel (16 gauge).

END OF SECTION

**OPENINGS**

## CHAPTER 9: SPECIFICATIONS

## SECTION 081116

## ALUMINUM DOORS AND FRAMES

**GENERAL GUIDELINES****1.1 SECTION INCLUDES**

- A. Qualitative requirements for hinged or pivoting doors and fixed panels manufactured from aluminum.

**1.2 STANDARD FULL GLASS ALUMINUM DOORS**

- A. Major portions of the door stiles shall be .125 inch in thickness, and glazing molding shall be .050 inch thick.
- B. Doors **Design: Wide stile.**
  - 1. Interior glazing stops shall be square snap-in type with neoprene bulb type glazing. Square stops on exterior side shall be lock-in tamperproof type. No exposed screws shall be required to secure stops.
- C. Door shall be weatherstripped on 3 sides with metal backed pile cloth installed in the door and/or frame. An adjustable weatherstrip astragal with stainless steel backing shall be provided at the meeting stiles of a pair of doors.

**1.3 FLUSH ALUMINUM DOORS**

- A. **Standard Flush Aluminum Doors, for Manual Swing Operation**
  - 1. **Provide minimum 1-3/4 inch thick doors constructed from the following:**
    - a. **Framing and Hardware Backup: Extruded aluminum tubing, 0.125 inch minimum thickness.**
    - b. **Facing; provide one of the following:**
      - 1) **Seamless aluminum sheet 0.062 inch thick; smooth, ribbed, or pebbled texture; laminated to 0.125 inch tempered hardboard.**
      - 2) **Seamless aluminum sheet 0.090 inch thick; smooth, ribbed, or pebbled texture.**
      - 3) **Combined 0.100 inch thick tube shapes with smooth or ribbed texture.**
  - 2. **Core: Rigid insulating material of not less than 2.0 lb/cu.ft. density.**
  - 3. **Exterior stops shall be an integral part of the door construction with a minimum wall thickness of .132 inch and minimum height of 3/4 inch. Glazing tape shall be applied to stop prior to installation of glass or panel. Doors shall be interior glazed with 3/4 inch high extruded aluminum snap-in glass stops with a minimum wall thickness of .060 inch with a roll-in gasket.**

**1.4 HARDWARE**

- A. Door shall be modified in width for continuous gear hinge installation.

END OF SECTION

## SECTION 081416

## FLUSH WOOD DOORS

**GENERAL GUIDELINES****1.1 SECTION INCLUDES**

- A. Qualitative requirements for hinged doors and fixed panels with flush panel construction; solid cores; wood veneers.
  - 1. Flush wood doors.

**1.2 QUALITY ASSURANCE**

- A. Quality Standards: WDMA I.S. 1-A.

**1.3 INTERIOR SOLID CORE DOORS**

- A. Grade: Custom grade with “A” faces.
- B. Cut: Plain sliced or rotary cut.
- C. Match between Veneer Leaves: Book or slip match.
- D. Assembly of Veneer Leaves on Door Faces: Running match.
- E. Construction: 5-ply construction with particleboard, stave core, or “SCL” structural composite lumber core with stiles and rails glued to core.
- F. WDMA I.S. 1-A Performance Grade: Extra Heavy Duty

**1.4 FITTING AND FINISH**

- A. Fitting: Factory prefit and premachine doors.
- B. Factory Finish: Transparent factory finish, WDMA TR-4 conversion varnish or TR-6 catalyzed polyurethane.
  - 1. Grade: Custom

**LEED SUGGESTIONS**

- 2.1** *Many domestic hardwood species are readily available, and as certified wood, including some that produce strikingly attractive veneers. Cherry, American black walnut, pecan, and butternut provide fine veneers. Brown ash, figured hard maple, red gum, or hickory can also provide fine veneers that are out of the ordinary. Red and white oak, white ash, and American elm also produce fine-quality veneers. Using less well-known tropical species that are not endangered may also be environmentally desirable because it may encourage sustainable forestry. The database “Woods of the World”, Version 2.5, listed in the “References” article in these evaluations, provides information for many lesser-known tropical hardwoods that are not endangered.*

**OPENINGS****CHAPTER 9: SPECIFICATIONS**

- 2.2** *All door core materials use fast-growing, low-density wood species that are typically farmed or removed as weeds from hardwood stands. None require cutting old-growth stands, so environmental implications associated with decisions about core type are generally not critical. For particleboard cores, however, there is a possibility for positive environmental effects, because particleboard is available made from recycled wood as well as from straw, which is an agricultural waste. Recycled content of particleboard can consist of sawdust and scraps from lumber mills or urban wood waste from demolition activities or from tree trimming.*
- 2.3** *LEED Rating: The U.S. Green Building Council's (USGBC) LEED for Schools, requires that a minimum of 50% of wood-based materials be certified as having been obtained from forests that comply with FSC STD-01-001, FSC Principles and Criteria for Forest Stewardship, in order for a building to qualify for LEED Credit MR 7. The Section Text includes optional paragraphs to require flush wood doors produced from certified wood and to require documentation of chain of custody for the wood. Note that USGBC will allow credit for the full value of the door as certified wood if the door manufacturer is listed for chain-of-custody certification and at least 70% of the wood materials in the door are from certified forests; otherwise, it only allows credit for the value of the certified wood materials used in making the door.*

END OF SECTION

## SECTION 081613

FIBERGLASS DOORS **AND FRAMES**GENERAL **GUIDELINES****1.1 SECTION INCLUDES**

- A. Qualitative requirements for fiberglass reinforced plastic (FRP) doors and frames.

**1.2 WARRANTY**

- A. Materials: 10 years

**1.3 MATERIALS**

- A. Door
1. Door Face Sheets
    - a. **Fiberglass reinforced plastic.**
    - b. Total door thickness to be a nominal 1-3/4 inch.
  2. Internal Construction
    - a. Core
      - 1) **Rigid Insulation or** Polyurethane Foam Core (non-rated interior)
      - 2) Mineral Core – fire-rated.
    - b. Stiles and Rails: Pultruded fiberglass **or aluminum tubes. Wood is not acceptable.**
- B. Door Frames (**optional**): High modulus pultruded structural RFP shape.
1. The frame section shall be standard double rabbeted. 5-3/4 inches deep by 2 inch face, 3/16 inch thick, with integral 5/8 inch doorstop, to match typical hollow metal configurations.
  2. **Design may use either aluminum or fiberglass frames.**

END OF SECTION

**OPENINGS****CHAPTER 9: SPECIFICATIONS****SECTION 083113****ACCESS DOORS AND FRAMES****GENERAL GUIDELINES****1.1 SECTION INCLUDES**

- A. Qualitative requirements for access doors and panels in walls and ceilings.

**1.2 QUALITY ASSURANCE**

- A. Fire-Rated Vertical Access Doors and Frames: NFPA 252 or **UL 10 B**.
- B. Fire-Rated Horizontal Access Doors and Frames: ASTM E119 or UL 263.

**1.3 ACCESS DOORS**

- A. Frames: minimum 0.060 inch thick sheet steel (16 gauge) with flange suitable for adjacent material.
- B. Doors: minimum 0.075 inch thick sheet steel (14 gauge).
- C. Door Type
  - 1. Flush panel, unless noted otherwise.
  - 2. Recessed panel, at gypsum wallboard and acoustical ceiling.
  - 3. Fire-rated where indicated.
- D. Locking Devices: Cylinder locks where exposed to public.
  - 1. Screw driver latching may be used where access to door is controlled, i.e. janitor's closet.

END OF SECTION

## SECTION 083320

## OVERHEAD COILING DOORS AND GRILLES

GENERAL GUIDELINES

## 1.1 SECTION INCLUDES

- A. Qualitative requirements for doors and grilles that open by folding as an accordion or as a set of panels.
  - 1. Coiling counter doors.
  - 2. Overhead coiling doors.
  - 3. Overhead coiling grilles.
  - 4. Wood counter shutters.

## 1.2 QUALITY ASSURANCE

- A. Fire Rated Assemblies: NFPA 80, and acceptable testing agency listing.
- B. ***Energy Performance at Insulated Standard Service Door***
  - 1. ***Thermal Requirements (Assembly): U-0.500 maximum (R-2, minimum).***
  - 2. ***Air Leakage: Shall not exceed 0.2 cfm/ft<sup>2</sup> when tested at a pressure of at least 1.57 pounds per square foot (psf) in accordance with AAMA/WDMA/CSA 101/I.S.2/A440 or NFRC 400.***

## 1.3 COILING COUNTER DOORS

- A. Type
  - 1. Standard counter door.
  - 2. Fire rated counter door.
- B. Door curtain, provide one of the following:
  - 1. Zinc-coated (galvanized) cold-rolled structural steel (ss) sheet, complying with ASTM A653, G90 coating designation.
  - 2. Stainless steel, Type 304 Series, ASTM A666.
- C. Slat Profile: Flat face slats.

## 1.4 OVERHEAD COILING DOORS

- A. Type
  - 1. Standard service door.
  - 2. Insulated standard service door.
  - 3. Fire rated service door.
    - a. Motor operated for testing.
- B. Door Curtain, provide one of the following:
  - 1. Zinc-coated (galvanized) cold-rolled structural steel (ss) sheet, complying with ASTM A653, G90 coating designation.
  - 2. Stainless steel, Type 304 Series, ASTM A666.
- C. Slat Profile: Flat face slats.

**OPENINGS**CHAPTER 9: SPECIFICATIONS

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**1.5 OVERHEAD COILING GRILLES**

- A. Grille curtain and finish, provide one of the following:
1. Stainless steel, AISI Type 302/304 with No. 4 satin finish.
  2. Aluminum, ASTM B 221, with clear anodized finish.
  3. Hot dip zinc (galvanized), complying with ASTM A123 or electrogalvanized complying with ASTM 653.

**LESSONS LEARNED**

- 2.1 Overhead coiling doors, sometimes called rolling doors, include non-insulated, insulated, and fire-rated service doors that have traditionally been used where security, smoke, containment, and fire containment are primary considerations. An advantage of coiling doors is their compact door storage assembly, which is at the head of the opening, frequently above the suspended ceiling height.
- 2.2 The installation and maintenance of doors and assemblies used to protect openings against the spread of fire and smoke are regulated by NFPA 80. This standard requires door testing and labeling with fire-resistance ratings that requires that fire-rated doors be installed in fire-rated construction. Overhead doors cannot be used to close off a means of egress unless special provisions are made for an emergency pass door within or adjacent to the rated door.

END OF SECTION



## SECTION 083613

## SECTIONAL DOORS

GENERAL GUIDELINES

## 1.1 SECTION INCLUDES

- A. Qualitative requirements for doors that open by moving upward into a nonvertical position, guided on a track.

## 1.2 PERFORMANCE REQUIREMENTS

- A. Operation-Cycle Requirements: Provide sectional overhead door components and operators capable of operating for not less than 5,000 cycles.
- B. **Energy Performance:**
  - 1. **Thermal Requirements (Assembly): U- .22, maximum (R-4.5 minimum).**
  - 2. **Air Leakage: Shall not exceed 0.2 cfm/ft<sup>2</sup> when tested at a pressure of at least 1.57 pounds per square foot (psf) in accordance with AAMA/WDMA/CSA 101/I.S.2/A440 or NFRC 400.**

## 1.3 SECTIONAL OVERHEAD DOORS

- A. Steel Door Sections: Insulated panels.
  - 1. Frame and Panels: Galvanized (G60) steel frame and steel panels.
    - a. Steel Thickness for Sectional Faces: 0.040 inch thick (20 gauge).
  - 2. Thermal Insulation
- B. Track: Galvanized Steel.
- C. Weather Seals.
- D. Windows: Optional.
- E. Operation: Manual or Electric Door Operator.

## 1.4 AUXILIARY MATERIALS

- A. Automatic reversing control for bottom bar for electric sectional overhead doors.

END OF SECTION

**OPENINGS****CHAPTER 9: SPECIFICATIONS****SECTION 084413****GLAZED ALUMINUM CURTAIN WALLS****GENERAL GUIDELINES****1.1 SECTION INCLUDES**

- A. Qualitative requirements for glazed curtain walls with metal framing members.

**1.2 QUALITY ASSURANCE**

- A. Energy Performance: Glazed aluminum curtain walls shall have energy performance ratings per NFRC.
  - 1. Thermal ***Requirements (Assembly): U-0.45, maximum (R-2.2 minimum) but*** shall not be less than value determined by Mechanical Engineer by "Building Modeling" in order to meet project's LEED objectives.
  - 2. ***Air Leakage: Shall not exceed 0.06 cfm/ft<sup>2</sup> when tested at pressure of at least 1.57 pounds per square foot (psf) or higher in accordance with NFRC 400 or ASTM E283.***

**1.3 GLAZED ALUMINUM CURTAIN WALLS**

- A. Primary Components: Extruded aluminum framing, internal reinforcement, trim, and filler units, sealants, and gaskets.
- B. Glazing: Refer to Division 08, Section "Glazing".
- C. Construction: Thermally improved.

END OF SECTION

## SECTION 085113

## ALUMINUM WINDOWS

GENERAL GUIDELINES

## 1.1 SECTION INCLUDES

- A. Qualitative requirements for fixed and operable aluminum framed windows used singly and in multiples.

## 1.2 QUALITY ASSURANCE

- A. Manufacturer shall certify that windows have been tested and conform to AAMA/WDMA 101/I.S.2.
  - 1. Performance Class: AW Architectural.
  - 2. Performance Grade: Not less than 60.
- B. Energy Performance: Aluminum windows shall have energy performance ratings per NFRC.
  - 1. Thermal Requirements (Assembly): U-0.55, maximum, (R-1.8 minimum) but shall not be less than value determined by Mechanical Engineer by "Building Modeling" in order to meet project's LEED objectives.
  - 2. Air Leakage: Shall not exceed 0.2 cfm/ft<sup>2</sup> when tested at a pressure of at least 1.57 pounds per square foot (psf) in accordance with AAMA/WDMA/CSA 101/I.S.2/A440 or NFRC 400.
  - 3. ***Provide early delivery sample window of the type and profile used in the classrooms for the mock-up required in the Unit Masonry section 042000.***

## 1.3 ALUMINUM WINDOWS

- A. Window Operation
  - 1. Projected.
  - 2. Casement.
  - 3. Fixed.
  - 4. Awning.
  - 5. Top hinged in-swinging windows.
- B. Glazing: Sealed Insulated Units
  - 1. Refer to Division 08, Section "Glazing".
- C. Construction: Thermally improved as required to meet energy requirements.

## 1.4 AUXILIARY MATERIALS

- A. Insect Screening: Provide at operable vents.
  - 1. Aluminum frame.
  - 2. Screen: Glass-fiber-mesh, aluminum wire, or solar-screening mesh.
  - 3. Wickets: Sliding or hinged.
- B. Blinds Between Glazing: Where required at vision glass, provide remotely operated horizontal louver blinds in the space between glazing panes. Construct blinds of aluminum shades, equipped for tilting, raising, and lowering by standard operating hardware located on inside face of sash.
  - 1. Access Panel: Shall be hinged, lift-off type not acceptable.

END OF SECTION

**OPENINGS****CHAPTER 9: SPECIFICATIONS****SECTION 085200****WOOD WINDOWS****GENERAL GUIDELINES****1.1 SECTION INCLUDES**

- A. Qualitative requirements for fixed and operable wood framed windows used singly and in multiples.
  - 1. Aluminum or vinyl clad

**1.2 QUALITY ASSURANCE**

- A. Provide wood windows of performance class and grade indicated that comply with **AAMA / WDMA 101 / I.S.2 / NAFS**
  - 1. Performance Class: C minimum.
  - 2. Performance Grade: 30 minimum.
- B. Energy Performance: Windows shall have energy performance ratings per **NFRC-100**.
  - 1. Thermal Transmittance (u-factor): Shall not be less than value determined by Mechanical Engineer by "Building Modeling" in order to meet project's LEED objectives.
  - 2. **Provide early delivery sample window of the type and profile used in the classrooms for the mock-up required in the Unit Masonry section 042000.**

**1.3 WOOD WINDOWS**

- A. Window Operation
  - 1. Projected.
  - 2. Casement.
  - 3. Fixed.
  - 4. Single-Hung.

**1.4 MATERIALS**

- A. Aluminum Cladding
  - 1. Trim Members: Provide aluminum-clad wood, hollow-aluminum extrusions, or roll-formed aluminum trim members.
- B. Vinyl Cladding
  - 1. Trim Members: Vinyl-Clad Wood.
- C. Hardware
  - 1. Operating Device: Combination lever handle or crank Cam latch lock.
  - 2. Hinges: Heavy-duty, two-knuckle butt hinges (Minimum of two per ventilator).
- D. Glazing: Sealed Insulated Units
  - 1. Refer to Division 08, Section "Glazing".

**1.5 AUXILIARY MATERIALS**

- A. Insect Screening
  - 1. Provide at operable vents.
  - 2. Screen: Glass-fiber-mesh or aluminum wire fabric.
  - 3. Wickets: Sliding or hinged.
- B. Blinds Between Glazing: Where required at vision glass, provide remotely operated horizontal louver blinds in the space between glazing panes. Construct blinds of aluminum slats equipped to tilting, raising, and lowering by standard operating hardware located on inside face of sash.
- C. **Insulating-Foam Sealant: Refer to Division 08, Section "Thermal Insulation."**
- D. **Aluminum subsill and sill flashing.**

LESSONS LEARNED

- 3.1 Water infiltration is a problem only if there is not a means for controlling its path and weeping the water out. Proper installation methods for installing wood windows need to include a means of controlling water even if it comes from within the wall cavity.
- 3.2 Most schools are a brick and block design and **wood windows** need to be installed with an installation clip. Proper exterior sealant and application of interior foam is critical to create a “dead air” space in the wall cavity. This dead air space will help prevent the negative interior pressure of the building trying to pull any water into the building. The second critical installation item is use of a subsill, especially when units are mulled together. Use of a subsill system will provide a path for any water that penetrates the **window assembly** to **drain** without causing damage to the windows **or building**.
- 3.3 A mock-up and a pre-installation conference **are necessary to verify** coordination with **the air barrier** and **to prevent** water infiltration.

END OF SECTION

## SECTION 085410

## FIBERGLASS WINDOWS

GENERAL GUIDELINES

## 1.1 SECTION INCLUDES

- A. Qualitative requirements for fiberglass windows.

## 1.2 QUALITY ASSURANCE

- A. Provide fiberglass windows of performance class and grade indicated that comply with AAMA/NWDA 101.1.5.2
  - 1. Performance Class: C minimum.
  - 2. Performance Grade: 30 minimum.
- B. Energy Performance: Fiberglass windows shall have energy performance ratings per NFRC.
  - 1. Thermal Requirements (Assembly): U-0.55, maximum, (R-1.8 minimum) but shall not be less than value determined by Mechanical Engineer by "Building Modeling" in order to meet project's LEED objectives.
  - 2. Air Leakage: Shall not exceed 0.2 cmf/ft<sup>2</sup> when tested at a pressure of at least 1.57 pounds per square foot (psf) in accordance with AAMA/WDMA/CSA 101/I.S.2/A440 or NFRC 400.
  - 3. ***Provide early delivery sample window of the type and profile used in the classrooms for the mock-up required in the Unit Masonry section 042000.***

## 1.3 FIBERGLASS WINDOWS

- A. Window Operation
  - 1. Projected.
  - 2. Casement.
  - 3. Fixed.
  - 4. Single-Hung.

## 1.4 MATERIALS

- A. Fiberglass: AAMA 305 glass fiber reinforced thermoset profile.
- B. Glazing: Refer to Division 08, Section "Glazing".

## 1.5 AUXILIARY MATERIALS

- A. Insect Screening
  - 1. Provide at operable vents.
  - 2. Screen: Glass-fiber-mesh or aluminum wire fabric.
  - 3. Wickets: Sliding or hinged.
- B. Integral Louver (Venetian) Blinds.

END OF SECTION

**OPENINGS****CHAPTER 9: SPECIFICATIONS****SECTION 085656****SECURITY WINDOW SCREENS / *GLAZING*****GENERAL GUIDELINES****1.1 SECTION INCLUDES**

- A. Qualitative requirements for security window screens for preventing glass breakage and forced entry.

- 1. ***Security glazing may be used in lieu of mesh.***

**1.2 PERFORMANCE REQUIREMENTS**

- A. Test Requirements:

- 1. Comply with test criteria of SMA 6001-2002 ***for screens.***

- a. Impact Test: An impact of 50 ft/lbs of force causing a deflection of not more than 3 inches as specified for medium rating.
    - b. Sag Test: 90 lbs. of weight applied for 5 minutes with a permanent sage of not more than 0/063 inches as specified for heavy rating.
    - c. Force Entry Test: Three loads of force: A:150 lbs, B: 300 lbs, C:50 lbs applied to screen. As specified for heavy rating.

- 2. ***Security glazing shall comply with Forced-Entry Resistance: Class III per ASTM F 1233.***

- B. Product Certificates (***screens***): Certifications, performance and testing must comply with impact, sag, and forced entry resistance requirements of SMA 6001-2002. Manufacturer must submit the AAMA notice of product certification in compliance with CFR 200.935 as "Security Screen-medium".

**1.3 MATERIALS**

- A. Aluminum Extrusions: All frame and retainer sections shall be extruded aluminum shaped produced from commercial quality 6063-T5 alloy and shall be free from defect that impair strength and durability.
- B. Sub Frame: All sub frame members to be made of extruded aluminum alloy with a nominal wall thickness of .062 inches that incorporates an aluminum snap on cover to conceal the installation fasteners. All frame corners to be miter cut and crimped.
- C. Hinge: Two hinges shall be located at the jamb opposite of the operating mechanisms. Each hinge shall fit in an aluminum raceway that allows for removal of hinge or adding of hinges without the need of processing to the subframe or screen. The hinges shall be powder-coated pre-assembled 3-wing design made of aluminum, using nylon bushings. Pins, pressure, plates, and screws shall be stainless steel. Grub screw to allow removal of pin, grub screw shall only be accessible once the screen is opened.
- D. Screens: Screen to be full configuration and be operable. Screen main frame to be of mitered construction and contain a noise reduction gasket to prevent rattle between main frame and sub frame, frame members and tie bar to have a hollow, with .078 nominal wall thickness. No exposed fastener to the interior or exterior will be acceptable. Screen to lock in a closed secure position by means of a single point release lock.

- E. Mesh: Screen cloth to be .028 inch stainless steel 12 x 12 mesh black painted. Each edge of screen to have a 1/2 inch 90 degree bend.
  - 1. ***Laminated Polycarbonate (option to mesh): Polycarbonate sheets laminated with clear urethane interlayer that complies with ASTM C 1349, Appendix X2, and has a proven record of no tendency to bubble, discolor, or lose physical and mechanical properties after fabrication and installation. Provide laminated units that comply with requirements of ASTM C 1349 for maximum allowable laminating process blemishes and haze.***
- F. Locking Mechanism: Provide single handle that activates a cast metal bolt at the sill and a two directional metal lock and keeper mid span of the upper lite.
- G. Limit Device: An adjustable arm made of galvanized steel shall be located at the head to limit the screen from swinging open past 90 degrees from the manufacturer, field adjustment shall be possible to accommodate existing conditions. Optional hold open stays are available.

END OF SECTION



**OPENINGS****CHAPTER 9: SPECIFICATIONS****SECTION 086300****METAL-FRAMED SKYLIGHTS****GENERAL GUIDELINES****1.1 SECTION INCLUDES**

- A. Qualitative requirements for factory assembled and field assembled aluminum frame skylight systems with insulating glazing consisting of either polycarbonate, heat strengthened and laminated glass units, or translucent fiberglass sandwich panels.

**1.2 QUALITY ASSURANCE****A. Energy Performance:****1. Thermal Requirements (Assembly):**

- a. **Skylight with Curb, Glass: U-1.17 maximum, (R- .85 minimum) but shall not be less than value determined by Mechanical Engineer by "Building Modeling" in order to meet project's LEED objectives.**
- b. **Skylight with Curb, Plastic: U- 1.10 maximum, (R- .91 minimum) but shall not be less than value determined by Mechanical Engineer by "Building Modeling" in order to meet project's LEED objectives.**
- c. **Skylight without Curb, All: U- .69 maximum (E- 1.45 minimum), but shall not be less than value determined by Mechanical Engineer by "Building Modeling" in order to meet project's LEED objectives.**

- 2. **Air Leakage: Shall not exceed 0.3 cfm/ft<sup>2</sup> for unit skylights having condensation weepage openings, when tested at a pressure of at least 1.57 pounds per square foot (psf) in accordance with AAMA/WDMA/CSA 101/I.S.2/A440 or NFRC 400.**

**1.3 UNIT SKYLIGHTS**

- A. Integral Curb: Self-flashing type.
- B. Polycarbonate glazing: Thermoformable extruded polycarbonate sheets with a minimum impact strength of 12 foot/lb. Per ASTM D 256, test method A, and burglar resistant per UL 972. UV resistant and double glazed.
- C. Insulating Glass:
  - 1. Exterior lite 1/4 inch heat strengthened glass.
  - 2. Interior lite 2 plies 1/8 inch clear, heat strengthened glass with 0.030 clear polyvinyl butyral interlayer.
  - 3. Low E coating.
- D. Fiberglass sandwich panel: Manufacturer's standard, uniformly colored, translucent fiberglass reinforced polymer face sheets permanently adhered to a grid core.
- E. Aluminum Components.
- F. Thermal break.
- G. Protective screens when required by Design Team.

**1.4 FRAMED SKYLIGHTS**

- A. Framing Materials: Aluminum.
  - 1. Extrusions: ASTM B221.
  - 2. Sheet and plate: ASTM B 209.
  - 3. Bars, rods, and wire: ASTM B 211.
- B. Polycarbonate Insulating Panels: Double layer, minimum 2.2 inches thick.
- C. Insulating Glass
  - 1. Exterior lite: Heat strengthened glass.
  - 2. Interior lite: Clear laminated glass.
  - 3. Low-E coating.
- D. Fiberglass Sandwich Panels: Manufacturer's standard, uniformly colored, translucent, fiberglass reinforced polymer sheets permanently adhered to a grid core.

**1.5 INSTALLATION**

- A. Install unit skylights according to construction details of NRCA's "The NRCA Roofing and Waterproofing Manual".

END OF SECTION

**OPENINGS****CHAPTER 9: SPECIFICATIONS****SECTION 087100****DOOR HARDWARE****GENERAL GUIDELINES****1.1 SECTION INCLUDES**

- A. Qualitative requirements for hinges, pivots, sliding and folding door hardware, and other hanging hardware; locks, exit devices, cylinders and other latching hardware; closers, holders, self-closing hinges and other controlling hardware; and push plates, pulls, kickplates, and other door trim.

**1.2 QUALITY ASSURANCE**

- A. Hardware for Fire Rated Openings: NFPA 80, and local requirements.
- B. Materials and Application: ANSI A156 series standards.

**1.3 DOOR HARDWARE**

- A. Quality Level: Grade 1, ANSI/BHMA A156.
- B. Locksets and Latchsets: Mortise type.
- C. Lock Cylinders: Interchangeable or recodeable type.
- D. Keying: Owner's requirements keying and key control system.
- E. Hinges and Butts: Full mortise type with nonremovable pins at exterior doors.
- F. Closers, Door Control, and Exit Devices
  - 1. Grade 1 devices.
- G. Pivots: Offset or center hung type.
- H. Push/Pull Units: Through bolted type.
- I. Hardware Finishes
  - 1. Satin chrome.
  - 2. Polished stainless.
  - 3. Satin stainless.

**1.4 AUXILIARY MATERIALS**

- A. Door Trim Units: Kickplates, edge trim, and related trim.
- B. Stops and overhead door holders.
- C. Soundstripping.
- D. Weatherstripping and thresholds.
- E. Electromagnetic hold open devices.

LEED SUGGESTIONS

- 2.1 LEED for Schools requires Minimum Acoustical Performance as a prerequisite for Indoor Environmental Quality. This may require sound gasketing of the doors. The Design Team is encouraged to study this prerequisite carefully so as to avoid not being able to obtain certification by failing to meet the requirements of the prerequisite.
- 2.2 Selection of the proper type and quality of gasketing materials for exterior door openings can have a significant effect on energy savings for the building. The seal should be continuous around the entire perimeter of the door. High-quality closers should also be used on exterior doors to ensure that no door is inadvertently left open.
- 2.3 Thresholds with thermal breaks should be considered. Avoid creating conditions that interfere with the operation of other door hardware. Do not overlook difficulties that people with disabilities might encounter when using the door. Door gasketing must also be coordinated with door and frame types because benefits gained through using quality gasketing can be lost if the door does not have similar thermal performance capabilities.

LESSONS LEARNED

- 3.1 Carefully review OSFC's requirements for three manufacturers with your Door and Hardware consultant.
- 3.2 ***Review and coordinate door hardware characteristics and integration requirements with the Technology Designer for access control and intrusion detections systems.***

END OF SECTION

**OPENINGS****CHAPTER 9: SPECIFICATIONS**

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**SECTION 087113****AUTOMATIC DOOR OPERATORS****GENERAL GUIDELINES****1.1 SECTION INCLUDES**

- A. Qualitative requirements for an automatic door operator is the operating mechanism attached to a door for the purpose of mechanically opening and closing a door upon the receipt of an actuating signal.
  - 1. Application: Provide a minimum of one at main entrance.

**1.2 AUTOMATIC DOOR OPERATOR**

- A. Electromechanical Operating System: Unit powered by permanent magnet dc motor; with closing speed controlled mechanically by gear train and dynamically by braking action of electric motor, and with manual operation including spring closing with power off.

**LESSONS LEARNED**

- 2.1 Indicate doors to receive automated openers on the Door Schedule.

**END OF SECTION**

## SECTION 088000

## GLAZING

GENERAL GUIDELINES

## 1.1 SECTION INCLUDES

- A. Qualitative requirements for transparent and translucent glass for general and special purpose applications.

## 1.2 QUALITY ASSURANCE

- A. Comply with applicable codes and regulations and with the Consumer Product Safety Commission CPSC 16 CFR 1201 and with applicable recommendations of Flat Glass Marketing Association (FGMA) "Glazing Manual."
- B. Energy Performance: Glazing shall combine with framing to achieve rating per NFRC.
1. Thermal **Requirements (Assembly)**: Shall not be less than value determined by Mechanical Engineer by "Building Modeling" in order to meet project's LEED objectives **for each fenestration type**.
  2. **Sealed Insulated Unit: Third pane glazing and blinds enclosed by third pane not required or recommended in daylighting application. Use of motorized roll-up blind is acceptable where room darkening is required.**
  3. **Solar Heat Gain Coefficient (SHGC): Assembly maximum, 0.40.**
  4. When selecting windows, utilize the following chart to determine the best window for each application and exposure:

<u>Application</u>	<u>Exposure</u>	<u>Type</u>
View Glass (non-daylighting apertures) <b>with blinds between glazing</b>	South	clear <b>sealed insulated unit</b> , low-e
	North	clear <b>sealed insulated unit</b> , low-e
	East/West, unshaded	tinted <b>sealed insulated unit</b> , low-e
Windows above lightshelves	South	clear <b>sealed insulated unit</b>
High windows above view glass	North	clear <b>sealed insulated unit</b>
Roof monitor	South	clear <b>sealed insulated unit</b>

## 1.3 GLASS

- A. Primary Glass Products.
- B. Heat Treated Glass Products.
- C. Laminated Glass Units.
- D. Sealed Insulating Glass Units
1. Glazing: Shall be triple glazed consisting of 1 inch thick insulated outer unit comprised of 1/4 inch outer panel, 1/2 wide hermetically sealed air or gas space, and 1/4 inch thick clear inner panel.

**OPENINGS****CHAPTER 9: SPECIFICATIONS**

- E. Fire-Rated Glazing Products; Provide any of the following as required to meet performance conditions:
1. Specialty Tempered Monolithic Glass
  2. Laminated Ceramic Glazing Material
  3. Laminated Glass with Intumescent Interlayer
  4. Gel-Filled, Dual-Glazed Units
  5. Wire glass of any form is not acceptable.

**1.4 GLASS USAGE****A. Exterior**

1. Glass for Exterior Doors
  - a. 1 inch thick insulated glass with optional low-e coating.
2. Exterior Sidelights, Transoms, Storefront, and Curtainwall: Shall be 1 inch thick insulated glass consisting of 1/4 inch thick, outer panel, a 1/2 inch wide hermetically sealed air or gas space, and 1/4 inch clear glass inner panel.
3. Windows: **(vision glass) Sill elevation less than 6' above floor.**
4. **Windows: (daylighting) Placed above nominal vision line and designed to provide or supplement interior illumination.**
5. Sound Rated Glazing (35 or better)
  - a. Kind LT, consisting of two lites of fully tempered float glass.
  - b. Outer Lite: Class 1 float glass.
    - 1) Thickness: 6.0 mm, minimum
  - c. Inner Lite: Class 1 float glass.
    - 1) Thickness: 6.0 mm.
  - d. Plastic Interlayer
    - 1) Thickness: 0.060 inch, but not less than that required to comply as a Type II safety glass material.
    - 2) Color: Clear, unless otherwise noted.
6. Ceramic-Coated Spandrel Insulating Glass
7. Laminated Glass for Skylights and Sloped Glazing
  - a. Glazing shall be 1-1/4 inch thick insulated glass consisting of 1/4 inch thick outer panel, 1/2 inch wide hermetically sealed air or gas space, and 1/2 inch thick laminated glass inner panel.
    - 1) Laminated Glass: Kind LT, consisting of two lites of fully tempered float glass.
      - a) Inner and Outer Lite: Type I (transparent glass, flat) float glass.
        - .1 Class I.
        - .2 FT (fully tempered).
        - .3 Thickness: 6 mm.
      - b) Plastic Interlayer: 0.060 inch thick.
    - 2) Low Emissivity Coating: Optional.

## CHAPTER 9: SPECIFICATIONS

**OPENINGS**

- B. Interior
  - 1. Glass for Vestible Doors, Sidelights, and Transoms: 1/4 inch thick clear tempered glass.
  - 2. Glass for Interior Fire Rated Doors and Windows: 1/4 inch fire-rated glazing product.
  - 3. Glass for Interior Non-Fire Rated Doors and Windows: 1/4 inch clear tempered safety glass.
  - 4. Sound Rated Doors (30 or better)
    - a. Kind LT, consisting of two lites of fully tempered float glass.
    - b. Outer Lite: Class 1 clear float glass.
      - 1) Thickness: 6.0 mm.
    - c. Inner Lite: Class 1 clear float glass.
      - 1) Thickness 6.0 mm.
    - d. Plastic Interlayer
      - 1) Thickness: 0.060 inch, but not less than that required to comply as a Type II safety glass material.
      - 2) Color: Clear, unless otherwise noted.
        - a) Provide a semi-transparent film, where privacy is indicated.

**LEED SUGGESTIONS**

- 2.1 Carefully selecting glass and associated elements of the wall system can drastically reduce energy consumption for both winter and summer seasons. There is no simple set of instructions for absolute analysis of the situation; a range of considerations is involved.
  - A. Although it has been estimated that only 4% of the total energy consumption in the U.S. is heat transferred through building window glass, every source of conservation is worthy of consideration. The general public easily recognizes the window-glass heat-loss problem.
- 2.2 Coatings on glass are an important part of the overall capability now available for minimizing heat transmission through vision lites. Their effectiveness depends on many factors, which are explained and documented in published product literature and other publications. Solar-control low-e coatings maximize the amount of daylight transmitted through the glass, while minimizing both the amount of solar heat transmitted into the building and the amount of heat loss from the long-wave infrared portion of the heat spectrum (radiant heat generated by electric coil-type heat and sensible heat from air-handling systems). For most commercial buildings, regardless of climate, in which the primary concern is reducing the solar heat gain, the coating's location is of less concern, and placing it on either the second or third surface should remain an option; for units with clear glass on both outdoor and indoor lites, the low-e coating is typically placed on the second surface.
- 2.3 LEED for Schools Credit Energy and Atmosphere (Optimize Energy Performance) provides up to 10 points for improving the building performance rating compared to the baseline building performance rating per ASHRAE/IESNA 9.0.1-2004. Selecting glass to reduce energy losses through fenestration and energy consumption for cooling that is caused by solar heat gain through fenestration can help contribute toward earning some of those points. Additionally, credits for Indoor Environmental Quality that can be obtained for daylighting will be affected based on the amount and location of fenestrations. Glass selection is a factor affecting "daylighting" because it is a function of visible light transmittance.

END OF SECTION



## **OPENINGS**

## **CHAPTER 9: SPECIFICATIONS**

### **SECTION 088300**

#### **MIRRORS**

##### **GENERAL GUIDELINES**

##### **1.1 SECTION INCLUDES**

- A. Qualitative requirements for unframed mirrors.

##### **1.2 PRODUCTS**

- A. Glass Mirrors: ASTM C 1503.
- B. Clear Glass: Nominal thickness of 6.0 mm.
- C. Miscellaneous Materials: Setting blocks, edge sealer, and mirror mastic.
- D. Mirror Hardware: Bottom aluminum J-channels and top aluminum J-channels.
- E. Mirror Edges: Rounded polished or beveled polished.

**END OF SECTION**

## SECTION 089000

## LOUVERS AND VENTS

GENERAL GUIDELINES

## 1.1 SECTION INCLUDES

- A. Qualitative requirements for exterior wall louvers.

## 1.2 QUALITY ASSURANCE

- A. Wind Loads: Minimum 29 lb/sq.ft.

## 1.3 PRODUCTS

- A. Fixed, Extruded-Aluminum Louvers
  - 1. Exterior
    - a. Horizontal Storm-Resistant Louver.
    - b. Vertical Storm-Resistant Louver.
    - c. Horizontal, Drainable-Blade Louver.
    - d. Horizontal, Continuous-Line, Drainable-Blade Louver.
  - 2. Interior
    - a. Horizontal, Nondrainable-Blade Louver.
    - b. Vertical, Sightproof, Louver.
    - c. Fixed, Acoustical Louver.
- B. Louver Screens
  - 1. Provided at each exterior louver.
  - 2. Screening Type: Bird screening.
- C. Blank-Off Panels: Uninsulated or insulated.
- D. Wall Vents (Brick Vents): Extruded or cast aluminum.

END OF SECTION