

**MICHIGAN TECHNOLOGICAL UNIVERSITY
FACILITIES MANAGEMENT
DESIGN AND CONSTRUCTION STANDARDS**

Engineering Services 2019

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1. DESIGN PHILOSOPHY

1.1 General Statement

Michigan Technological University strives to provide a distinctive and rigorous action-based learning experience grounded in science, engineering, technology, business, sustainability, and an understanding of the social and cultural contexts of our contemporary world. Our Vision is to be a globally recognized technological university that educates students, advances knowledge, and innovates to improve the quality of life and to promote mutual respect and equity for all people within the state, the nation, and the global community.

Michigan Technological University's recent Strategic Plan, approved by the Board of Trustees in May 2018, includes the following Mission Statement:

We create solutions for society's challenges by delivering action-based undergraduate and graduate education, discovering new knowledge through research, and launching new technologies through innovation.

One primary Goal of the Strategic Plan relates to People, and supporting our people by providing exceptional services and infrastructure

- a) Promote a university-wide culture of safety, responsiveness, effectiveness, and efficiency;
- b) Provide exceptional technology, library, classroom, and laboratory facilities that support education, research, and innovation;
- c) Create and maintain aesthetic, sustainable, and effective infrastructure.

Our physical facilities must support and embody the University's educational Vision, and implement the goals of the Strategic Plan to the extent that our fiscal resources allow. Therefore, designs for new and renovated facilities, both building and site, must cost-effectively coincide with specific project program requirements at Michigan Tech, and also with Michigan Tech's overall objectives; thus creating an environment that fosters interaction, discourse, and respect.

1.2 Universal Accessibility

It is Michigan Technological University's intent to create a diverse and inclusive learning environment, and as such, designs must allow for access of all persons unsegregated, as a primary planning criterion. Universal design reaches beyond the minimum code requirements; thus providing facilities that are accessible to everyone, regardless of age, ability, or status.

1.3 Sustainability

Michigan Tech intends that designs utilize sustainable design principles in all aspects of a project. New buildings and major remodeling projects should be designed to qualify for

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the most current version of LEED Certified available at a minimum. Actual certification will be addressed per individual project.

Sustainable building design needs to address the objectives of cost reduction, energy conservation, renewable energy, energy security, carbon reduction, water conservation, waste reduction and community service that the University has aspired to.

All options that affect sustainability should be evaluated per life cycle cost analysis. If the University places an economic value on carbon reduction at some time in the future, it shall be included in the life cycle cost analysis.

The key attributes of the University's sustainability program are that our efforts are actionable, affordable, measurable and scalable.

If financial constraints arise during budget development, one key strategy to consider is to use pilot projects that are expandable to the remainder of the facility at a later time. Provisions should be made to allow for future expandability without creating major future changes to the building design or infrastructure.

In general, the following should be given consideration for incorporation into building design:

- a) Solar panels for domestic hot water or process water.
- b) Photovoltaic panels to offset electrical usage.
- c) Heat recovery on waste streams.
- d) High efficiency equipment in converting energy from one form to another.
- e) Built in spaces on each floor and at the loading dock to conveniently allow for collection of recyclables. This should include additional areas for grease/oil collection and organic diversion if the facility has a significant percentage of these in the potential waste stream.
- f) Use of natural lighting without overly affecting heating or cooling loads.
- g) Free cooling capability using outside air.
- h) Occupancy controls for lighting, ventilation, fume hood exhausts and auxiliary equipment when applicable.
- i) Designs should also include aspects to connect people with the outdoor natural environment; while understanding, respecting, and celebrating our winter location.

2. PROJECT DOCUMENT STANDARDS

2.1 Drawing Format

- a) Drawings shall utilize a 24"x36" (Arch D standard) size format, unless the consultant makes a compelling case for use of a different industry standard.
- b) All plans, both building and site plans, shall have the north direction either towards the top of the page, or towards the left-hand side. Indicate true north and building north on all site plans.

2.2 Code Compliance Sheet

- a) All building related construction documents for new construction and major remodeling projects shall include a code compliance drawing sheet(s). This shall indicate the codes that the design complies with, and indicate pertinent overall code information. This would include (but not be limited to) fire wall locations, exiting distance, building occupancy type and number, and construction classification.

2.3 Design Deliverables

Deliverables through the course of the project shall be as follows:

- a) At the completion of schematic/preliminary design and design development, consultant shall provide to the University electronic pdf versions of all final design drawings and/or reports. In addition, 3 paper copies of all final design drawings and/or reports shall be provided. Note that copies of special renderings or presentation material shall be negotiated on a case-by-case basis.
- b) At the completion of construction documents, the consultant shall provide electronic pdf versions of all final documents to the University. In addition, 3 paper copies of the final document shall be provided to the University for its use.
- c) The consultant shall provide electronic pdf versions of all drawings and specifications for use during the bidding process, as well as for any addendums. The electronic pdf versions will be posted on the University Facilities Management website, the consultant's website (if applicable), and various Construction Plan Room entities. Paper copies may be purchased by contractors from the consultant, or from an outside print shop for larger projects.
- d) For construction purposes, the consultant will provide updated pdf construction documents to the University and the contractor incorporating any addendum items. Paper copies may be purchased by contractors from the consultant, or from an outside print shop for larger projects.
- e) Upon completion of the project, the consultant shall revise the construction documents based on all changes from bulletins, field orders, and contractor as-built markups. This

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will be additional work to the contract on a Time and Material basis per the consultant's standard rates.

- f) Final deliverables shall be a complete electronic pdf of the construction documents, and all electronic drawing files, including sheets and model files, developed for the project including, but not limited to, the civil, structural, architectural, mechanical, and electrical drawings. In addition, the University will require all plans converted to Autocad, in the version in current use by the University.

2.4 CAD Standards

- a) This standard is based on the United States National Cad Standard (NCS), latest version. All modules of the NCS shall be followed unless specifically noted otherwise in this document.
- b) Software Formats
 - i. Use of AutoDesk products is required for building drawings unless consultant can make a case for using other software.
 - ii. Convert files for use by the University to the version of software that is currently in use by Facilities Management.
 - iii. For projects where Revit is utilized, consultant may be required to export Revit sheets to AutoCAD for use by the University.
- c) Project Control
 - i. Site drawings shall be drawn projected to state plane coordinates NAD83 zone horizontal, and vertical reference NAVD88, FIPS 2111 Michigan North International feet.
 - ii. Site drawings shall be tied to at least 3 control points referenced to state plane.
 - iii. Building drawings may be drawn to local grid coordinates or state plane coordinates, however, if they are drawn to local coordinates the contractor must provide 3 control points visible in each cad file with coordinates provided in both local grid and state plane.
 - iv. If the building drawing model is set up such that each floor is offset in the file there must be 3 control points visible in each floor drawing so that the floors can be stacked vertically and referenced to state plane for use with the campus GIS system.
- d) Sheet Border
 - i. A standard project border shall be used for all sheets. Consultants may use their own border as long as it contains the following information:
 - a) Building Number
 - b) Building Name

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- c) Project Name
 - d) Project status (preliminary, construction, as-built)
 - e) Sheet Name
 - f) Sheet ID (A-101)
 - g) Sheet Issue Date
 - h) Cad file name – automatic stamp
 - i) Plot date stamp –automatic stamp
 - j) Consultant Name
 - k) Consultant Address
 - l) Designed By (P.E. or Architect)
 - m) Drawn By
 - n) Checked By (P.E. or Architect)
 - o) Approved By (principal)
- e) Drawing Sheets: Note, not all sheet types listed below are required for each project.
- i. General Drawings (G Sheets)
 - a) Horizontal coordinate system
 - b) Vertical datum
 - c) Project name
 - d) Project number
 - e) Building number
 - f) Project location map or diagram
 - g) Consultant name and address
 - h) Date
 - i) Cad file name
 - j) Project status (preliminary, bidding, addendum, construction, revision/modification, as-built)
 - k) Vicinity and location maps
 - l) Drawing index (SHEET NUMBER, SHEET NAME, CAD FILE NAME)
EXAMPLE: G-001, COVER SHEET, CB1234_G-001.dwg
 - ii. Geotechnical Drawings (B Sheets)
 - a) Include boring location symbols and name of boring. Identify method used such as machine boring, CPT, etc. (M100-15, C-100-15).
 - iii. Survey Drawings (V Sheets)
 - a) Show topography and planimetric features such building outlines, utilities, trees, roads, etc. Show control points and benchmarks.
 - b) Identify source and date of mapping data (GPS survey, Total Station, photogrammetry, lidar).
 - iv. Civil Site Drawings (C Sheets)
 - C- 101 General Plan: This is only required for projects with multiple plan sheets with different plan extents (road or utilities projects) Show small scale overview of project. Show page outline shapes for each civil sheet.

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- C-102 Site Plan: Large scale plan of project site. If contours are shown list source and date of survey. Show control points and benchmarks.
- v. Architectural Plan Drawings (A Sheets)
 - a) Room numbers on plans shall be coordinated with Michigan Technological University's numbering standards. Once assigned room numbers will not be changed.
- vi. Mechanical, Electrical, Plumbing Drawings (MEP Sheets)
 - a) All abbreviations used shall be verified to be on the provided abbreviation list.

2.5 Specification Standards

- a) Specifications shall be organized per the Construction Specifications Institute (CSI) Masterformat 2016 six number format.
- b) Use Michigan Tech's Division 1 template for the front end of the specification. The template is available from Michigan Tech in a Word format.

3. CONSULTANT REQUIREMENTS

3.1 Point of Contact

- a) The point of contact between Michigan Tech and the consultant shall be the Michigan Tech's Facilities Project Manager. The consultant shall coordinate all activities, correspondence, and meetings with user groups and other University entities through the Facilities Project Manager. All submittals, presentations, all contract issues, and all pay requests shall be made through the contact person. The consultant shall only make direct connections if the Facilities Project Manager directs otherwise in special circumstances, in which case all information shall be copied to this person.

3.2 Project Budget

- a) The consultant shall be responsible for verifying that the project construction budget is reasonable for the scope of work defined for the project. The consultant is then responsible to design the project within the construction budget, working with Michigan Technological University's Facilities Project Manager to prevent scope creep and program change. Any changes to the scope or program shall be noted immediately, and the project budget redefined or adjusted as necessary at that time.

4. SUSTAINABILITY STANDARDS

4.1 General Statement

- a) In general, the design of buildings shall comply with ASHRAE 90.1, the State of Michigan Uniform Energy Code and the referenced International Energy Conservation Code.
- b) Provide continuous online energy monitoring per ASHRAE 10.4.5.

4.2 Building Envelope

- a) Michigan Technological University is located in Climate Zone 7 as indicated in the Code. This shall dictate the minimum standards for the design of the building envelope. In addition, the building envelope shall incorporate:
 - i. Building should be oriented and designed with prevailing wind direction and sun angles throughout the year in mind.
 - ii. All entrances shall include vestibules.
 - iii. Windows shall be designed to maximize daylighting into the building interior and to reduce electrical lighting loads.
 - iv. Windows and fenestration shall be designed to minimize excessive heat gain during the warmer summer months, and heat loss in the winter.
 - v. Windows shall exceed the minimum u-value required in the Michigan Uniform Energy Code. Operable windows shall not exceed an air infiltration rates outlined in the Michigan Uniform Energy Code.
 - vi. Provide and properly detail a high-quality air barrier system around the building envelope to virtually eliminate air infiltration.
 - vii. Structural design of members that penetrate the building envelope shall incorporate thermal breaks when feasible to reduce conductive heat loss.

4.3 Building HVAC System

- a) Buildings must be energy efficient and shall strive to achieve a maximum energy efficiency and indoor air quality.
- b) Buildings that are generally not occupied 24-7 shall be designed so that air-handling units can be shut down or considerably slowed during unoccupied times, with heat loads maintained at minimum levels by perimeter hot water radiation (cycling of air handlers with outside air dampers closed to maintain minimum heat levels is not desirable).
- c) Laboratory spaces shall have occupancy and air quality monitoring to maximize safety and minimize energy consumption.
- d) Each type of space should have its own separate air handler. Where possible provide separate air handlers for classrooms, lecture halls, labs, offices. Each of these areas are likely to operate on different occupancy schedules.

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- e) Building spaces that require considerable exhaust of conditioned air (such as laboratories), shall incorporate energy recovery systems to capture the heating or cooling energy.
- f) Outside air intake rates shall be designed to meet ASHRAE 62.1 (the latest version) requirements.
- g) CO2 demand control, as well as the ability to close or restrict outside air dampers during unoccupied periods, is required for ventilation systems.
- h) Exhaust fans shall have VFD's and be tied to controls that will reduce air flow when air-handlers are turned off or have reduced flow.
- i) Air economizer systems shall be utilized where feasible, with all air handlers capable of 100% outdoor air for free cooling.
- j) Steam radiation systems are not permitted. Only hot water radiation.
- k) Install VFD's on all HVAC fans and pumps.

4.4 Plumbing Systems

- a) All plumbing fixtures shall have low flow, touchless faucets and flush valves. Potable water shall not be used for process cooling or once through processes. Closed loop systems shall be used.

4.5 Lighting Systems

- a) Lighting wattage should not exceed watt per square foot limits outlined in ASHRAE 90.1.
- b) Primarily use dimmable LED fixtures for all interior lighting.
- c) Use medium base LED lamps rated at 50,000 hrs. + for all difficult to reach areas and for accent and spot lighting.
- d) For exterior, use LED fixtures.
- e) Alternative lighting types will be considered based on performance if life cycle costs indicate a better value.

4.6 Compliance Standard

- a) The consultant shall provide a written summary of both the HVAC system and lighting system and design for the proposed space or building.
- b) For new buildings, or new additions, the consultant shall submit to Michigan Technological University calculations and other information indicating how the facility design complies with these standards.

5. SPACE STANDARDS

5.1 Project Type

- a) For the design of new buildings and building additions, Michigan Technological University's Space Utilization Guideline noted below shall be utilized for all rooms unless the Facilities Project Manager directs otherwise for a special circumstance.
- b) For renovation projects involving substantial changes to the existing space, the Space Utilization Guidelines shall be utilized to the extent practical.
- c) For small renovation projects involving minimal wall changes the Space Utilization Guidelines will not be applicable.

5.2 Space Utilization Guidelines

- a) Michigan Technological University's Space Utilization Guidelines follows the State of Michigan space standards for Universities and Colleges as published by the State Department of Technology, Management, and Budget (DTMB).

5.3 Specific Room Requirements

- a) All new buildings shall include the following rooms in the design and layout. Where existing buildings have an addition or renovation project that impact these existing rooms they shall be replaced with new rooms that meet these requirements.
 - i. Loading Dock – Receiving Area:
 - a) Minimum size of 250 SF, however, size should be dictated by needs of the building.
 - b) Loading dock should be raised if feasible, or if not, should have a scissors lift for unloading freight trucks.
 - c) If raised, loading dock shall include a dock leveler.
 - d) Provide a double door without a mullion directly to a building corridor, and an insulated overhead door to the exterior.
 - e) Room shall not be cooled, but should have a robust heating system to reheat the area after use of the overhead door.
 - f) Provide a floor drain in this room.
 - ii. Maintenance Storage/Supply Room:
 - a) Minimum size 300 SF adjacent to the loading dock.
 - b) Required for unpacking and storing custodial and building maintenance supplies, materials, and equipment.
 - c) Requires a water source, floor drain, and utility sink.
 - d) Provide a double door without a mullion into the Receiving Area.
 - e) Provide a 3'x6' work bench in this room.

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- iii. Building Mechanics Office:
 - a) 100 SF office near the Maintenance Storage/Supply room, the Loading Dock, and the Custodians Room.
 - b) Centralized building control panels shall be located in this room.
 - c) Provide hard surface flooring.
- iv. Custodians Room:
 - a) 240 SF area shared employee break/locker room.
 - b) Locate near Building Mechanics Office.
- v. Custodial Closet:
 - a) 64 SF closet, one per floor or wing, centrally located.
 - b) Provide floor drain, floor sink, shelf, and mop/broom holders.
 - c) Provide a water connection with a back flow preventer for cleaning chemicals.
 - d) Door shall have hold open device approved by fire codes.
 - e) Provide epoxy floor finish in this room.
- vi. Data Closet:
 - a) 100 SF minimum closet, or larger if required by Michigan Tech's Information Technology (IT) department.
 - b) Provide minimum one IDF closet within 85 meters of end jack locations. Stack closets in building.
 - c) Room requires one wall with fire rated $\frac{3}{4}$ " plywood.
 - d) Provide sufficient cooling for heat load of equipment.
 - e) Building generator circuits minimum 3 per room, or more required by Michigan Tech's IT department.
 - f) Dedicated space, no co-location of custodial, electrical or mechanical.
 - g) Secured room with card reader access.
 - h) 2 - 4" Conduit paths between IDF closets in the building stack.
 - i) 2 - 4" Conduit paths from building entrance MDF closet to existing manhole system or existing building entrance closet if attached to an existing structure.
 - j) Minimum 1 - 4" conduit from top most closet to roof penetration with a weather head.
 - k) Each closet to have a ground bar tied to building ground.
- vii. Electrical Closet:
 - a) Provide a separate room for electrical panels and equipment sized as required by the building design to provide proper clearance, etc.
 - b) Room is not to be combined with Custodial Closet or Data Closet.

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- viii. Lactation Room:
 - a) Provide in buildings where 10 or more faculty, staff, or graduate students have offices.
 - b) 64 SF room minimum.
 - c) Provide counter with small hand sink.
 - d) Lighting shall have dimming capabilities.
 - e) Room finishes shall be warm and comfortable.
- ix. Gender Neutral Restroom
 - a) One single occupancy 'Family' restroom per floor for new buildings shall be provided. For renovation projects install to meet this requirement as feasible. Room shall meet all barrier free requirements, and include a baby changing station.

6. ARCHITECTURAL STANDARDS

6.1 General Statement

- a) In addition to previous requirements, provide a building design that utilizes durable and low maintenance materials, both interior and exterior.
- b) Building designs shall conform to the latest update of the Campus Master Plan.
- c) No exterior building finishes shall require future painting maintenance.

6.2 Demolition

- a) To the extent possible in our geographic area, demolished materials shall be specified to be recycled. This may include concrete, metals, and interior finishes.
- b) Demolition activities shall be specified to occur in a manner that allows the continued functioning of the University. Separation barrier/walls must be in place separating occupied areas from the construction prior to the start of demolition.

6.3 Concrete

- a) Interior and/or exterior structural concrete surfaces shall not be scheduled to receive a sandblasted finish unless specifically approved by the University.
- b) Building interior structural concrete painted surfaces shall not be scheduled to receive a rubbed finish. If a smooth plaster-like finish is desired, specify a thin coat of veneer plaster over the concrete substrate.
- c) Building exterior expressed concrete structural frame shall be detailed (incorporating insulation and finish systems) to prevent thermal loss or gain.
- d) Exposed interior concrete floors shall be sealed. A hardener shall be required where the floor surface is subject to heavy, impact, and/or rolling loads.
- e) A sample panel of exterior exposed "Architectural" concrete shall be provided to establish an acceptable standard of workmanship/quality concerning finishing, texture of formed material, etc. The concrete used in the sample panel shall be furnished by the project concrete supplier, and shall represent the approved mix for strength and texture.
- f) Exterior concrete flatwork shall be six inches nominal thickness, 4000 PSI air-entrained concrete, reinforced with welded wire fabric (except use rebar in high impact areas such as dumpster pads) located two inches below the top surface. The flatwork shall be placed over a six-inch aggregate stone base, and shall generally be a minimum of eight feet wide. The top surface shall be broom finished with sawn or tooled joints at a maximum of six feet on-center.
- g) All defects, form irregularities or honeycomb in the concrete will be examined by the engineer. Repairs will not commence until repair method is approved by the engineer.

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6.4 Masonry

- a) Masonry cavity wall designs shall conform to the recommendations of the Michigan Masonry Institute.
- b) Masonry ties for masonry veneer shall be the wire ties with adjustable pintle (hook) connection, galvanized or stainless steel.

6.5 Metals

- a) Metal guardrails shall be installed at all roof areas where maintenance staff will come within 15 feet of the roof edge.

6.6 Wood and Plastic

- a) Cabinets, other than for laboratories, shall meet the Architectural Woodwork Standards, current edition, Custom Grade requirements.
- b) Design Considerations: Avoid depletion of natural resources by specifying wood species from sustainable sources, such as FSC Certified Wood or regionally harvested wood from abundant species. Avoid use of exported or exotic species such as mahogany that are limited in supply or not sustainably harvested. Products shall be free of urea-formaldehyde binders, copper or arsenic.
- c) Laboratory cabinets shall be modular cabinets specifically manufactured for laboratories.
- d) Countertops, other than for laboratories, may include non-wood products such as recycled glass cast concrete, recycled content synthetic cast slabs, regionally quarried stone, bio-based materials, and recycled plastic solid surfacing or plastic laminates.
- e) Laboratory countertops shall be made from phenolic resin, unless specific lab requirements call for different material.

6.7 Thermal and Moisture Protection

- a) Building Insulation
 - i. Spray applied rigid polyurethane closed cell foam is preferred for building shell insulation. A properly rigid insulation/air barrier system that is taped and sealed is also acceptable.
 - ii. Fiberglass batt insulation shall be installed to minimize exposed fiberglass in areas needing to be accessed for inspections, maintenance, etc. Designs shall encapsulate fiberglass using foil or pre-applied backing, plastic or gypsum board covering.
- b) Roofing
 - i. Single-ply roofing systems (60 Mil minimum) shall be specified for low slope (less than 4 in 12 pitch) applications and shall be fully adhered systems.

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- ii. Specify service walkways (minimum 2'0" wide) appropriately located to service all roof top equipment from the roof access.
 - iii. Specify roof hatches that are insulated, lockable, and include built-in guardrails.
 - iv. Rating of complete roof assemblies shall be a minimum Class I-90 designed in accordance with FM P7825.
- c) Waterproofing:
- i. Toilet rooms with showers, and other rooms subject to high water usage, shall have a waterproof (not damp-proof) membrane installed under the finish floor and turned up the wall a minimum of 6 inches. Showers shall have a waterproof membrane behind all wall finishes to a minimum height of 7 feet.
 - ii. All sub-grade exterior walls shall have a water proof membrane with a protection board.

6.8 Doors and Windows

- a) Exterior Doors
- i. All primary entry doors shall have one leaf power operated. Operators shall be Stanley Magic Access Units.
 - ii. Exterior doors shall be fully insulated FRP or aluminum doors.
 - iii. All primary entry doors shall have one door with card access control and electric strikes.
- b) Interior Doors
- i. Standard, 3'-0" x 7'-0" x 1-3/4" wood faced, pre-finished, solid core.
 - ii. Use hollow metal doors in service areas that do not have normal public access.
 - iii. All doors in new construction shall have lever handles that comply with ADAAG requirements. When renovation work requires changing door hardware, or where hardware change is requested for functional change, all replacement hardware shall include ADAAG compliant lever handles.
- c) Door Hardware
- i. Mortised Locksets; Series 4000, Grade 1 (ANSI A156.2), Lever handle with through bolted trim, Round rose - varying in size between 2-9/16" to 3-3/8" or largest available size. Lockset shall be complete with a combined core and must accept a Best 7-pin 'A' keyway interchangeable core. NO SUBSTITUTES. Provide one of the options noted below:
 - a) Corbin Russwin ML2000 Series
 - b) Schlage L9000 Series
 - c) Stanley Best 40H Series
 - ii. University personnel shall accomplish the final keying and installation of cores. Construction cores may be installed by the Contractor during construction, but must be removed prior to occupancy.

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- iii. Closers; Super Smoothy LCN-4040 Regular or Super Smoothy LCN-4041 Handicapped.
- iv. Panic Exit Devices; Von Duprin 98-99 series.
- d) Windows
 - i. Exterior windows shall be thermally broken aluminum or steel frames, with compression seal weather-stripping on all operable windows. Provide operable windows where reasonable in all areas.
 - ii. All exterior glazing (tempered or otherwise) shall have “Low E” or “Comfort E” coatings at a minimum.

6.9 Finishes

- a) General:
 - i. In general, interior walls shall go to the structural deck above and have sound insulation within the cavities.
 - ii. The preliminary selection of interior finish materials shall take place during the schematic design phase. Informal discussions of finish materials appropriate to the intended project use shall precede a formal Interior Design Presentation of interior finish boards by the A/E consultant’s interior designer with design input and approval from Facility User Group and the Facilities Management Project Manager, who will also approve the color selections of all finishes.
 - iii. The interior finish boards shall include representative samples of adequate size to visualize colors and patterns. Particular attention shall be given to finishes in public spaces. The finish boards shall be labeled and keyed sufficient to cross reference to a floor plan presentation and finish legend for easy reference.
 - iv. Interior finish selections shall be high quality, durable materials that are manufactured regionally, if possible, with a strong preference for Michigan based manufacturers. Specialty or higher end finishes may be acceptable for public spaces as deemed appropriate during the informal discussions during schematic design. Avoid the use of imported materials.
 - v. Extravagant, costly and/or high maintenance finishes shall be avoided. Finishes or detailing that have minimal tolerances and place unrealistic expectations on the installing contractor(s) shall be avoided.
 - vi. Specify that contractor is to provide attic stock equal to 5% (100 SF minimum) of all flooring material used on the project.
- b) Paints and Coatings: Products used in interior spaces shall be top quality coatings with characteristics of scrubability, hiding power and washability. Use flat paint for ceilings, eggshell finish for walls, and semi-gloss for trim paint. Paint shall be latex low VOC products except for specific situations.

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c) Tile

- i. General: The use of ceramic tile shall be limited to high profile/high use public areas, restrooms, shower, and locker rooms, or other such spaces where a durable, aesthetically pleasing floor or wall material is deemed appropriate.
- ii. Products: Products used in interior spaces shall be top quality with characteristics of smooth texture, minimum porosity, low absorption, cleanability and slip resistance. All floors and wet walls with ceramic tile shall receive epoxy grout to be waterproof, stain proof, durable and easy to maintain. Floor tile and grout color selections shall minimize the showing of dust and/or footprints. Avoid dark colors, extremely light colors and white or light colored floor grout.

d) Suspended Acoustical Ceilings

- i. General: Products used in interior spaces shall be top quality mineral fiber panels with a highly reflective surface that are resistant to humidity, sagging, mold and mildew. Suspension systems shall have exposed tee profile fabricated of hot galvanized steel with baked on painted finish.
- ii. Design Considerations: Specify tiles and grid with high recycled content that can be recycled in the future to minimize resource use.
- iii. Standard Acoustical Ceiling Tile (ACT): 2' x 2' x 5/8", non-directional, mineral fiber panels, for use in offices, classrooms, conference rooms and corridors. Specify fire rated tiles if required.
- iv. Specialty Acoustical Ceiling Tile (ACT) for use in wet areas and laboratories to resist moisture, steam and chemicals: 2' x 2' x 5/8", vinyl faced. Specify fire rated tiles if required.
- v. Suspended Grid; Heavy Duty (HD) or Intermediate Duty (ID) exposed tee grid system with 15/16" standard grid dimension or 9/16" narrow grid dimension. Specify fire rated grid if required.

e) Resilient Flooring

- i. General: The use of resilient flooring provides an economical solution for flooring in a variety of areas, including but not limited to corridors, work rooms, copy rooms, offices and classrooms. Resilient flooring selections for laboratories shall meet project criteria for chemical resistance and maintainability and in general should be a seamless floor. Specify top quality aesthetically pleasing products, with characteristics of cleanability and slip resistance. Color selections shall minimize the showing of dust and/or footprints.
- ii. Design Considerations: High quality resilient flooring is a long lasting, durable product that is easy to maintain over its lifetime. The use of flooring manufactured with high recycled post-consumer and/or post-industrial content

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is encouraged. The selection of zero or low VOC primers, adhesives and sealants will help to eliminate indoor air quality problems.

- iii. Vinyl composition tile (VCT) shall not be used.
- iv. Products: Selections may include the following choices, as suitable for the particular application.
 - a) Linoleum Sheet Flooring.
 - b) Rubber Tile or Sheet Flooring.
 - c) Vinyl Composition Sheet Flooring.
 - d) LVT Tile Products.
 - e) Rubber or Vinyl Base: Specify cove base, four inches high, using 100 foot rolls. Avoid the use of preformed interior and exterior corners.
 - f) Other as approved by Michigan Tech Facilities.
- f) Carpet
 - i. General: The use of carpet provides an economical solution for flooring in a variety of areas, including but not limited to offices, conference rooms, and classrooms. Specify top quality aesthetically pleasing products, with characteristics of cleanability and acoustical properties. Avoid the use of cut pile carpeting, instead selecting loop or cut and loop combination for increased durability.
 - ii. Sustainable Considerations: High quality carpet is a long lasting, durable product that is easy to maintain over its lifetime. The use of carpet tiles allows damaged or stained tiles to be replaced individually, without having to replace carpet in its entirety. The use of carpet manufactured from bio-based materials or with high recycled post-consumer and/or post-industrial content is encouraged. The selection of zero or low VOC adhesives and leveling compounds will help to eliminate indoor air quality problems.
 - iii. Products: Carpet at Michigan Tech shall be carpet tile, generally installed with a ¼ turn pattern. Carpet for high traffic areas shall have smooth surface texture. Selections should be limited to tufted carpet tile.
 - iv. Utilize carpet tile that has a manufacturer's glue free installation system. Only use glue at transition/edge areas.
 - v. Characteristics: Selection and warranty criteria as follows:
 - a) Yarn System: 100% Invista Type 6,6; Solutia Type 6,6; BASF Type 6.
 - b) Dye Method: 100% Solution Dyed.
 - c) Construction: Tufted.
 - d) Texture: Textured loop or cut/loop.
 - e) Gauge: Minimum 1/10.
 - f) Stitches per Inch: Minimum 9.
 - g) Pile Weight: 18-20 oz. per yard (high traffic areas) 20-26 oz. per yard (medium traffic areas).

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- h) Backing: Polyolefin, polypropylene, polyvinyl butryal or urethane.
- i) Soil/Stain Resistance: Application by fiber producer and manufacturer required.
- j) Warranty for dimensional instability; against delaminating, edge ravel.
- k) 15-year wear warranty.
- l) Should comply with Carpet and Rug Institute Green Label Plus program.
- vi. It is recommended in renovation projects that existing carpet be removed and recycled through the Carpet America Recovery Effort (CARE) or other approved third-party certification programs to divert carpet from the landfill.

6.10 Specialties

a) Toilet Accessories

- i. Paper towel, soap, and toilet paper dispensers shall be provided by the university's vendor.
- ii. Trash cans in toilet rooms shall be provided by the university.
- iii. Sanitary Napkin dispensers, if desired, will be provided by the University.
- iv. Sanitary Napkin Disposal; Stainless steel type 304, 22 gage, satin finish, surface mounted, cover to have full length piano hinge and bottom unlocks with key, equal to Bobrick B-270.

b) Toilet Partitions

- i. Stall Partitions; solid composite, smooth.
- ii. Stall Support; Stalls shall be floor mounted ceiling braced type. Stall Pilaster Shoes; 3" high polished 20 gage stainless steel shoe of one piece construction. Tamper-proof shoe assembly with concealed hold down anchor clips. Exposed shoe is unacceptable.
- iii. Stall Hardware and Fittings; All doors, panels and pilasters shall be prepared with suitable internal reinforcement and pre-drilled to accommodate all hardware and fittings. Each compartment shall be complete with all hardware, door hinges, door latch, stop and keeper, coat hook and necessary fittings and fastenings for a complete installation.
- iv. Stall Pilaster and Wall Fittings; Wall and pilaster brackets shall be heavy Zamac #3 chrome plated die casting. The dividing partitions and pilasters shall be attached to wall with two brackets of double EAR or one EAR type depending on wall conditions. Dividing partitions shall be attached to the pilasters with two "U" brackets. All hinge brackets, strike and keeper shall be through bolted, one-way theft-proof heads. All other hardware and fittings to have appropriate screws. All fastenings to have a highly polished finish.
- v. Partition Locks; Slide bolt latch equal to SURFACO, 3-1/2" Bet screw #9G0136.
- vi. Handicapped Grab Bars; Stainless steel sizes to barrier free requirements.

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- vii. Provide wall mounted shelving in restrooms to accommodate books, backpacks, etc.
- c) Fire Extinguishers and Cabinets
 - i. Fire extinguisher cabinets shall be incorporated into all projects as required by code and sized for the required extinguisher.
 - ii. Provide recessed cabinets typically.
 - iii. Fire extinguisher cabinet doors shall not be equipped with any type of lock. Only roller latches, or something providing an equivalent level of function, shall be used. Access without a key is required for extinguisher inspections.
 - iv. Contract specifications shall identify the extinguisher type and size.
- d) Interior Signage:
 - i. Interior signs shall be specified for all rooms to comply with current ADA sign requirements.
 - ii. Signs shall be Vista Wall Signs as manufactured by Vista Systems, or equal if approved by the University.
 - a) Signs shall be ordered with the room number embossed on the plastic cover in numbers and braille. The paper insert shall be provided and installed by Michigan Technological University.

6.11 Equipment

- a) Loading Dock Equipment:
 - i. For raised loading docks, provide a dock leveler, dock bumpers, and dock seals.

6.12 Furnishings

- a) General
 - i. During the preliminary design phase, furniture and equipment plans are to be submitted to demonstrate the functional use of space. These plans shall be used as the basis for locating receptacles, switches, data outlets, lighting, etc. during the remainder of the design process.
 - ii. The A/E contract may be amended to include professional interior design services related to furniture selection and procurement OR Michigan Tech may enter into a separate interior design or furniture contract.
 - iii. All furniture plans shall be labeled and keyed sufficiently to cross reference to specifications and procurement documents for easy reference.
- b) Sustainable Considerations
 - i. Furniture selections shall be high quality, durable with a preference for manufacturers within a 500 mile radius of the project site, with established environmental policies in place.

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- ii. Furniture that is extravagant, costly or with high maintenance finishes shall be avoided. Specialty or higher end furniture may be acceptable for public spaces as deemed appropriate by Michigan Tech Facilities.
 - iii. Plan layouts and furniture selections with respect to maximizing daylight and access to views for all building occupants. Consider lower panels and glazed panels for systems workstations. Avoid the use of panels that are 80" or higher that may obstruct adequate air flow and daylight penetration.
 - iv. Furniture items selected shall emit zero or very low amounts of volatile organic compounds (VOCs) to eliminate problems associated with off-gassing and indoor air quality.
 - v. Furniture and upholstery selections shall include the following design strategies wherever possible:
 - a) Post-consumer and/or post-industrial recycled content.
 - b) Refurbished furniture, including systems workstations.
 - c) Products with a 10-year warranty, 15 years preferred.
 - d) Materials that have been extracted locally or regionally.
 - e) Certified wood products or sustainable species from abundant, local sources.
 - f) Rapidly renewable materials.
 - g) Nontoxic, low emitting adhesives, sealants, paints and finishes.
 - h) Energy efficient task lighting.
 - i) Products/materials free of formaldehyde, halogen, heavy metals, polyvinyl chloride, chlorine, plasticizers, antimony, harmful dyes, topical treatments.
 - j) Products/materials that are safely disposable, recyclable, or biodegradable.
 - k) Fabrics that are durable, minimum 50,000 double rubs, 100,000 preferred.
 - l) Fabrics that are flame retardant, antibacterial, easy to clean.
 - m) If the use of leather is approved, specify only vegetable tanned leather.
- c) Floor Mats
- i. Provide recessed floor mats at all building entrances. Floor mat to be CS Pedigrid, model GI level base frame with HD carpet, or approved equal.
 - ii. Concrete recess to be coated with epoxy coating. Epoxy coating to be Duraltex as manufactured by Euclid Chemicals, or approved equal.
 - iii. Do NOT provide a floor drain for the recess.

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6.13 Conveyance Systems

a) Elevators

- i. A minimum of two elevators shall be provided in every building. Provide a service elevator and a passenger elevator. Service elevator should reach the highest mechanical room.
- ii. Perform work in accordance with the State of Michigan Elevator Code.
- iii. Elevator shall be provided with a 12 month warranty which begins on the date of Substantial Completion.
- iv. Hydraulic Elevator. If provided, install piping above ground where possible. If necessary to route underground, cover with permanent protective wrapping before backfilling. Provide shut off valve in machine room for maintenance purposes. Underground hydraulic piping for elevators shall be schedule 80. Provide a means for removing oil from the jack casing without pulling the casing out of the hole.
- v. Include a forecast cost of expected elevator maintenance. Include a list of big ticket items and how frequently they must be replaced or overhauled.
- vi. Submittals: Contract documents shall require a letter from the elevator manufacturer (on manufacturer's letterhead) verifying that the manufacturer acknowledges and will comply with all requirements of the specifications relative to repair and maintenance tools. Specifically, the letter shall include language that acknowledges the acceptance of the following:
 - a) Any and all maintenance diagnostic tools, electrical schematic wiring diagrams and any access codes and passwords required to perform any maintenance function over the life of the equipment such as diagnostics, adjustments or parameter reprogramming shall be provided to the Owner on the Date of Substantial Completion. Tools may be handheld or built into the control system and shall function for the life of the equipment without the requirement to return them to the Manufacturer. Provide complete operations and maintenance manuals and maintenance training manuals including diagnostics instructions for troubleshooting the microprocessor system. Changes to the maintenance tool or software shall be guaranteed for 10 years, or replaced at the manufacturers cost. The Owner shall not be required to sign licensing agreements related to the use of maintenance or repair tools.
 - b) It is the intention of the Owner to obtain competitive bids for all maintenance and repair services and material for the elevator provided. Accordingly, the use of proprietary equipment or equipment requiring the use of any proprietary items throughout the life of the equipment is

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unacceptable. In addition, any special tools, prints, technical data, layouts, hardware, software, etc. required throughout the life of the equipment and which cannot be obtained from multiple suppliers, must be provided by the manufacturer to the Owner at substantial completion of the project.

- vii. All locks and keyed switches for elevators shall comply with Michigan Technological University's lock standards.

7. FIRE SUPPRESSION SYSTEM STANDARDS

7.1 General Provisions

- a) All new buildings, new additions, and major renovation projects shall include a complete fire suppression system to meet NFPA 13 requirements.
- b) In all buildings with fire alarm systems, all control valves, including post indicator and wall indicator valves, shall be electrically supervised by the fire alarm panel. At all locations that control valves are concealed above ceilings or behind access doors, a sign shall be provided on the ceiling below the valve or the access door indicating the location of the control valve.
- c) A digital set of as-built sprinkler system plans shall be provided and shall include information for every individual sprinkler head location which identifies the manufacturer, model, temperature rating and date of manufacture for the head that was actually installed. In addition, a digital summary shall also be provided which lists all the individual types of heads installed for the whole building, and the total number installed of each type. It is the responsibility of the sprinkler contractor to verify in the field that the inventory accurately represents the heads that were actually installed. Reliance solely on the approved shop drawings is not acceptable.

7.2 Residential Buildings

- a) In residential buildings, all control valves that are located in spaces accessible by the occupants of the building shall be provided with lockable tamper prevention devices and locks (locks shall be provided by the University).
- b) In residential buildings, each fire department hose valve shall be provided with a lockable tamper prevention device and a lock (that shall be provided by the University).

7.3 Control Valves

- a) Control valves shall only be installed in corridors, stairwells, mechanical rooms, fire pump rooms and sprinkler valve rooms and shall be easily accessible. The control valves shall be accessible with the use of no more than a six foot stepladder. Provide 24" x 24" access door for valves located above inaccessible ceiling types.
- b) Control valves shall not be installed, above or below ceilings in classrooms, offices, conference rooms or any dormitory living quarters.
- c) Each control valve shall be supplied with a sign indicating the area of the building that is served by the valve.

7.4 Test Valves and Drains

- a) Inspector Test Valves (ITV) shall only be installed in mechanical rooms, corridors, stairwells, fire pump rooms, sprinkler valve rooms and custodial closets and shall be easily accessible. The ITV's shall be accessible with the use of no more than a six-foot stepladder.
- b) Inspector test valves discharge shall be piped to a floor drain or floor sink.
- c) Drain valves shall only be installed in corridors, stairwells, mechanical rooms, fire pump rooms and sprinkler valve rooms and shall be easily accessible. The drain valves shall be accessible with the use of no more than a six-foot stepladder.
- d) Main drains discharge shall be piped to the exterior of the building.
- e) Auxiliary drain valves discharge shall be piped to a drain capable of handling the discharge at full flow or to the exterior of the building.

8. GENERAL MECHANICAL STANDARDS

8.1 General Provisions

- a) Provide access doors for all maintenance items above inaccessible ceilings and into inaccessible walls. If necessary, fire rated access doors shall be used to preserve wall fire rating.
- b) Locate filter boxes and other maintainable equipment outside of critical areas served, such as laboratories, so that items can be serviced without disrupting operations in the room or releasing contaminants into space.
- c) Locate humidifiers, fan coil units, terminal boxes, and other equipment containing water over hallways rather than occupied or critical spaces wherever possible. Where necessary to locate such equipment over such spaces, provide secondary drain pans.
- d) Provide adequate roof access (stairs or elevator) wherever serviceable equipment is roof mounted. Ladders to roof hatches are not desirable.
- e) Provide guard rails and fall protection for service of roof mount equipment.
- f) In atriums or other multi-story open to roof areas, maintenance and accessibility shall be a consideration when mounting fans, lights and other equipment above the floor.
- g) Process cooling requirements shall be addressed by a dedicated process cooling system. Process cooling shall not be achieved using the building chilled water system, or the building domestic water system.
- h) Any new HVAC systems (especially involving 100% outside makeup air) shall include an energy recovery system.
- i) All HVAC systems installed in excess of 1 hp shall have a variable speed drive on the fan motor.

8.2 Mechanical Identification

- a) Mark location of air handlers, fan coil units, mixing boxes, etc., above ceilings with identifying "buttons" to facilitate maintenance through ceiling.
- b) Tag exhaust fans and associated fume hood to facilitate maintenance and identification.
- c) Utilize standard tag or placard to mark all major equipment. Tag all valves and provide valve chart for each floor.
- d) All systems handling hazardous materials must have appropriate marking and visual or audible alarms to protect building occupants and maintenance personnel. Mark exhaust fans on roof which handle hazardous fumes with appropriate color code.
- e) Mark air handling units with a minimum size of 2-inch letters and numbers.
- f) All fire dampers shall be numbered and identified on a chart in mechanical room.

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8.3 Mechanical Rooms and Equipment Locations: The Architect/Engineer shall, in the earliest stages of design development, be responsible for establishing and/or verifying programmatic requirements for mechanical rooms in order to:

- a) Provide adequate safe access and manufacturer's recommended working clearances for all equipment.
- b) Provide for replacement of the largest piece of equipment without removing permanent walls, large items of equipment or equipment essential to the principal on-going day to day building use.
- c) In phased projects mechanical rooms shall be sized to include equipment for all the phases.
- d) Air handling units, zone control devices, such as VAV boxes, mixing boxes, reheat coils, etc., shall also be located to provide unobstructed access to filters, manual valves, zone control devices and automatic control equipment, and allow for adequate access to replace equipment sub-assemblies.
- e) Mechanical rooms shall have a floor drain.
- f) Access to ducted fan coil units on occupied floors shall be from corridors, rather than through offices, classrooms, laboratory ceilings, or other occupied spaces.
- g) Equipment mounting stands shall be constructed of steel. Wood stands are not acceptable.
- h) Machine guarding, work platforms, access ladders, railings, etc. must meet MiOSHA general industry standards.
- i) It is desirable to have most equipment service points directly accessible from the mechanical room floor.
- j) Permanent accessible work platforms must be provided to service any equipment not accessible for the floor level.
- k) Mechanical rooms should be accessible from within the building as opposed to a roof access.
- l) If feasible, the service elevator should reach the mechanical room floor.

9. PLUMBING STANDARDS

9.1 Pipes and Fittings

- a) ABS piping is unacceptable.
- b) 'Pro-Press' fittings are acceptable for all piping except steam lines. Alternate press systems must be pre-approved.
- c) Do not install heating hot water or other similar service piping susceptible to freezing in overhanging soffit areas.
- d) All piping on high pressure steam systems (above 15 psi) shall be minimum Schedule 40.
- e) All condensate piping shall be schedule 80.
- f) All piping shall be insulated per ASHRAE 90.1.
- g) All main water service lines that have water pressure greater than 80 psi shall have pressure reducing valves.
- h) Provide water filter system for the main water service lines.

9.2 Valves:

- a) Include sufficient zone isolation/shut off valves in cold/hot water, heating hot water, chilled water, steam and other service piping to allow maintenance and replacement of terminal equipment without shutting down entire building.
- b) Install valves on all lines that penetrate the floor from below.
- c) Install valves on all branch lines off of main lines.
- d) Install valves on all lines at locations such that each floor can be isolated independent of main building.
- e) Any equipment such as showers, lavatories, etc., requiring mixing of hot and cold water shall utilize a pressure compensated mixing valve rather than a temperature compensated mixing valve.
- f) Install control valves where they can be reached from the floor where possible.
- g) All valves and steam devices used on steam lines shall be rated for the design pressure of the system in which they will operate.
- h) On valves 2" and less, use ball valves except when flow control is needed. Use full port ball valves to minimize flow restriction.
- i) Any point that the piping of supply and return water is connected on chilled water or heating water there shall be hand valves to isolate each. Control valves shall not be used for isolation.

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9.3 Piping Specialties:

- a) Provide sufficient air vents in chilled and hot water piping systems to easily bleed entrapped air.
- b) Pipe chases shall be provided in sufficient size to accommodate maintenance personnel (at least three feet wide). Do not locate pipe chases in custodial closets.

9.4 Pumps

- a) Provide parallel stand-by pump for all primary pumped building systems, such as chilled water, heating and domestic hot water, etc.
- b) Any pump motor installed over 1 hp shall have a variable speed drive.

9.5 Domestic Water

- a) Shut off valves are required on each floor, on take-offs from all vertical risers, and at the connection to each piece of equipment.
- b) Dielectric fittings shall be used with connecting piping of dissimilar metals.
- c) Drain valves shall be installed in accessible locations at all low points in the piping system to permit drainage and servicing.
- d) No iron pipe or fittings (including galvanized) shall be used in any potable water system.

9.6 Restrooms

- a) Floor Drains shall be installed in all restrooms, centrally located with floor slightly sloped toward drain, 6" inlet with 2" outlet, chrome plated brass or nickel bronze.
- b) Provide water-saver vitreous china water closets, wall hung, siphon jet, elongated closet bowl.
- c) In all restrooms in new construction and major renovation projects, touchless faucets on lavatories and touchless flush valves on commodes and urinals shall be used. Hard-wired type shall be installed where practical. Battery pack type shall only be used in areas where hard-wired is not feasible.
- d) Consider the use of two speed water closets.
- e) Specify energy efficient hand dryers in gang toilets; Dyson or equal.

9.7 Custodial Closets

- a) Provide floor mounted service sink, 8" maximum height from floor to rim, 24" x 24" (minimum size). Faucet - vacuum breaker, integral stops, spout with pail hook and hose end, top single brace, renewable units and valve seats, equal to Eljer 749-1200 or 749-1400.
- b) Provide floor drains.

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- c) Provide plumbing for Owner's chemical cleaning system, including vacuum breakers.

9.8 Laboratories

- a) Drain and waste lines shall be selected for chemical resistance and heat resistance where required.

10. HEATING, VENTILATING & AIR CONDITIONING (HVAC) STANDARDS

10.1 General Provisions

- a) Use only steam (not hot water) pre-heat coils on air handlers with high outside air percentage.
- b) Provide adequate freeze proofing for all air handling equipment. Provide coils that can be drained.
- c) Provide stand-by or redundant equipment, cycled or alternating lead-lag sequence for critical needs (e.g. standby compressors on refrigeration for food storage).
- d) Use dual independent refrigeration circuits on HVAC equipment where available, particularly when serving critical areas.
- e) Provide minimum 5-year parts and labor warranty on HVAC compressors.
- f) Any new or renovated building containing more than one chiller shall have a primary/secondary chilled water pumping system.
- g) Aluminum tubing in HVAC coils is unacceptable.
- h) All air handlers and fan coil units shall be located with provisions for sufficient space to service units, (e.g., change filters, sheaves, bearings, motors and coils, lubricate components and replace belts).
- i) Eliminate water coils and piping in rooftop air handling units.
- j) Air handling unit fans shall be specified to mid-range speed instead of near maximum. Use of slower turning fans is preferred. Fans should be designed to allow for 30% additional air flow per the fan curve.
- k) Specify variable frequency drives instead of vortex dampers for air flow volume control.
- l) No un-pumped condensate return lines shall run on an upgrade for either steam or air conditioning condensate.
- m) For steam humidifiers located in air handling units or in supply air ducts, the source of steam shall be provided by separate units from the Central Energy Heating System.
- n) Temperature sensors shall be installed on the discharge side of all coils, return air, and mixed air.
- o) Provide HW radiant heat around the perimeter of buildings capable of handling the minimum heating loads when AHU's are turned off at night during non-use periods.
- p) Humidification is required in the University buildings during the winter. Provide humidification in the 25-30% range typically. For special situations requiring higher

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humidity, provide 50% maximum humidity. Verify that this higher humidity is addressed with a proper vapor barrier in the building envelope, and that the interior surfaces are compatible with higher interior humidity.

- q) Air handlers should have adequate space between outside air damper and open outside to prevent snow migration from jamming the dampers.

10.2 Air Distribution

- a) Restroom grilles and diffusers shall be stainless steel, type 304, or aluminum; satin or brushed finish shall be used.
- b) Use care in locating outside air intake relative to exhausts, vents, or other discharges. Do not locate near loading docks, parking areas, or other vehicular traffic areas. Do not locate in areas prone to snow drifts.
- c) Where fume hoods are present, provision must be made for make-up-air, such as hoods being of the "add-air" or "auxiliary-air" design and including a motor operated shut off valve in the exhaust stack.
- d) All fire dampers shall have access doors.
- e) No interior duct insulation (liner) shall be used.
 - i. Duct insulation shall be by use of either:
 - a) Exterior duct wrap or,
 - b) Factory fabricated double wall metal duct with solid metal inner wall with insulation between walls or,
 - c) Factory fabricated double wall metal duct with perforated metal inner wall with insulation between walls and 2 mil thick Mylar between inner liner and insulation. (Use this method only where noise is of particular concern)
 - d) Where perforated inner walls are used on double wall duct, the metal perforations are not to be bridged with paint prior to assembly of double wall ducts. Painting shall not be done after assembly to prevent bridging sheet metal perforations.
- f) Double wall construction shall be specified for Air Handling Units, Fan Coil Units, Variable Air Volume Boxes or other Terminal Boxes. Insulation shall be between the inner and outer walls. The inner wall shall be solid metal (not perforated) so that no insulation is exposed to the air stream.
- g) Air filtration efficiency shall be minimum MERV-13 per ASHRAE 52.2. Consider electronic air cleaners to maximize AIQ and energy efficiency of systems.
- h) Keep air handling equipment clean during construction:
 - i. If equipment is going to be operated during construction, change filters once/month or more often if needed and install filter media over return grilles
 - ii. Keep fan coil units clean by covering inlet and outlet during construction when not in use.

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- iii. Building must be turned over to the University upon project completion with clean air handling equipment and duct systems; including a clean set of air filters installed in the air handling equipment and with a quantity of filters for one additional change left in the building.
- i) Ductwork that is exposed to the weather shall be double wall, smooth inside and out, insulated, with flanged connections. Joints shall be insulated and the outside panel painted with weather resistant paint or be stainless steel exterior.

10.3 Air Conditioning

- a) Chilled water is the preferred cooling medium for all new buildings.
- b) Water-cooled condensing units using domestic, potable water on a single-pass cycle are prohibited.
- c) Provide chiller bypass for 'free' cooling when available.
- d) For long term cogeneration considerations of the central plant, two stage steam absorption chillers would be preferred over electrical driven chillers.

10.4 Cooling Towers

- a) Ambient sound of the cooling towers to surrounding areas shall be considered when selecting equipment and locating the cooling tower.
- b) Top decks should be covered to stop sunlight from reaching the cooling water
- c) Construction of tower should be made of inert materials. Lumber or wood framing should not be used in areas in contact with cooling water or evaporation areas.
- d) Cooling towers should be equipped with blowdown solenoids controlled by a continuous monitoring conductivity meter.
- e) The blow down line should be of adequate size to dispel water significantly faster than its evaporation rate.
- f) All cooling towers shall have variable speed driven fans.
- g) Provide water meters for make-up water.

10.5 AHU Cooling Coil Condensate

- a) Cooling coil condensate shall be piped to sanitary drains.
- b) Pumped condensate return systems shall not be used.
- c) Cooling coil condensate lines shall have cleanouts which allow access of all branches of the condensate drain system.
- d) Cooling coil condensate lines shall be minimum 1 ¼ inch ID.

10.6 Refrigeration Systems

- a) Installations shall be complete with dryers, sight glasses, thermostatic expansion valves and thermostatically controlled solenoid valves for pump-down operation (except for

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capillary tube units). Refrigerant liquid and suction piping shall be type "K" hard-drawn copper. Suction lines shall be insulated. The need for defrosting is not limited to electrical units. In larger installations, hot gas defrost is required. Installation shall be provided with necessary protective devices, including, but not limited to, electrical overload devices, low suction-pressure cutouts, oil traps, crankcase heaters, anti-cycling timers and head pressure control.

- b) Main piping fittings for dryers, sight glasses, expansion valves and controls shall be flared. A nitrogen purge shall be maintained while soldering all joints. Copper-to-copper joints shall be evacuated to 29.5 inches (water) gauge vacuum and held for at least 24 hours under this vacuum prior to charging the system with refrigerant.
- c) Refrigerant type shall be approved by Facilities Management.

10.7 Meters

- a) Provide meters on electrical, steam, water, and gas utilities entering a building. Meters are to be tied to the University Building Automation System.
- b) Provide differential pressure indicator (manometer) for all serviceable filters and locate the indicator where it can be readily observed. Mark on the indicator the "clean" and "replace filter" points.

10.8 Chemical Treatment

- a) The Architect/Engineer shall coordinate with the Project Manager as to the required specifications for chemical cleaning and equipment to be furnished by the Contractor. The chemicals to be used by the Contractor for the specified initial treatment shall be furnished by the University. All chemical treatments shall be performed by the University after systems have been cleaned, flushed, and filled.
- b) An encompassing list of metallurgy should be included for each heating hot water system and cooling tower water system for reference with water treatment compatibility.
- c) Corrosion coupon racks should be included in both cooling water and closed loop systems. The coupon racks should be equipped with an appropriate adjustable rotameter to reflect velocities through the system.
- d) Both cooling tower water and Heating hot water should have adequate sample testing points.
- e) Both heating hot water and cooling tower makeup water lines should be equipped with a water flow meter.
- f) Cooling tower chemical treatment systems should utilize a dry solid chemical feeder that supports both chemical scale inhibitors and biocides.

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- g) After cleaning and chemically treating the HVAC system, the Contractor shall furnish the University in writing, the following information:
 - i. Date of initial treatment.
 - ii. Type of chemical(s) used for treatment.
 - iii. Estimated date that further treatment or testing will be required.
- h) As a minimum, the heating hot water and chilled water loops must be protected with a corrosion inhibitor and have a pot feeder or other means to conveniently monitor and add chemicals.
- i) Provisions need to be made for condenser water and cooling tower water treatment.

10.9 Variable Frequency Drives (VFD)

- a) All VFD's shall have a harmonic analysis performed by the drive manufacturer based on the system documentation. Provide this information as a part of the submittal. Provide isolation transformers in a separate enclosure. VFD's shall include input line reactor.
- b) Electrical output for variable speed drives shall not exceed 10% THD.

10.10 Laboratory Buildings

- a) "Co-Mingling" or mixing of general laboratory exhaust and exhaust directly from fume hoods is allowable as long as it is accomplished in compliance with any applicable building and life safety codes.
- b) It is preferred that fume hoods fans be grouped so that the fewest number of exhaust fans is required, and which are VFD controlled operating off of static pressure.
- c) Where fume hoods and general room exhaust streams are combined, the duct shall be round stainless steel ductwork with welded seams and flanged or welded connections. The stainless steel ductwork shall be run from the point of collection (hood connection or room exhaust grille/inlet) to the main riser for that portion of the building. The main duct riser may be constructed of stainless steel or anti corrosion coated galvanized or other suitable materials. Where exhaust streams are NOT combined, only the fume hood exhaust ductwork need be run in stainless steel, coated, or other suitable anti-corrosion materials.
- d) No heat recovery wheels (or any other technology which does not completely separate the exhaust and intake airstreams) will be considered for energy recovery building exhausts which handle fume hood exhaust, whether combined or not.
- e) Variable air volume control dampers controlling the exhaust flow from fume hoods and general room exhaust shall fail OPEN upon loss of control power.
- f) Emergency generators shall be sized to provide adequate power for all exhaust fans serving combined fume hood and general room exhaust systems. Supply air handler outside air intake louvers shall fail or power OPEN to prevent excessive negative building pressurization upon loss of primary power source. Supply air handlers do not

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have to be included in emergency generator capacity. Where fume hood exhaust is separate from general room exhaust, only the fume hood exhaust fans need to be included in calculating the emergency generator capacity.

- g) Co-mingled or combined fume hood and general room exhaust systems must be considered and designed as “hazardous exhaust systems” in accordance with the International Mechanical Code, and other applicable building and life safety codes.

10.11 Mechanical Systems Commissioning

- a) Scope of Work: The Mechanical equipment and systems defined in Division 1 – General Commissioning Requirements will be commissioned. List the project-specific items of Mechanical equipment and systems to be commissioned in this Section.
- b) Work Included: As a minimum, the following commissioning tasks will require the cooperation, labor, materials and assistance from the Contractor and subcontractors:
 - i. Mechanical equipment installation verification
 - ii. Mechanical system and equipment startup testing, adjusting and calibration
 - iii. Mechanical Systems Functional Performance Testing
- c) Test Procedures: Provide adequately detailed test procedures for all commissioning pre-functional and functional performance tests and inspections, which require the cooperation and assistance of the Contractor and subcontractors for completion.
- d) Testing and Re-Testing: Require that the Contractor and subcontractors provide all required assistance, labor, materials and supplies for specified commissioning tests. Specify that tests failed due to improper Contractor work or preparation shall be rescheduled, and all costs of re-testing will be borne by the Contractor.
- e) Project Closeout: Specify that the Contractor is responsible for the satisfactory completion of all commissioning items of this section, and of Division 1 – General Commissioning Requirements, prior to approval of project closeout.

11. Steam and Condensate Standards

11.1 General Provisions

- a) Remote vaults for steam/condensate need to be large enough for proper maintenance and access of equipment.
- b) Vaults must include permanent ladders.
- c) Exterior covers need to be vandal proof and recessed so snow removal equipment does not catch on the edge.
- d) Expansion loops are preferred over slip joint or bellows type expansion.
- e) Valves, expansion joints and other frequently maintained equipment must be insulated with removable jackets.
- f) Size and locate drip legs per industry standards. Steam traps must be accessible for testing and maintenance.
- g) Locate air coils, heat exchangers and equipment to allow for full condensate drainage from coils and meet the vertical condensate drop requirements as recommended by the trap manufacturer.
- h) Provide isolation valves before and after all major components.
- i) Provide isolation valves and by-pass piping on steam traps.
- j) All valves 3" and greater shall be specified by the following manufacturers:
 - i. Apollo
 - ii. Nibko

12. ELECTRICAL POWER STANDARDS

12.1 General Provisions

- a) Electrical closets and distribution shall be centrally located throughout the building.
- b) In atriums or other multi-story open to roof areas, accessibility and maintenance shall be a consideration when mounting lights.
- c) Access doors to crawl spaces shall be located as close as possible to electrical equipment under floor.
- d) Provide separate electrical and telecommunications closets where feasible. Custodial closets shall not be used to house electrical or telecommunications equipment.
- e) Provide one duplex receptacle for each stair landing.
- f) Corridor wall receptacles (primarily used for floor cleaning equipment) shall be circuited separate from interior office/classroom receptacles.
- g) In demolition associated with renovations, all wire shall be removed back to the panel board and all accessible conduits shall be removed.
- h) Neon and/or cold cathode lighting systems are not permitted for use in exterior lighting systems.

12.2 Raceways

- a) Minimum conduit size shall be $\frac{3}{4}$ ". Flexible metal conduit shall be used only for whips to lighting fixtures and equipment. All empty conduit shall have a 65-lb. test polymer (or equivalent) pull string tied off at both ends.

12.3 Conductors

- a) Use of MC or BX cable is not permitted.
- b) All conductors shall be copper. All power conductors shall be awg #12 or larger. Minimum control wire shall be awg #14 and minimum signal wire size no smaller than awg #18. All awg #10 and smaller wire shall be solid conductors and awg #8 and larger wire shall be stranded.
- c) Neutrals shall not be under sized.

12.4 Wiring Devices

- a) All wiring devices shall be industrial heavy duty specification grade, rated a minimum 20A, 125V.

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12.5 Emergency Generators

- a) Emergency generators shall be powered by natural gas and shall be sized to add 50% future additional critical emergency loads.

12.6 Service and Distribution

- a) The campus distribution system operates at 12,470 volts on a wye connection. Two sets of lines from the three-line system should be brought into any new facility and connected to high voltage switchgear.
- b) One-line diagram of electrical system shall be posted in the switchgear room or in vicinity of main distribution panel.
- c) Panel boards shall be flush mounted only in areas with grid type ceilings or open ceilings. Do not locate panel boards in custodial closets.
- d) Distribution panel board shall be provided complete with all mounting hardware for mounting any size breaker that the panel will accept and breakers shall be plug-in type.
- e) Provide a minimum of one 100 ampere, 30 pole panel board per laboratory.
- f) Provide 50% spare breaker space in each distribution panel in all new buildings. Provide 20% spare breaker space in each panel board.
- g) All panel board indices shall identify all equipment served by each circuit, (i.e. Rcpt - Rooms 111, 112, 115).
- h) Any panel board spaces shall be fully bussed.

12.7 Motors and Controls

- a) All motor variable frequency controls shall meet IEEE recommended practices and requirements for harmonic control in electrical power systems.
- b) Motors of $\frac{3}{4}$ horsepower and larger shall be 3-phase power 480 V.
- c) Motors of 1 hp and larger shall be "Premium Efficiency."
- d) No shaded pole motors are permitted for fractional motors. Only capacitor motors.

12.8 Electrical Systems Commissioning

- a) Scope of Work: The Electrical equipment and systems defined in Division 1 – General Commissioning Requirements will be commissioned. List the project-specific items of Electrical equipment and systems to be commissioned in this Section.
- b) Work Included: As a minimum, the following commissioning tasks will require the cooperation, labor, materials and assistance from the Contractor and subcontractors:
 - a) Electrical equipment installation verification
 - b) Electrical system and equipment startup testing, adjusting and calibration
 - c) Electrical Systems Functional Performance Testing

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- c) Test Procedures: Provide adequately detailed test procedures for all commissioning pre-functional and functional performance tests and inspections, which require the cooperation and assistance of the Contractor and subcontractors for completion.
- d) Testing and Re-Testing: Require that the Contractor and subcontractors provide all required assistance, labor, materials and supplies for specified commissioning tests. Specify that tests failed due to improper Contractor work, equipment malfunction or lack of adequate preparation shall be rescheduled at the convenience of the Owner and Commissioning Authority, and that all costs of re-testing will be borne by the Contractor.
- e) Project Closeout: Specify that the Contractor is responsible for the satisfactory completion of all commissioning items of this section, and of Division 1 – General Commissioning Requirements, prior to approval of project closeout.

13. ELECTRICAL LIGHTING STANDARDS

13.1 Interior Lighting Fixtures and Lamps

- a) Standard light fixtures shall be LED lay-in fixtures, dimmable.
- b) All other new light fixtures shall be LED fixtures. Incandescent, inductive, compact fluorescent, metal halide and halogen lamps shall not be specified unless the designer can provide a Life Cycle Cost Analysis (LCCA) justifying the design.
- c) No lighting fixtures shall be specified for which the manufacturer will require a minimum order for the purchase of replacements. Non-catalog and custom lighting fixtures not to be specified unless approved by Facilities Management.
- d) Exit signs shall be LED with red letters.
- e) Any dimmable light fixtures shall be LED.
- f) If a daylight harvesting system is specified, it shall be furnished by one manufacturer as opposed to a system made from components by various manufacturers. All components shall be manufacturer's standard products. Daylight harvesting systems specification shall also require job specific installation instructions and wiring diagrams for use during installation. Record as-built drawings indicating any changes for these systems shall also be provided upon project completion.

13.2 Interior Lighting Control Systems

- a) Each typically occupied room shall have at least one accessible lighting control to independently control lighting with that room.
- b) All enclosed areas larger than 500 SF shall have an accessible lighting control so that general lighting may be reduced by at least one half throughout the area.
- c) The use of occupancy sensors shall be planned for all corridors, restrooms, classrooms, break rooms, conference rooms, and small storage rooms like closets, supply rooms or recycling rooms.
- d) Simplification of all lighting control devices and strategies is important at Michigan Tech.
- e) Automatic or programmable lighting control units shall be coordinated with Michigan Tech's IT department, and shall be purchased for the project through them.

13.3 Exterior Lighting Systems

- a) Neon lights and cold cathode lighting systems shall not be allowed for exterior lighting applications.
- b) All exterior light fixtures shall be of the 'light cut off' type to minimize light pollution.
- c) Lamps shall be LED.
- d) Exterior light poles shall be installed on concrete bases that are 24" to 30" high.
- e) Install non-shrink grout between pole anchor base and concrete foundation.

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- f) All poles shall be 20-foot-tall maximum.
- g) Light poles on the main campus walkways shall be pre-cast concrete as manufactured by Stresscrete, model P140, 14' pole with outlet 24" above pole connection to Type 1 base plate, or equal approved by the university.
- h) All wiring shall be in conduit.
- i) Outlets and lighting require in-line fuses with holders installed in pole handholes. Provide weather proof covers for wet locations.
- j) All wire connectors used in underground or exterior pull boxes shall be gel-filled twist connectors or a connector designed for damp and wet locations. For splices inside poles and in exterior ground boxes utilize 'easy-splice' gel splice kits.

14. INFORMATION TECHNOLOGY STANDARDS

14.1 Communication Closets

- a) All communication closets shall be supplied with air conditioning suitable for the heat load of the intended equipment.

14.1 Data Closets

- a) See section 5.3 Data closet.

14.2 Data Distribution

- a) All data outlets shall be in a double gang box.
- b) All conduits for data boxes shall be a 1" metal or PVC conduit home run to a pull box, data closet, or approved end point not to exceed a total of a 270-degree bend.
- c) All cable and jacks to be Commscope as specified by Michigan Tech's IT Department reference section 27-15-00 from Michigan Tech's IT Department.
- d) Data cable will be used for both data and telephone.
- e) Wireless Access points will connect to data jacks. Rooms should have minimum 1 - 2 port location in ceiling for access point. Larger lecture halls (seating over 50) should have 1- 4 port locations per 50-person capacity. Coordinate location with Michigan Tech IT.
- f) Network jack locations on walls should have power outlet adjacent.
- g) Place at a minimum of 1 - 4 port location per wall coordinated with Michigan Tech IT as other needs may be present depending upon room, equipment, and other needs.

14.3 Security cameras

- a) Security Cameras to be coordinated with Michigan Tech IT department.
- b) Each security camera location requires a 2-port data jack. No coax or power is required for Michigan Tech's camera system. Data jacks are fed from data closets.
- c) At a minimum there should be a camera to cover each building entrance to capture people entering the building.
- d) Additional cameras will be defined based on room use or need within specific areas of the building.
- e) Consideration should be given to provide conduit to new light poles if installed for potential security cameras or outdoor access points. Michigan Tech IT can provide specific consultation based on project.

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14.4 Card Readers

- a) Card readers to be coordinated with Michigan Tech IT department. Specific hardware will be specified to work with existing card reader system.
- b) Each exterior door will have a card reader installed. Additional doors at each entrance will be tied to card reader system for automated locking and unlocking.
- c) Card reader equipment is run from controllers that will be placed in the data closets, conduit path from card reader location as well as strike locations to run to data closet.
- d) 12 vDC strikes to be used for all card reader location. 24vDC panic bars to be used. Strikes and panic bars to be Von Duprin specified by Michigan Tech IT.
- e) Exterior doors with assisted hardware will need to be tied into the card system such that a card swipe will activate the door assist when going in. On exit, door assist button will activate door and release panic bar strike.

14.5 Fiber optic cable

- a) All fiber optic cable to be single mode.
- b) All fiber termination will be Clearfield panels as specified by Michigan Tech IT.
- c) Fiber will run between MDF and IDF closets (24 strand) as well as from MDF (48 strand) to location as specified by Michigan Tech IT.

14.6 Coax distribution

- a) RG6 cable to be used for any coax distribution. Coax to be home run from location to nearest IDF closet.

15. BUILDING AUTOMATION SYSTEM STANDARDS (BAS)

15.1 General Provisions

- a) Locate thermometers, gauges, etc., where they can be readily observed from floor level. Provide instruments with the appropriate range.
- b) BAS design must conform to Michigan Tech's Temperature Control System specifications.
- c) The Temperature Control System (TCS) shall be comprised of a network of interoperable, stand-alone digital controllers and other devices as required.
- d) Provide interoperable digital controllers (IDC) and ancillary devices. Control the following equipment:
 - i. Air terminal devices (i.e. VAV, Dual Duct, Fan Coil Units, etc.)
 - ii. Air handling units (fans, valve and damper actuators, sensors, etc.)
 - iii. Pumps.
 - iv. Chillers (via interface provided by manufacturer)
 - v. Make-up air units.
 - vi. Exhaust fans for ventilation and pressurization control.
 - vii. Additional equipment outlined herein or on the Mechanical and Electrical drawings.

15.2 Building Automation Commissioning

- a) Scope of Work: The Building Automation equipment and systems will be commissioned.
- b) Work Included: As a minimum, the following commissioning tasks will require the cooperation, labor, materials and assistance from the Contractor and subcontractors:
 - i. Verification of digital display screens, alarm points, and links.
 - ii. Building Automation equipment installation verification.
 - iii. Building Automation system and equipment startup testing, adjusting and calibration.
 - iv. Building Automation Systems Functional Performance Testing.
- c) Test Procedures: Provide adequately detailed test procedures for all commissioning pre-functional and functional performance tests and inspections, which require the cooperation and assistance of the Contractor and subcontractors for completion.
- d) Testing and Re-Testing: Require that the Contractor and subcontractors provide all required assistance, labor, materials and supplies for specified commissioning tests. Specify that tests failed due to improper Contractor work or preparation shall be rescheduled, and all costs of re-testing will be borne by the Contractor.
- e) Project Closeout: Specify that the Contractor is responsible for the satisfactory completion of all commissioning items of this section, and of Division 1 – General Commissioning Requirements, prior to approval of project closeout.

16. FIRE ALARM/MASS NOTIFICATION SYSTEM REQUIREMENTS

16.1 Fire Alarm System/Mass Notification System

- a) Fire alarm systems shall comply with the "Michigan Tech Fire Alarm/Mass notification Design Standards".
- b) Fire alarm components must have tags and numbers on all pumps and valves. Tags will also provide information on area served by that particular valve or pump.7.

17. SITE/CIVIL STANDARDS

17.1 Site Utilities

- a) General Information:
 - i. Where possible, all utilities shall enter at one area of a building.
 - ii. For utilities and buildings outside the main campus, obtain information from Facilities Management.
 - iii. Provide underground utility warning tape for both metallic and non-metallic utility lines.
 - iv. Utility design and installation/construction must follow local, state, and federal regulations and ordinances, etc. Permits must be acquired as necessary.
 - a) Resources:
 - b) State of Michigan EGLE
 - c) State of Michigan DOT
 - d) AASHTO
 - e) Houghton County Road Commission Utility Construction Requirements:
<http://www.houghtoncountyroads.org/info-utilities.php>
 - f) MDOT Publications:
http://www.michigan.gov/mdot/0,4616,7-151-9622_11044_11367---,00.html
 - g) MDOT Utility Trenches, R-83-B:
<https://mdotjboss.state.mi.us/stdplan/standardPlansHome.htm>
 - v. Site design and site work must follow MEGLE/USACE Joint Permit and the Houghton County Drain Commission, Part 91, Soil Erosion and Sedimentation Control (SESC) requirements.
 - a) Resources:
https://www.michigan.gov/egle/0,9429,7-135-3313_71520_24403---,00.html
 - vi. Designs, plans, and implementation/construction must follow engineering design practices that include sufficient backup information. As an example, the Great Lakes Upper Mississippi Board (GLUMRB) has published standard guidelines for water and waste water.
 - a) Resources:
 - b) <http://10statesstandards.com/index.html>
 - c) http://mdotwiki.state.mi.us/design/images/f/fa/MDOT_Sample_Plans_Road.pdf
- b) Water Distribution:
 - i. Water is distributed around campus by a central University system that delivers water at 80 psi to each system on the main campus. All new water piping

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outside the building shall be ductile iron type with push-on gasketed joints, complying with AWWA C150, C151, and C111. If water service is less than 2 ½" use copper piping.

- ii. All water piping shall be covered with rigid insulation and protection board where there is less than 8' of ground cover.
- c) Sanitary Sewer/Waste Water:
- i. Sanitary sewers are Michigan Tech's system which connects to the main City of Houghton system located on Phoenix Drive. This 42" line runs to the Portage Lake Water & Sewage Authority (PLWS&A).
 - ii. Sanitary sewer piping outside buildings shall in general be PVC complying with AWWA requirements.
 - iii. All man-holes shall be pre-cast concrete in compliance with ASTM C478.
 - iv. Wastewater design and construction must comply with MEGLE Water Resources Division Wastewater Construction Permit Applications; MEGLE is the authority, under the authority of Part 41, Sewerage Systems, of the Natural Resources and Environmental Protection Act, 1994 PA 451, as amended.
Resources:
https://www.michigan.gov/egle/0,9429,7-135-3313_71618_44117---,00.html
- d) Storm Sewer:
- i. Storm sewers on campus are separate from the sanitary sewer. The University central system drains into Portage Lake.
 - ii. Low-Impact Design (LID) should be accomplished according to the statewide LID Manual, Low Impact Development Manual for Michigan: A Design Guide for Implementers and Reviewers
<https://www.semco.org/desktopmodules/SEMCOG.Publications/GetFile.ashx?filename=LowImpactDevelopmentManualforMichiganSeptember2008.pdf>
 - iii. All man-holes shall be pre-cast concrete in compliance with ASTM C478
 - iv. Storm sewer design and construction shall follow Michigan Department of Environment, Great Lakes, and Energy regulations for National Pollutant Discharge Elimination System permits and in conjunction with the Houghton County Drain Commission, Part 91, Soil Erosion and Sedimentation Control (SECS), of the Natural Resources and Environmental Protection Act (NREPA) (Part 91).
Resources:
https://www.michigan.gov/egle/0,9429,7-135-3311_4113---,00.html
MDOT Soil Erosion & Sedimentation Control Measures, R-96-E:
<https://mdotjboss.state.mi.us/stdplan/standardPlansHome.htm>

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- e) Steam:
 - i. Central high pressure steam is distributed around the main campus at 80psi for heating and other uses.
 - ii. The system is extended via walk-through tunnels, commonly known as steam vaults that supply house steam and pumped condensate.

17.2 Paving; Roadways, and Parking Lots

- a) Paving:
 - i. Pavement new/reconstruction, rehabilitation, and preventative maintenance must follow MDOT Local Agency Programs Guidelines for Geometrics on Local Agency Projects and MDOT Specifications to the highest extent possible, and must be coordinated and approved through the University Project Manager assigned to the project.
 - ii. Roadways and driveways with loading docks should be designed to meet roadway standards. Parking lots can be designed to meet passenger vehicle axle standards (volumes).
 - iii. New construction/reconstruction, resurfacing, restoration and rehabilitation: Sections B and C, list 3R and 4R guidelines.
 - iv. Preventative Maintenance: Section D lists approved preventative maintenance (PM) treatments: recommended pavement treatments according to PASER rating, required treatment thicknesses and application rates, etc.
 - v. Follow the most current copy of State of Michigan DOT Hot Mix Asphalt Selection Guidelines:
https://www.michigan.gov/documents/mdot/HMA_Selection_Guidelines_2017_12-26_609733_7.pdf
 - vi. Ultimately, minimum pavement thickness must be determined by the American Association of State Highway and Transportation Officials (AASHTO) Guide for Design of Pavement Structures.
Resources:
https://bookstore.transportation.org/item_details.aspx?id=374
<https://mdotjboss.state.mi.us/SpecProv/specBookHome.htm>

17.3 Sidewalks

- a) Concrete sidewalks
 - i. Safe sidewalk design must follow MDOT standard designs, R-28-I, R-29-I:
<https://mdotjboss.state.mi.us/stdplan/keywordTextSearch.htm>
 - ii. New sidewalks design must follow ADA requirements.

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17.4 Landscaping

- a) Seeding and Trees
 - i. In general comply with MDOT Seeding and Tree Planting, R-100-H, <http://mdotcf.state.mi.us/public/design/englishstandardplans/>
 - ii. Coordinate all landscape designs and plans with Michigan Tech Grounds/Master Gardener.

17.5 Lighting

- a) Exterior Lighting
 - i. See Section 13.2 for exterior lighting requirements.

17.6 Exterior Signs

- a) Traffic Signs
 - i. New traffic signs for Michigan Tech must follow the Michigan Manual on Uniform Traffic Control Devices. New decorative sign types not included in this manual must match existing signs of the same type if available and be coordinated with the University Project Manager assigned to the project.

Resources:

<https://mdotjboss.state.mi.us/TSSD/tssdHome.htm>

- b) Building Signs
 - i. For new exterior building signs, follow Michigan Tech's standard.

17.7 Snow Storage

- a) Snow Storage
 - i. Michigan Technological University's site designs shall accommodate snow removal requirements and provide sufficient space for prolonged snow storage.
 - ii. To ensure that these are met, coordination is mandatory throughout project planning, design, and construction with Michigan Tech Grounds through the University Project Manager assigned to the project.

END OF DESIGN AND CONSTRUCTION STANDARDS