OSU Construction Standards

Introduction

The Construction Standards support OSU’s policies related to the design and maintenance of facilities on campus and the Campus Master Plan. They identify specific materials, equipment and furnishings that should be utilized in the construction of buildings and outdoor spaces on campus. They also note requirements for project drawings and address sustainability, universal design and environmental best practices and requirements.

The document is organized in standard construction specification institute (CSI) format. The table of contents provides easy identification of the sections covered in the document.

The document is to be used by all A/E and other design and construction professionals under contract to do work at and for OSU. It is also a resource for staff and faculty. Technical Bulletins are considered appendices to the Construction Standards and must be adhered to as well. The pertinent Technical Bulletins are listed below the Construction Standards on the same website.

The standards in the document have been researched and selected by a cross section of staff and professional consultants. They are standards, but are not absolutes. If a more appropriate product, material or practice provides additional value to OSU, it should be considered. Items different from those identified in the Construction Standards will be reviewed by OSU for life cycle cost, environmental impact and future flexibility. Proposed changes should be submitted as early as possible during the design process. Designs must comply with the Construction Standards unless written verification of substitution is provided by OSU.

Please note that OSU’s University Housing and Dining Services department has a similar document that directs work within their facilities. For more information you can contact Dan Larson, Associate Director for University Housing & Dining Services at 102 Buxton Hall, by phone at 541-737-0683, and email at dan.larson@oregonstate.edu.

Additionally, OSU’s Network Services department has a set of design standards that are applicable to network infrastructure, internet connectivity and phone services. For more information you can contact Gregory S. Edmaiston, Manager of Information Technology Design Services at A012 Kerr Admin Building, by phone at 541-713-3442, and email at greg.edmaiston@oregonstate.edu. Both documents must be adhered to by design and construction professionals under contract to provide services at OSU.
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Section 01100 – GENERAL

1. PROJECT DRAWING REQUIREMENTS
   A. For projects that do not include an A&E design firm or are self-performed by OSU, the Owner requires the receipt of marked-up record drawings indicating modifications, dimensions, equipment lists and other information necessary for ongoing operations and maintenance.
   B. For projects that include an A&E design firm, the Owner requires the following:
      01. The Construction Drawings will be plotted on sheets not exceeding 30x42”.
      02. All documents and drawings shall include the Owners Project Number and Title Block. It is required that the final ‘Record’ drawings be provided as AutoCAD files on CD-ROM for use in Facilities Services Vault Record System.
      03. The design professional will also provide the Owner with a complete set of Mylar ‘Record’ drawings, and a full-size scanned image of each sheet in tiff and PDF format at a minimum resolution of 400dpi.
      04. Each tif and PDF file shall be named equal to the sheet name. On applicable projects the design professional shall provide AutoCAD BookPlans to OSU standards.
   C. The Owner requires the receipt of a complete set of the construction documents in digital form at the following stages:
      01. 100% Construction or Bid and;
      02. Record (as-constructed) Drawing.
   D. If the work is performed through the OSU Shops, the appropriate vendor, contractor or internal construction group is responsible for providing these drawing updates at the completion of the project.
   E. All ‘External References’ (including nested ExRefs) must be included and fully resolved.
   F. When submitting the final ‘Record’ drawing files, all exrefs shall be bound to the parent file using the ‘insert’ option of the ‘Bind exref’ dialog.
   G. All AutoCAD data must be accompanied by the proper plotter configuration file(s) and any font (shx), shape (shp) or proprietary files necessary for reproduction.
   H. If ‘vertical applications’ are used in addition to a basic AutoCAD installation, the design professional shall include the correct AutoDesk ‘object enabler’ file(s) for resolution with a basic install of AutoCAD.
   I. Life Safety Cover Sheets
      01. All architectural drawings will include life safety cover sheets which should include:
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a. Zoning requirements
b. Required side yards
c. Fire resistivity of exterior walls
d. Fire classification of the building’s construction type
e. The sheet will include a schematic drawing indicating:
   1. Required exit corridors and the required fire classification of walls, doors, windows, and duct work.
   2. Area separation
   3. Flame spread characteristics
   4. Rated ceilings
   5. Allowable areas or occupancy types
   6. Number of stories, basements, and attics
   7. Other elements important to a zoning/life safety code check.
   8. Identify corridors.

02. This sheet will include Americans with Disabilities Act (ADA) items such as:
   a. Assistance route
   b. Areas of refuge
   c. Building areas by floor

J. Book Plans
01. Book Plans are the drawing of record for OSU space on and off campus.
02. Book plans shall be drawn to scale and printed on 11” x 17” sheets.
03. OSU will provide the appropriate title block and drawing layers.
04. Creation/updating of book plans is required for every new and remodel construction project.
05. Book plans shall be prepared for all affected floors including:
   a. Basement
   b. First Floor and all floors above the first floor
   c. Attic and/or roof.
06. Book plans should include the following information:
   a. Building identification
   b. Floor identification
   c. Room numbers
   d. Use of space (i.e. lab, classroom, mechanical room, corridor)
   e. General interior and exterior dimensions
   f. Net useable area for each room
   g. Total square feet calculations – gross area and net useable area – for each affected floor.

K. Building Map
01. Provide an 11x17 building map that clearly identifies the location of the building exits, elevators, fire extinguishers, ADA restrooms, men’s restroom, women’s, restrooms, unisex restrooms, fire alarm pull stations, and closest exit.
L. When a project involves the modification of Public utilities, the Owner requires 2 sets of digital and hard copy ‘Record Drawings’ within 30 days following the City of Corvallis approval of that portion of the project.

M. The Design Professional shall provide one set to City of Corvallis Public Works Department, and one set to the Owner.

2. SUSTAINABILITY
   A. Oregon State University shall follow the Sustainability Facilities Standards and Guidelines outlined in the Oregon Department of Administrative Services to follow Policy Manual number 125-6-010.
   B. All new buildings are required to reach a minimum of 33 sustainability points out of a possible 65.
   C. All major remodeling projects are required to reach a minimum of 26 sustainability points.
   D. Certain sections of the Construction Standards and Specifications have been modified to guide accomplishment of this goal. It is the responsibility of the A/E to review these and other applicable criteria for appropriate inclusion.

3. UNIVERSAL DESIGN
   A. It is the intention of Oregon State University to develop a built environment which is universally designed to incorporate access for persons with disabilities as an integral element in anything built, or purchased. The designer will take the initiative to provide these accommodations, which are not separate or special, but rather are universal in utility. Successful examples that accommodate the greatest diversity of human characteristic and enhance esthetics are: 1. Grade level building approaches with automatic snow melting rather than separate unheated ramps and steps provide hazard free entrances for everyone.
   B. Signs on automatic doors that read "automatic door" rather than a barrier free logo. Mobility aid users can select which door to use like everyone else.
   C. Lever-handle hardware, which is more convenient for everyone.
   D. Exit signs that flash when an emergency alarm is activated, which reinforces that an emergency exit condition exists and warns the hearing impaired as well.
   E. Low service counters, where possible, to be equally functional for wheelchair users and non-wheelchair users.
   F. Room number signs with raised or incised characters, which can be read by touch as well as by sight, and at a standard mounting height.
   G. Refer to Section 13200 – Universal Access for more information.

4. SITE PLANNING
   A. All site planning, design and development for new and existing construction (e.g., renovations and remodels, additions) for any building or structure located within the Campus Master Plan boundary shall conform with the policies and regulations within the Campus Master Plan. In addition the development project shall conform to all applicable land use regulations per the OSU Zoning District. A
copy of the Campus Master Plan and the OSU Zoning District, Section 3.36 can be obtained by contacting Campus Planning. Section 3.36 can also be obtained from the City of Corvallis Planning Department. http://www.ci.corvallis.or.us/

B. The siting of new construction within the Campus Master Plan boundary is subject to review and approval by the Campus Planning Committee (CPC). (Refer to the CPC Development Review Process Requirements.)

C. The siting and design of the building shall conform to applicable design guidelines set forth in the Campus Master Plan and the OSU Zoning District. No deviation for set guidelines and regulations shall be permitted without approval from the Director of Facilities Services

D. Site work drawing shall include at a minimum:
   01. Any drawings necessary to meet minimum submission requirements for the City of Corvallis’
   02. Proposed footprint of new building or structure;
   03. Adjacent streets; sidewalks, paths, etc.
   04. Existing lighting;
   05. Landscape features; and
   06. Parking areas

5. DESIGN DRAWINGS

A. Coordinate with the OSU PM and team to develop the project scope of work

B. Prepare and submit cost effectiveness studies of alternate systems. Recommend to the PM the most appropriate system and materials to use for the project.

C. Review existing conditions and as-built information in relation to the proposed project.

D. Respond to all design review comments and incorporate them into the drawings.

E. Drawings: Provide complete drawings suitable for competitive bidding. Drawing packages must include the following as appropriate:
   01. Cover Sheet
   02. Legend Sheet
   03. The legend sheet shall include all symbols used on the drawings with a description of what that symbol indicates. The symbols used shall comply with industry standards.

F. Schedule Sheets
   01. Schedules for new and existing mechanical equipment shall include all performance data including capacity, air/water pressure drops, rpm, entering and leaving conditions, motor horsepower, KW, or amps, voltage/phase, basis of design manufacturer, location of equipment, identification numbers, unit physical dimensions, and weight.
   02. In the upper right hand corner, on the first sheet of the plumbing drawing, or on the title sheet of projects without separate plumbing drawings, include a 01."PLUMBING FIXTURE SCHEDULE." This information will be used in determining the fixture count for the City of Corvallis review.
03. List all abandoned, demolished or deleted fixtures as well as the new fixtures.
04. In the case of total demolition of structures for new construction, note number and type of fixtures demolished in the previous construction.
05. Plumbing fixture schedules shall include fixture identification, connection sizes for water, waste and vent, and gases.
06. Riser Diagrams
   a. Modification to existing systems shall include the riser diagram for the existing systems and piping back to the nearest main branch.
07. Include diagrams for all mechanical systems including heating water, chilled water, condenser water, and refrigerant piping.
08. Include diagrams for all waste and vent systems, hot and cold water, and storm water systems.
09. Fire protection one line riser diagrams.
10. Underground and Foundation Plans
   a. Indicate all buried piping, starting invert elevations, and invert elevations at point five feet outside building. Provide invert elevations on underground sanitary waste, storm, water, and other underground piping on plans.

6. FLOOR PLANS
   A. Show all ductwork, piping, and equipment on floor plans at a scale to match the architectural.
   B. Provide Enlarged or Partial Plans to adequately show the work in complex or confined installations.
   C. Show locations of steam system anchors, slides, guides, and expansion joints.

7. SECTIONS AND DETAILS
   A. Provide building sections to show locations of mechanical system components in relation to building elements. Mechanical components shall be coordinated with work of other trades.
   B. Provide details for mounting or connection of equipment.
   C. Provide pipe support and anchoring details for steam piping 4 inches and above. Mechanical rooms shall be detailed at no less that ¼" per foot with piping and ductwork shown double line. Drops and offsets shall take into consideration the actual space it takes to make connections and turns.

8. SPECIFICATIONS
   A. Submit, as part of the design development package and at each construction document review stage, a list of equipment and the manufactures to be used on the project in the following CSI format:

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9. **STORM WATER MANAGEMENT**

A. Discharge of pollutants (any substance, material, or waste other than clear, uncontaminated storm water) into a storm drain system or a water body is prohibited by the Department of Environmental Quality (DEQ).

B. Any proposed new development or expansion of development along an open natural drainage way shall comply with OSU Zoning District Section 3.36.50.07 – Drainageway Management Agreement. Where applicable, consider water quality and/or detention swales that use biological methods for water purification to address unavoidable post-development storm water sources.

C. Storm water runoff from loading dock areas shall be drained to a sanitary sewer system where feasible.

   01. Where sanitary sewer is not available, best management practices must be implemented

D. All wastewater generated from water wash down and other cleaning activities within confined animal facilities and that contacts manure areas must be handled so as to not impair ground or surface water quality.

E. **Physical Separation of Runoff Sources**

F. **Regulations and Standards**

   01. Projects shall comply with all applicable Federal, State, and Local Code Regulations.

10. **HAZARD MATERIALS**

A. Hazardous materials described in the following section refer, at a minimum, to asbestos, lead, mercury, PCBs, and containerized chemicals.

B. On every project involving existing facilities, a hazardous materials survey shall be performed prior to any demolition. This survey will be performed by OSU Facilities Services Environmental Health and Safety (EH&S) or by independent consultants as directed by EH&S.

C. The survey will provide an overview of typical surfaces and locations containing the hazardous material in question but may not specifically delineate every location where the hazardous material may be found. Under no circumstance shall demolition work occur prior to approval from OSU EH&S.

D. All contractors are responsible to contacting OSU EH&S prior to any construction activities or demolition of existing structures within an OSU building. Removal of asbestos shall be performed by an OUS-approved asbestos contractor under the direction of OSU EH&S. Refer to Section 02120 – Asbestos Abatement.

E. Lead abatement projects shall be performed by OUS-approved lead abatement contractor under the direction of OSU EH&S. Lead abatement projects have the intent to remove (or encapsulate) lead surfaces to make them less hazardous.

F. Demolition of surfaces with lead-containing paint in NOT lead abatement. If contractors, for any reason, cannot perform demolition on lead-containing materials, a separate contractor will be hired by OSU for that work.
11. SPACE ALLOCATION
   A. The University Space Committee has approved a Space Allocation Model which is
      implemented by Facilities Services. Information about OSU’s Space Allocation
      Model can be found at http://oregonstate.edu/osusc/, or from Campus Planning.

12. OSU HISTORIC DISTRICT
   A. Development in the OSU National Historic District is subject to the requirements
      of the City of Corvallis Land Development Code, Chapter 2.9 – Historic
      Resources. All historic preservation permit applications (HPP) will be submitted
      for review, coordination and disposition by Campus Planning.

13. BUILDING EXTERIORS
   A. All exterior building features must meet or exceed Oregon Energy Code, Chapter
      13, of the State of Oregon, the most current Edition of the Structural Specialty
   B. Select materials for compatibility with adjacent structures per Campus Master
      Plan design guidelines.
   C. Exterior brick for the envelope must be of the highest quality selected for
      harmonious color, texture, appearance, the Pacific Northwest climate, and
      environmental impacts.
   D. Metal coping is required on all brick or masonry parapets.
   E. Asbestos containing materials are not allowed.
   F. Provide exterior architectural louvers with factory finish that does not require
      field painting.
   G. Exterior louvers to be specified by the architect.

14. EH&S MITIGATION REQUIREMENTS: Environmental Mitigation requirements may
    included, but are not limited to, procedures and standards to control:
   A. Dust Control and Fugitive Emissions.
      01. Construction project activity shall not cause or permit the emission of any
          particular matter at sufficient duration or quantity as to create a nuisance
          or observable deposition upon real property of another person.
      02. Reasonable precautions to control particulate emissions can include but
          are not limited to:
          a. Use of water or chemicals for control of dust during demolition of
             structures, construction, or during grading of roads or clearing of
             land.
          b. Covering at all times when in motion, open bodied trucks
             transporting materials likely to become airborne.
          c. Full or partial enclosure of stockpiled materials.
          d. Dirt or debris spilled onto paved surfaces should be swept up
             immediately to reduce re-suspension of particulate matter caused
             by vehicle movement.
   B. Odors
01. Work that causes excessive odors shall be performed only after coordination with the University's Representative. Filtering of air intakes may be needed to prevent odors and vapors from entering buildings.

01. In cases where unavoidable odors will be produced, Contractor shall provide 7 business days advance notice to the University's Representative in order that adequate notice can be forwarded to building occupants. Work stoppage may occur if advance notification has not been coordinated or odors and vapors from the work are found to generate complaints from building occupants.

C. Protection of Existing Air Handling Systems

01. Contractor shall be responsible for protection of the cleanliness of existing air handling systems at all times. This protection may include as needed:
   a. During site work or building demolition, pre-filters shall be provided and maintained on all building outside air intakes at all times throughout the construction duration.
   b. During any interior work that may create dust in the interior space and adjacent corridor/hallways, air filters shall be provided and maintained on all affected air return and exhaust grilles. Where air flow in or out of the space is not required, all air duct openings shall be temporarily sealed off with a suitable covering.
   c. Upon completion of all Work affecting existing air handling systems, the Contractor shall remove all temporary filters, covers and associated parts and restore the system to its original operating condition unless otherwise stated elsewhere in the Contract Documents.

D. Ventilation during Painting or Other Finish Work

01. The room/space shall be supplied with 100 percent outside air during painting and for a period of 72 hours following completion of painting.

02. The air leaving the room/space shall be exhausted only to the outside, with no re-entrainment to any occupied spaces during painting and for a period of 72 hours following completion of painting.

15. NON STRUCTURAL SEISMIC BUILDING ELEMENTS

A. Falling hazards from non-structural building elements including equipment, fixtures, ceilings, furniture, and other contents should be abated, to the extent practical. This includes the following guidelines:

01. Free-standing bookshelves, cabinets, and equipment shall be anchored according to the seismic design requirements of the International Building Code (as modified by applicable State Codes).

02. Shelves shall have doors or restraints to keep items from falling. For bookshelves, the restraint should extend at least on-half inch above the shelf. For chemicals and in other laboratory areas, the restraint should extend at least two inches above the shelf. Where glass chemical
containers will be stored, the restraint material should be of a nonmetallic or a rubber coated metallic material.

03. Shelving shall be provided with a lip or guard when used for the storage of individual containers of hazardous materials.

04. Sliding or swinging cabinet doors shall have mechanical latches.

05. Compressed gas cylinders shall be restrained using approved brackets with two metal straps or chains that have been firmly attached to walls. When using chains, one should be located approximately 8 inches from the floor and the second should be located approximately 34 inches from the floor.

06. Flexible utility connections shall be used for fume hoods and other equipment.

07. Biosafety cabinets and fume hoods should be seismically anchored.
Section 02050 – DEMOLITION

1. REQUIREMENTS
   A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.
   B. Demolition and disassembly will not be allowed until it is coordinated with OSU’s designated representative.
   C. Maintain free and safe passage to and from buildings.
   D. Prevent movement or settlement of structures.
   E. Provide and place bracing, shoring and underpinning, and be responsible for safety and support of structures and assume liability for such movement, settlement, damage or injury.
   F. Cease operations and notify OSU’s designated representative immediately if safety of structure appears to be endangered. Take precautions to properly support structure. Do not resume operations until safety is restored.
   G. All active utility mains traversing the project site shall be maintained.
   H. When removing a structure or building, establish a safety perimeter or corridor that restricts public access during the demolition operation. Provide, erect and maintain barricades, lighting and guard rails as required to protect the public.
   I. Any unearthed underground tank shall be removed in accordance with applicable Department of Environmental Quality regulations and standards. Contact the OSU designated representative immediately upon discovery of an underground tank or sub surface structure. (See Section 02100)
   J. On every project involving existing facilities, a hazardous materials survey shall be performed prior to any demolition. This survey will be performed by OSU Environmental Health & Safety (EH&S) OR by independent consultant as directed by EH&S. (See Section 01100 – 13 Hazardous Materials)

2. COORDINATION
   A. Cooperate with Oregon State University and utility companies whose work affects or will be affected by the demolition operations. It is the professional consultants and contractors responsibility to ascertain and understand the rules, regulations and requirements of these authorities which affect the demolition process; notify them of conditions affecting their work, and disconnect or arrange for disconnection of utility services if required.
   B. The professional consultant or contractor shall comply fully with all provisions of the local codes, laws and ordinances applicable to work of this Section, and other OSU plans and documents that relate to campus planning and development.

3. SUBMITTALS
   A. The professional consultant or contractor shall be required to submit all the required documents identified in local codes and ordinances applicable to work
of this Section, and/or during the pre-planning, pre-construction, and/or construction meetings with project review team.

B. The required number of copies shall be submitted to OSU

C. The documents shall include scaled drawings per:
   01. Section 01100 – General Requirements
   02. Proposed building or structure to be removed;
   03. Proposed walls, building systems, structures, etc. to be demolitions within an existing building;
   04. An indication of how building systems (e.g., HVAC, electrical, gas, water, etc) shall be capped where they were once connected to the portion identified for demolition;
   05. Access route to a building or structure to be demolished;
   06. Tree Root Protection Zone (TRPZ) for trees immediately adjacent to the demolition site or access route to the demolition site.

4. PRODUCTS
   A. Salvaged materials
      01. Owner shall have the option of retaining ownership of any or all existing equipment, materials, and items removed under this Work.
      02. Should Owner decide not to retain ownership of certain items removed under the work of this Section, those items shall become property of Contractor and shall be promptly removed from the Project Site.
      03. Deliver items which remain property of Owner to a location, or locations.
1. REQUIREMENTS
   A. This Construction Standard covers the requirements for removal and disposal of underground storage tank(s), buried piping, products remaining in the tank(s), contaminated soil and water, and related work in accordance with Federal, State, and local regulations.
   B. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.
   C. Provide all labor, materials and equipment as necessary to complete all work as indicated on the Drawings and specified herein.
   D. Work includes removal and disposal of an underground storage tank(s) and associated connections and piping, excavation and disposal of contaminated soil, backfill to a level of the adjacent grade, sampling of excavated soils and water in areas located immediately adjacent to the underground location of the tank(s) (surface and subsurface sampling points are required). In addition, the work will include the installation of any temporary fence, barricade systems, or other means to keep the project site and work area safe and restricted from public access. Restoration of landscape grounds and replacement of plant material that might have been impacted during the completion of the work described herein is also work to be performed as necessary. Access routes used to gain access to the project site and work area must be restored.
   E. Perform work in accordance with local, State and Federal regulations, and any other rules, laws or ordinances identified herein.
   F. Drawing submitted to OSU for review shall include:
      01. Dimensions, details, sections, elevations, and location of equipment.
      02. Configuration, slope, and sizes for each excavation.
      03. Locations, sizes, and type of temporary containment areas.
      04. Locations and details for special supports.

2. TANK CLOSURE
   A. Remove, and dispose of underground storage tank(s), and connecting piping; including but not limited to, dewatering, if approved by OSU Facilities Services Environmental Health, & Safety Department (EH&S), disposal of contaminated soil, laboratory testing, providing reports which are required by regulatory agencies, and backfilling.

3. DATA SUBMISSION
   A. Submit data for approval by the EH&S that the tank(s) removal contractor, subcontractors, and personnel employed on the project have been engaged in
removal, transportation, and disposal of underground tank(s) and associated piping, and are familiar with and shall abide by the following:

01. DEQ Underground Storage Tank Rules
02. OR-OSHA Rules
03. Applicable safety rules and regulations.
04. Use of equipment and procedures for testing and vapor freeing tank(s).
05. Handling and disposal of types of wastes encountered in underground tank(s) and pipe removal including disposal of underground tank(s) and associated piping.
06. Excavation, testing, and disposal of petroleum contaminated soils, liquids, and sludge.
07. Submit data proving experience on at least three prior projects which includes types of activities similar to those in this project. Provide project titles, dates of projects, owners of projects, point of contact for each project, and phone numbers of each point of contact.
08. Submit training certification statements for personnel performing work which requires a level of certification in accordance with DEQ’s licensed “Service Provider” requirements, and other applicable local, State, and Federal laws, rules, and regulations.
09. Include unit measures for cubic yards and cost of such items as:
   a. Removal and disposal of stockpiled contaminated soils from excavation site
   b. Clean fill used for backfilling
   c. Removal and disposal of contaminated water collected during dewatering
   d. Tank(s) and piping
   e. Units should be in cubic yards, gallons, along with associated unit costs for materials
   f. Include any other information necessary to complete this work

4. EXCAVATION AND MATERIAL HANDLING PLAN
   A. Prior to when work begins (coordinate with Project Manager for specific time frame) the consultant or contractor shall submit to EH&S for approval an Excavation and Material Handling Plan.
   01. Excavation: Describe the methods, means, equipment, sequence of operations and schedule to be employed in the excavation, transport, handling, and stockpiling of soil during underground tank(s) removal and disposal operation.
   02. Material Handling: Describe the phases of handling with the contaminated soil and water as it relates to the removal of the proposed tank(s) and piping. Include methods of excavating, handling of contaminated material, soil testing requirements and locations, safety
precautions and requirements, and water pumping and collection requirements

03. Field Sampling and Laboratory Testing Plan

04. Describe field sampling methods and quality control procedures.

05. Identify laboratory and laboratory methods to be used for contamination testing. Sample reports shall show sample identification for location, date, time, sample method, contamination level, name of individual sampler, identification of laboratory, and quality control procedures.

06. Tank and Piping Removal and Disposal Plan

07. Describe methods, means, sequence of operations, and schedule to be employed in the testing, pumping, cleaning, de-vaporizing, inspecting, removal, and disposal of underground storage tank(s) and piping.

08. Include other quality assurance measures specific to this project.

5. SITE SAFETY AND HEALTH PLAN

A. The Contractor shall submit to the (EH&S) for approval a Site Safety and Health Plan (SSH Plan). No work shall commence until the contractor obtains approval of the SSH Plan in writing from EH&S.

B. The SSH Plan shall include a site map, points of entry into the Exclusion Zone and Contamination Reduction Zone, location of Contractor’s field office and permitted access routes to the project site from adjacent streets.

C. The SSH Plan shall include at a minimum the safety, health and accident provisions. EH&S may request additional information 7 days prior to commencement of work described herein. The request of additional information shall be in writing via electronic or postal mail.

01. The SSH Plan shall be prepared in accordance with all applicable local, State and Federal laws and requirements for the work described herein.

02. The SSH Plan shall detail the practices and procedures to be followed when disposing of wastes. Upon completion of the project, the Contractor shall submit to OSU EH&S in written format that the equipment and materials used during the completion of the work described herein were properly decontaminated prior to being removed from the site.

a. The Contractor is responsible for reporting to EH&S the day-to-day monitoring results.

b. EH&S shall be contacted immediately in cases of accidents, unforeseen events, or other incidents that need immediate attention due to a safety or health risks and or concerns.

c. Include other elements to the SSH Plan specific to this project.
6. **SPILL AND DISCHARGE CONTROL PLAN**
   
   **A.** The Contractor shall submit to the EH&S approval a Spill and Discharge Control Plan. No work shall commence until the Contractor obtains approval of the SDC in writing from EH&S.
   
   **B.** The Spill and Discharge Control Plan (SDC Plan) shall describe at a minimum contingency measures for potential spills and discharge from the removal, handling and/or transportation of the underground tank, associated connections and piping, soil, and/or water.
   
   **01.** The SDC Plan shall be prepared in accordance with and comply to all applicable local, State, and Federal regulations and laws for the work described herein. It is the responsibility of the Contractor to obtain and understand said regulations and laws, as well as any and all permit requirements, ordinances, and/or rules.

7. **TRAINING**
   
   **A.** All Contractor employees shall be trained in accordance with applicable DEQ and OR OSHA rules. Documentation of this training shall be submitted to EH&S.
   
   **B.** Include other training elements specific to this project.

8. **PRODUCTS AND MATERIALS**
   
   **A.** Plastic sheeting - 10 mil or greater polyethylene sheeting (add UV resistant).

9. **REMOVAL AND DISPOSAL OF TANK(S)**
   
   **A.** All work performed shall be in accordance with DEQ’s Underground Storage Tank Rules.
   
   **B.** The Contractor shall furnish all labor, materials, necessary permits, laboratory tests, reports, and equipment to complete the work as defined in the project scope.
   
   **C.** All the plans described in Part 2 and Part 3. of Section 2100-Underground Storage Tank Removal and Disposal shall reside in the Contractor’s field office.

10. **EXCLUSION ZONE (EZ) AND CONTAMINATION REDUCTION ZONE (CRZ)**
    
    **A.** The limits of an Exclusion Zone (EZ) and the Contamination Reduction Zone (CRZ) shall be established by the Contractor, but approved by EH&S.
    
    **B.** Personnel who are not directly involved in the work described herein shall not be permitted to enter the EZ and CRZ.
    
    **C.** The equipment and personnel within the CRZ shall be cleaned as described in 11 – Personnel Protection.
    
    **D.** The Contractor’s site office or parking area shall not be stored in the EZ or CRZ.
    
    **E.** The boundary of the EZ and CRZ shall be fenced with temporary fencing as needed.
    
    **F.** The temporary fencing shall be clearly marked and posted with the appropriate signs that demonstrate a restricted work area. The sign shall include the phone
number of the OSU Work Coordination Center.

11. PERSONNEL PROTECTION
   A. All personnel assigned to perform work as described herein have the responsibility to have and appropriately use the necessary personal safety equipment and protective clothing.
   B. No one is permitted entry into the EZ or CRZ without the required and appropriate personal safety equipment or protective clothing.
   C. All personnel and equipment shall be decontaminated before exiting the EZ and/or CRZ.

12. FIRST AID AND EMERGENCY RESPONSE EQUIPMENT AND PROCEDURES
   A. The appropriate emergency first aid equipment for treatment of exposure to site physical and chemical hazards shall be located in the Contractor’s field office and readily accessible.
   B. A list of emergency phone numbers and points of contact for fire, hospital, police, ambulance, and other necessary contacts shall be clearly posted in the Contractor’s field office or job site.
   C. A route map that details the directions to the nearest medical facility shall be clearly posted in the Contractor’s field office and site vehicles.
   D. In an emergency, take action to remove or minimize the cause of the emergency, alert OSU EH&S, and institute necessary measures to prevent repetition of the emergency.

13. IGNITION SOURCES
   A. Do not permit ignition sources in the EZ and CRZ.

14. TEMPORARY CONTAINMENT OF EXCAVATED SOIL
   A. EH&S shall designate and approve the location of the temporary containment area prior to the start of any work.
   B. The containment area shall be covered with 10 mil or greater polyethylene sheeting.
   C. The excavated soil shall be placed on an impervious barrier and covered with 10mil or greater polyethylene sheeting.
   D. Straw bales or other material suitable to secure the edge of the containment area from seepage or spills shall be placed along the outer limits of the containment area.
   E. The area will be restored to a pre-project state upon completion of the project.

15. EXCAVATION – refer to Section 31050 – Earthwork
16. **TESTING**
   A. Stockpiled soils.
   B. Testing of underground tank(s) after removal of tank(s).
   C. Testing along piping and other system components.
   D. Testing of soils surrounding underground location of tank(s).
   E. Additional testing as requested by EH&S.

17. **WATER DISPOSAL**
   A. Dewatering will be permitted only with approval of EH&S.
   B. Water generated during removal of tank(s) and piping shall be stored and tested prior to its disposal.
   C. If contaminated, transport and dispose of water in accordance with local, State, and Federal laws and requirements.
   D. Non-contaminated water may be disposed of on-site at an approved location.

18. **SECURING TANK SYSTEM**
   A. Any stored product shall be removed from the tank(s) using the following methods:
      01. Drain product lines into the tank(s).
      02. Remove liquid and sludge from the tank(s) in accordance with this Section and all applicable local, State, and Federal laws and regulations for the work being performed.
      03. Remove flammable or combustible liquids in a secure and safe manner in accordance with this Section and all applicable local, State, and Federal laws and regulations for the work being performed.
      04. Include other securing methods or procedures specific to this project.
      05. If it is acceptable to fill the tank(s) with sand and cap the associated connections and piping such as fill pipe, gage pipe, tank vapor recovery fitting, etc, include such language to permit such a procedure.

19. **INSPECTIONS**
   A. The Contractor shall arrange for all required inspections in accordance with all applicable permits, and local, State and Federal laws and requirements.

20. **CLOSURE REPORT (SITE ASSESSMENT REPORT)**
   A. The Contractor shall provide EH&S a Closure Report that includes the field reports, records, inspections, or other documents obtained during the completion of the work described herein. Documents to be included in the report include, but are not limited to
   B. Description of work completed including removal procedures, number of tank(s) removed, identification of tank(s) removed and disposed of, cubic yards of excavated soil, location of disposal site, and dates of excavation.
      01. OSU EH&S may request additional information upon review of the report.
02. Site plan showing location of excavation, location of sampling points, results of excavation and depths.
03. Sampling and testing reports, data and test results from the laboratory testing.
04. Tank(s) disposal paperwork, contaminated soil disposal paperwork and any other documents required to comply with local, State, and Federal laws and regulations.

21. BACKFILL
   A. Backfill excavated area in accordance with Section 3.11 – Excavation.
Section 02120 – ASBESTOS REMEDIATION

1. REQUIREMENTS
   A. On every project involving existing OSU facilities the Project Manager shall ask that OSU Facilities Services Environmental Health & Safety (EH&S) survey for the existence of asbestos.
   B. No removal of building materials or building systems shall occur without the inspection for asbestos-containing material by the EH&S, OR by an independent consultant as directed by EH&S.
   C. All asbestos containing material that needs to be removed in support of any project will be coordinated by EH&S. Exemptions for OR-OSHA Class 2 asbestos work can be made by the University.
Section 07100 – ROOFING AND WATERPROOFING

1. REQUIREMENTS

A. Note: indicate applicable American Society for Testing and Materials (ASTM) specification in this section.
   01. Fire resistance based on ASTM E-108
B. Note: indicate applicable 2004 Oregon Structural Specialty Code (2003 IBC, as amended)
C. Note: indicate applicable Underwriters’ Laboratory (UL)
   01. Fire resistance based on UL- 790
D. Note: Indicate applicable Factory Mutual (FM) specifications
   01. Wind uplift criteria based on FM 1-90
E. Note: indicate applicable National Roofing Contractors Association standards.
F. LEED® Credit SSC-72 for Energy Star Roof – compliant or Green Roof, or as Directed by OSU.
G. No new clay tiles roof are permitted
H. All work described in this standard shall comply with the current editions of the following codes as adopted by the City of Corvallis Municipal Code and the latest edition of the International Building Code
I. Waterproofing systems shall be used at all building planters, plaza decks, and
J. Any and all overflow drainage from roof shall be managed in accordance with applicable municipal code requirements. All attic and/ or under deck ventilation shall be installed as required to control moisture.
K. Moisture control:
   01. Install condensation control/ vapor retarders as required per the needs of the roof system.
   02. All attic and/ or under deck ventilation shall be installed as required to control moisture.
L. Testing for water tightness and material performance may be required at OSU’s discretion prior to OSU’s acceptance of roofing and drainage systems. Obtain acceptance of testing method from Owner and roofing materials manufacturer
M. Refer to Division 22 for additional information on Roof Drains.

2. Fall Protection:

A. All roofs requiring maintenance must have fall protection from one of the following methods, or a combination thereof:
   01. Parapet wall [preferred]
   02. Guardrails [consider/minimize visibility of the guard rails from the ground or adjacent buildings]
   03. Tie-offs [provide specialized equipment and access from roof hatches]
3. MANUFACTURER QUALIFICATIONS
   A. The Manufacturer’s Roof System Warranty: Single source not less than 20 years, No Dollar Limit (NDL) labor and material for entire system including system and other roof systems.
   B. Manufacturer shall have manufactured products continuously by same company for a period of time not less than ten years.
   C. Manufacturer shall not be in any form of bankruptcy.
   D. Manufacturer shall be the primary manufacturer of the membrane system.

4. ROOFING
   A. All roof designs and specifications shall be reviewed and approved by OSU Project Manager.
      01. All roof projects completed in the OSU National Historic District must be coordinated with Campus Planning.
   B. The existing architecture of the building will be accommodated.
   C. Install attic draft stops as required by Building Code.
   D. For renovation - All roofs shall be provided with code compliant fall protection systems.
   E. For New construction mechanical equipment located on roof be screened by the parapet or screen wall or installed in a penthouse.
   F. All roofs require access for maintenance of equipment, roof drains, etc.
      01. Provide walking/tread pads from point(s) of egress to the roof to point(s) requiring maintenance.
      02. The walking tread pad material must be manufactured by the roof system manufacturer.
      03. The walk pads must be placed in the design, such that all locations requiring maintenance are accessible from the walking surfaces.
   G. All roofs shall be constructed or installed in a manner that provides for positive drainage without ponding or the occurrence of standing water to a drain per all applicable building code requirements and related specifications and standards.

5. ROOF INSULATION
   A. Provide separation board suitable for attachment to structure, as a base for roofing or insulation and to provide for required fire ratings.
   B. All insulation assembly shall meet thermal and fire rating requirements and shall be approved in writing by the roofing manufacturer.
   C. Insulation overlay shall be designed and suitable for the roofing material.
   D. Drainage
      01. Provide required slopes to drain in structure, unless otherwise approved by OSU Project Manager.
      02. Provide tapered insulation and crickets as required to achieve drainage requirements.
E. Ballasted extruded polystyrene inverted insulation system shall meet FM and UL requirements.
F. Install vapor retarder, as required, as part of the roofing assembly.
G. Fasten, adhere, stagger, offset to provide a proper base for roofing and to meet FM and UL requirements.
H. All fasteners shall be increased by 50% in number at all perimeter locations and at corners.
I. Insulation R-Value shall be 20% better than the requirement of the current Oregon Energy Code.

6. LOW SLOPE ROOFING
A. Applied Locations
   01. Use on low slope concrete, steel, wood or insulated roof decks.
   02. Minimum ¼” per foot slope to maximum 1” per foot slope to drain. ¼” per foot is preferred.
   03. Other slopes may be considered and approved by OSU’s Project Manager, if necessary.
   04. Special securement may be required on slopes exceeding ½” per foot.
B. Elastomeric Membrane Roofing:
   01. Use on low slope concrete, steel, wood or insulated roof decks, minimum ¼” per foot slope or as approved by OSU’s project manager.
   02. Vapor Barrier:
   03. Substrate: Separation board, insulation system, overlay board assembly as required to meet Code/energy, wind uplift, fire rating, and manufacturer and OSU requirements as a suitable base for roofing.
   04. Material: EPDM (Ethylene Propylene Diene Monomer) fire rated 60 mils minimum thickness in largest sheets possible.
   05. Application: Fully adhered.
   06. Terminations: All perimeters and roof penetrations at vertical surfaces.
C. Seams
   01. Protective Coating: Elastomeric as approved by membrane manufacturer.
D. Standards
   02. ASTM – Standard Specifications for material Properties.
   03. UL – Fire Hazard Clarifications, Class A.
   04. FM – Roof Assembly Classifications – Class 1-90.
   05. OSSC, Chapter 15 – Roofing and Roof Structures.
   06. Approved Manufacturers: Siplast, Carlisle and Firestone or approved equal.
   07. Bituminous Membrane Roofing (preferred low slope roofing systems):
E. Hot Asphalt Roofing
01. Use of new hot asphalt roofing system is not allowed.
02. Major repairs for hot asphalt roofing systems – must plan and mitigate for odors entering air intakes and/or windows of the building being repaired and adjacent buildings as needed. University’s representative to confer with EH&S on mitigation plan prior to work being commenced.

F. Vapor Barrier

7. METAL ROOFING
A. Applied Locations
01. Use on low slope framing and steel or wood roof decks, minimum three inch (3") per foot slope.
B. System: Sealed standing seams with concealed fastening and provision for expansion and contraction.
C. Precoated Galvanized Steel: 24 gauge minimum core steel, G90 galvanized, Kynar coated.
D. Underlayment: Rosin paper slip sheet, 30# asphalt saturated felt and rosin paper, self adhering underlayment, special underlayments when required by design or manufacturer’s insulation system.
E. Standards
01. NRCA Roofing and Waterproofing Manual – Metal Roof Systems.
03. ASTM B370 – Standard Specification for Copper Sheet and Strip.
05. ASTM A308 – Standard Specification for Terne Coated Steel.
07. ASTM UL580 – Tested for Wind Uplift, Class 90 Rated.
F. System
01. Standing seams or approved design with concealed fastening system; provisions for expansion and contraction.
G. Warranty:
01. Provide 50-year Manufacturer’s warranty
02. Manufacturer’s standard warranty for color

8. STEEP ROOFING
A. Applied Locations
01. Use on steep slope wood roof decks, minimum three inch (3") per foot pitch.
B. Materials
01. Shingles
a. Self-sealing Architectural asphalt or SBS (Styrene-Butadiene-Styrene) modified bitumen, polyester/fiberglass or fiberglass
reinforced, mineral granule surfacing, minimum 245# per 100 square feet, Certainteed Grand Manor or approved.
b. Shingle shall be moss protected and have minimum 50-year manufacturer’s warranty.

02. Underlayment
   a. 30# asphalt saturated roofing felt or breathable underlayment as approved by OSU’s Project Manager
   b. 1 layer for pitches of 4:12 and steeper,
   c. 2 layers for pitches of 3:12 to 4:12, and
   d. Self adhering underlayment for pitches less than 3:12.
   e. Self adhering underlayment at all valleys, eaves and rakes.
   f. Pitches of less than 4:12 are not recommended.

C. Standards

D. Warranty:
   01. Manufacturer’s standard 50 year material warranty
   02. Manufacturer’s standard warranty for color

E. Provide Code required ventilation under sheathing.

F. Insulation:
   01. Insulation is not permitted directly below shingles.
   02. Insulation to be designed and constructed to allow roofing material to function properly throughout warranty period.

9. FLASHING AND COUNTERFLASHING
   A. Systems
      01. Flashing and counterflashings, gutters and downspouts, copings, wall metal as required for the application.
      02. Standing, water shedding, sealed and soldered seams as required for the application.
      03. Expansion joints or other provisions for expansion as required.
      04. Back metal with felt as required.
   B. Materials: As required by application, compatible with roofing materials.
      01. Metals
          b. Terne Coated Carbon Steel: Gauge as required for application.
          c. Terne Coated Stainless Steel: Thickness as required for application.
          d. Stainless Steel: Thickness as required for application.
          e. Copper: Sixteen (16) ounce minimum.
f. Lead: Four (4) pound.

02. Underlayment
03. 30# asphalt saturated roofing felt and rosin paper.
04. 15# where approved by OSU
05. Other breathable underlayment as approved by OSU and self adhering underlayment.

C. Warranty
01. Two-year installation warranty.

10. TIE-OFFS
A. Structures fours stories or greater shall be equipped with roof tie off systems that allow for routine window cleaning on those stories four stories or greater.
Section 08020- General Requirements

PART 1 – GENERAL

1. REQUIREMENTS

A. All electronic access devices shall be Hirsch compatible.
B. All entry devices must be capable of being overridden by an Oregon State University Master Key.
C. All entrances shall be designed with appropriate air locks
D. All Entrances shall have a built in mat and/or dirt catch system
E. All main entrances to new buildings or buildings that are significantly renovated shall include a fully automatic door at main entrance.
F. All other doors to new buildings shall be ADA accessible.
   01. The doors shall have proximity sensors placed at an accessible and appropriate location and centered 33 inches from the finished floor.
   02. All doors shall have levers and power assist if over 5 pounds force is necessary to open
   03. Door operating hardware shall be in an easily and fully accessible location.
PART 1 – GENERAL

1. REQUIREMENTS
   A. Any key locking device e.g., programmers, interrogators, junction boxes, etc must be capable of accepting an OSU – supplied lock.
   B. The main entry of each new building must be equipped with a Knox box for emergency access by the Corvallis Fire Department.
      01. For renovation projects the OSU Project Manager is responsible for contacting the City of Corvallis Fire Marshal to determine of the installation of a Knox box is required.
   C. All exit devices shall be approved by the OSU Key Shop prior to installation.
   D. Fully automatic doors for main entrance, ADA accessible doors for all other, doors should have proximity sensors placed at an accessible an appropriate location and centered 33 inches above finished floor surface.
   E. All new hardware shall be supplied with Best cylinders.
   F. OSU Key Shop shall provide pinning for lock cylinders.
   G. For all remodel projects the existing hardware shall be matched
      01. All SCHLAGE cylindrical lock-sets shall be "D" (Vandlgard) series (Sparta Design). (ADA)
      02. All BEST cylindrical lock-sets shall be "93K" ("14D" Lever) series. (ADA)

2. EQUIPMENT
   A. Electric Strikes with Key Override
      01. All electric strikes with key override shall be set to the OSU system.
      02. Electric strikes shall provide remote release of latch-bolts.
      03. Electric strikes shall be designed for use with the type of locks shown at each opening where required.
      04. Electric strikes shall be UL Listed as Burglary-Resistant Electric Door Strikes and where required shall be UL Listed as Electric Strikes for Fire Doors or Frames.
      05. Faceplates shall be stainless steel with finish, as specified for each opening.
      06. The locking components shall be stainless steel to resist damage and abuse.
      07. Solenoids shall be of the continuous duty type for the voltage specified. Plug connectors will be furnished.
      08. Strikes shall have an adjustable back-box to compensate for misalignment of door and frame.
      09. Strikes must meet (or exceed) ANSI 156.5 and must fit within (a slightly modified) standard ANSI 115.2 cutout.
B. Electro-magnetic Locks
01. All electro-magnetic locks must have a key override set to the OSU system.
02. Must be manufactured by Von Duprin Inc., or an approved equal.
03. Electromagnetic lock enclosure must be surface applied.
04. Lock must be low voltage, 12V-24V dual coil with a tested hold force of no less than 1,800 pounds.
05. Electromagnetic lock must have built-in, as standard, electronics to eliminate residual magnetism and also to provide transient suppression.
   a. Build these devices into doors, jambs, and/or door closers. The Controls for electromagnetic holders shall work in conjunction with fire detection to provide fire/smoke barriers by an automatic door closing.

C. Exit Devices
01. Any mechanical emergency exit device (crash bar) must meet (or exceed) ANSI A156.3, 1984 Grade 1 and match existing hardware.
02. Ensure minimum ADA clearances with door in open position.

D. Lock-sets
01. If mortise lock-sets are specified they shall be supplied with BEST 7 PIN CYLINDERS, regardless of the lock manufacturer.
02. If cylindrical lock-sets are specified, they shall be BEST "93K7" series lever handle lock-sets prepared to receive BEST 7 pin REMOVABLE cores.
03. Lock functions – Series Numbers
   a. Classroom
      1. Schlage D94PD-SPA
      2. Best 93K7R14KS3
   b. Communicating
      1. Schlage D62PD-SPA
      2. Best 93K7S14KS3
   c. Dormitory
      1. Schlage D73PD-SPA
      2. Best 93K7T14KS3
   d. Double Fixed
      1. Schlage D82PD-SPA
      2. Best 93K7W14KS3
   e. Passage
      1. Schlage D10S-SPA
      2. Best 93K7N14KS3
   f. Privacy
      1. Schlage D40S-SPA
      2. Best 93K7L14KS3
   g. Store
      1. Schlage D66PD-SPA
2. Best 93K7G14KS3

h. Storeroom
   1. Schlage D96PD-SPA
   2. Best 93K7D14KS3

i. Twist-push
   1. Schlage D53PD-SPA
   2. Best 93K7B14KS3

j. Vestibule
   1. Schlage D60PD-SPA
   2. Best 93K7C14KS3

04. Best Cylinders
   a. Rim Cylinder – Part # 1E-72
   b. Mortise Cylinder – Part # 1E-74
   c. Dummy Rim – Part # 1E-02
   d. Dummy Mortise – Part # 1E-04

05. Standard Hardware Finishes
   a. Satin Bronze – 612 (US10)
   b. Oil-rubbed Bronze – 613 (US10B)
   c. Satin Chrome – 626 (US26D) – Part # 1E-72
   d. Mortise Cylinder – Part # 1E-74
   e. Dummy Rim – Part # 1E-02
   f. Dummy Mortise – Part # 1E-04

E. Door Closers
   01. LCN LC-4041 Super Smoothee Heavy Duty Door Closer.
   02. Panic hardware shall be Von Duprin 99 series or equal.

F. Automatic Door Actuator Sensors
   01. D-32 "touchless switch", manufactured by Microwave Sensors, Inc.
   02. These sensors are to be installed on exterior public entrances for toilet
        rooms in buildings that accommodate frequent public activities.

G. Card Readers
   01. The controller shall be capable of using proximity readers that output a
        standard 26-55 Bit Wiegand data format.
   02. The readers can have a short or long read range and be uni-directional or
        bi-directional.
   03. The proximity reader shall be a HID model 5355, or a HID Model 5365. In
        either case, it must be protected from attack, and/or concealed from
        view (i.e. mounted behind glass/sheetrock).
   04. Separate reader power is required, 12VDC/180mA. Each reader requires
        a MRIB (MATCH Reader Interface Board) or a MRIA (MATCH Reader
        Interface Assembly).
H. Access Cards

01. All access cards must be HID 1335 Series (ISO DuoProx), 1385 Series (ISO), or 1325 Series (ProxCard II), or, in certain instances may be 1345 Series (KeyFob).

02. All cards must be pre-programmed to match the existing Oregon State University facility code, and must be maintained in sequence.
PART 1 – GENERAL

1. REQUIREMENTS
   A. Any key locking device e.g., programmers, interrogators, junction boxes, etc must be capable of accepting an OSU – supplied lock.
   B. The main entry of each new building must be equipped with a Knox box for emergency access by the Corvallis Fire Department.
      01. For renovation projects the OSU Project Manager is responsible for contacting the City of Corvallis Fire Marshal to determine if the installation of a Knox box is required.
   C. All exit devices shall be approved by the USHS Lock and Key prior to installation.
   D. Fully automatic doors for main entrance, ADA accessible doors for all other, doors should have proximity sensors and touchless switches placed at an accessible an appropriate location and centered 33 inches above finished floor surface.
   E. All new hardware shall be equipped to receive Best or Falcon SFIC cylinders.
   F. UHDS Lock & Key shall provide pinning for lock cylinders.
   G. For all remodel projects the existing hardware shall be matched
      01. All SCHLAGE cylindrical lock-sets shall be "D" (Vandlgard) series (Rhodes Design). (ADA)
      02. All BEST cylindrical lock-sets shall be "93K" ("15D" Lever) series. (ADA)

2. EQUIPMENT
   A. Electric Strikes with Key Override
      01. All electric strikes with key override shall be set to the UHDS system.
      02. Electric strikes shall provide remote release of latch-bolts.
      03. Electric strikes shall be designed for use with the type of locks shown at each opening where required.
      04. Electric strikes shall be UL Listed as Burglary-Resistant Electric Door Strikes and where required shall be UL Listed as Electric Strikes for Fire Doors or Frames.
      05. Faceplates shall be stainless steel with finish, as specified for each opening.
      06. The locking components shall be stainless steel to resist damage and abuse.
      07. Solenoids shall be of the continuous duty type for the voltage specified. Plug connectors will be furnished.
      08. Strikes shall have an adjustable back-box to compensate for misalignment of door and frame.
      09. Strikes must meet (or exceed) ANSI 156.5 and must fit within (a slightly modified) standard ANSI 115.2 cutout.
B. Electro-magnetic Locks
01. All electro-magnetic locks must have a key override set to the UHDS system.
02. Must be manufactured by Von Duprin Inc., or an approved equal.
03. Electromagnetic lock enclosure must be surface applied.
04. Lock must be low voltage, 12V-24V dual coil with a tested hold force of no less than 1,800 pounds.
05. Electromagnetic lock must have built-in, as standard, electronics to eliminate residual magnetism and also to provide transient suppression.
   a. Build these devices into doors, jambs, and/or door closers. The Controls for electromagnetic holders shall work in conjunction with fire detection to provide fire/smoke barriers by an automatic door closing.

C. Exit Devices
01. Any mechanical emergency exit device (crash bar) must meet (or exceed) ANSI A156.3, 1984 Grade 1 and match existing hardware.
02. Ensure minimum ADA clearances with door in open position.

D. Lock-sets
01. If mortise lock-sets are specified they shall be designed to received BEST or FALCON 7 PIN CYLINDERS, regardless of the lock manufacturer.
02. If cylindrical lock-sets are specified, they shall be BEST "93K7" series lever handle lock-sets prepared to receive BEST OR FALCON 7 pin REMOVABLE cores.
03. Lock functions – Series Numbers
   a. Classroom
      1. Schlage D94PD-RHO
      2. Best 93K7R15DS3
   b. Communicating
      1. Schlage D62PD-RHO
      2. Best 93K7S15DS3
   c. Dormitory
      1. Schlage D73PD-RHO
      2. Best 93K7T15DS3
   d. Double Fixed
      1. Schlage D82PD-RHO
      2. Best 93K7W15DS3
   e. Passage
      1. Schlage D10S-RHO
      2. Best 93K7N15DS3
   f. Privacy
      1. Schlage D40S-RHO
      2. Best 93K7L15DS3
Division 08 – Openings

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g. Store
1. Schlage D66PD-RHO
2. Best 93K7G15DS3

h. Storeroom
1. Schlage D96PD-RHO
2. Best 93K7D15DS3

i. Twist-push
1. Schlage D53PD-RHO
2. Best 93K7B15DS3

j. Vestibule
1. Schlage D60PD-RHO
2. Best 93K7C15DS3

04. Best Cylinders
   a. Rim Cylinder – Part # 1E-72
   b. Mortise Cylinder – Part # 1E-74
   c. Dummy Rim – Part # 1E-02
   d. Dummy Mortise – Part # 1E-04

05. Standard Hardware Finishes
   a. Satin Bronze – 612 (US10)
   b. Oil-rubbed Bronze – 613 (US10B)
   c. Satin Chrome – 626 (US26D) – Part # 1E-72
   d. Mortise Cylinder – Part # 1E-74
   e. Dummy Rim – Part # 1E-02
   f. Dummy Mortise – Part # 1E-04

E. Door Closers
01. LCN LC-4010 and 4110 Super Smoother Heavy Duty Door Closer (LCN 4000 Series includes 4010 and 4110 used at UHDS).
02. Panic hardware shall be Von Duprin 99 series or equal.

F. Automatic Door Actuator Sensors
01. MS Sedco #216 Touchless Switch
02. These sensors are to be installed on exterior public entrances for toilet rooms in buildings that accommodate frequent public activities.

G. Card Readers
01. The controller shall be capable of using proximity readers that output a standard 26-55 Bit Wiegand data format.
02. The readers can have a short or long read range and be uni-directional or bi-directional.
03. The proximity reader shall be an HID model 5355, 5365, 5375, 5395 and 6005 HID Readers. Whichever case, it must be protected from attack, and/or concealed from view (i.e. flush mounted with polycarbonate lens or cover (any exceptions must be approved by UHDS and project manager).
04. Separate reader power is required, Von Duprin PS873, Altronix models, and AlarmSaf models depending on application. Each reader requires a MRIB (MATCH Reader Interface Board) or a MRIA (MATCH Reader Interface Assembly).

H. Access Cards
01. All access cards must be HID 1335 Series (ISO DuoProx), 1385 Series (ISO), or 1325 Series (ProxCard II), or 1345 Series (KeyFob).
02. All cards must be pre-programmed to match the existing Oregon State University facility codes, and must be maintained in sequence.
Section 08200 – Windows

PART 1 - GENERAL

1. REQUIREMENTS
   A. Windows must meet the Oregon State Energy Code requirements and the requirements of the State Energy Efficiency Design model for the building.
   B. All windows to be Tinted low "E" glass.
   C. All Window frames shall have a thermal break.
   D. No wire-glass windows are permitted.
   E. All window glass/glazing should have 5-year warranty.
1. REQUIREMENTS
   A. Provide access panels in non-accessible ceilings wherever there is equipment or a device that needs maintenance (valves, dampers, junction boxes, terminal units, etc.).
   B. Access panel shall be, at a minimum a 12” x 12” panel where the equipment or device is less than 18” from the finished ceiling.
   C. Use 24” x 24” access panels where the equipment or device is more than 18” from the finish ceiling and where equipment or device has a panel or door that needs to be opened or removed for service.
   D. Use a minimum of 8” x 8” access panels in walls to access valves or other appurtenances.
   E. Locate access panels directly under or in front of the equipment or device.
   F. Panels shall be sized to accommodate the largest piece of equipment. The location of access panels shall be reviewed by the Project Manager and PRT to ensure the location is accessible for maintenance and operation requirements.
   G. Final location of access panel shall be determined on site by project manager and EHS construction safety officer prior to installation.
Section 09050 – ACOUSTICAL CEILINGS

PART 1 – GENERAL

1. REQUIREMENTS
   A. Commercial grade ceiling assembly meeting (current Oregon adopted IBC Standards.) Typical
   B. All supporting components must be certified as UL approved.
   C. Light fixtures, ceiling mounted diffusers (or grills) and other openings in the ceiling must be supported in compliance with Oregon current IBC Standard s25-2.
   D. Supply & Install Armstrong No. 895, 2’ X 4’ ceiling panels as standard. Armstrong Prelude XL Fire Guard 15/16” is approved by ICBO.
   E. T-bar ceilings shall be full size T’s - need to be 15/16” grid heavy duty.
Section 09100 – REFLECTED CEILING PLANS

PART 1 – GENERAL

1. REQUIREMENTS
   A. The architect shall provide normal reflective ceiling plans.
   B. The reflective ceiling plans shall locate lighting fixtures, sprinkler heads, supply air diffusers, return air registers and all equipment mounted to or suspended from the ceiling.
   C. Lighting located to serve work stations may determine the direction of a ceiling grid pattern.
   D. Lighting located to serve work stations may influence location of fire sprinkler heads.
   E. Lighting located to serve work stations may influence supply and return air inlets and outlets.
   F. Orientation of the lighting fixtures may dictate that the ceiling grid be broken to accommodate some lighting fixtures.
Section 09150 – ROOM NUMBERING

PART 1 – GENERAL

1. REQUIREMENTS
   A. OSU has a specific system of numbering rooms within a building. Contact the Facilities Services Project Manager to arrange floor plan review for a numbering appointment.
   B. This designation should be done before submittal of 50% development documents. The OSU system will allow for changes in plan without disrupting the numbering of other spaces.
Section 09200 – PAINTS AND COATINGS

PART 1 – GENERAL

1. REQUIREMENTS
   A. Plans shall designate color and sheen to be used.
   B. Coat/seal all items prior to installation as much as able; special consideration(s) required in occupied buildings. At pre-construction meeting define plans to reduce impact to building users regarding application of finishes, paints, adhesives, etc.
   C. Paints should be selected for maximum durability (infrequent repainting) and minimum environmental and human impact for the given application. Consider ventilation, exposure to physical damage, vandalism potential, liquids, likely maintenance frequency, etc.
   D. Water based finishes only for interior and onsite applications.
   E. The following paint manufacturers are acceptable:
      01. Benjamin Moore
      02. Flecto (UHDS)
      03. Miller
      04. Pittsburgh
      05. Rust-Oleum
      06. Sherwin-Williams
   F. OSHA Safety Colors:
      01. All colors should conform to OSHA and ANSI specifications and are available in IronClad Quick Dry Industrial Enamel (071).
   G. Low VOC materials are to be used; zero VOC when available. Paint containing 5 grams/liter or less is considered "Zero VOC", according to the EPA Reference Test Method 24. On new construction or major remodels, follow applicable LEED criteria for low or zero VOC paint.
   H. The finish manufacturer’s recommendations for acceptable moisture ranges prior to application / installation shall be followed. Moisture testing on concrete, substrate, etc. is required prior to installation of finishes and results must be submitted to the Facilities PM.
   I. Covering or painting of any signs, labels, identification, etc. requires replacement.

2. APPROPRIATE PAINT APPLICATION BY AREA
   A. Interior surfaces
      01. OSU requires ceilings and walls in general purpose areas (offices, classrooms, conference rooms, break rooms, lobbies, hallways, etc) to receive low or zero VOC paint.
02. Doors, door frames, hand rails, corner trim, floors, certain lab surfaces and other areas exposed to high or frequent impact may receive higher durability products. These products may or may not be low or zero VOC.

B. Exterior surfaces

01. Exterior surfaces should be painted with products appropriate for the substrate and exposure to weather, vandalism, graffiti and other elements.

02. Minimum 15 year durability paint on all exterior surfaces. Acceptable paints include Benjamin Moore MoorGard; Miller Evolution-exterior; and Sherman Williams Duration.

03. Exterior metal accessories and/or furnishings shall be galvanized or powder coated; no painted finish.
   a. Galvanized when accessories are poured in place and/or not removable for refinishing.
   b. Powder coated when accessories are removable for refinishing.

C. Pavement Markings

01. Pavement markings that are painted on parking lot or road surfaces shall be applied using:
   a. Sherwin Williams, Setfast Waterborne pavement marking paint.
   b. Touchups and small applications can be made using Sherwin Williams SherLiner solvent based aerosol inverted spray cans.

02. Thermal Pavement Markings
   a. Thermal (melt down) pavement markings are supplied by either 3M or Flint Trading INC and are applied according to manufacturer’s specifications.
Section 09300 – FLOOR COVERINGS

PART 1 – GENERAL

1. REQUIREMENTS
   A. All floor coverings must be asbestos free.
   B. Material that is manufactured overseas shall be certified to be asbestos free prior to delivery. Low VOC adhesives shall be used for flooring installation. Concrete sealer shall be applied to slab on grade concrete if modular carpet or tile will be applied on top of it.
   C. Indoor hallways, classrooms, elevators, dining rooms -- vinyl tile or linoleum (Marmoleum preferred) flooring. Restrooms -- Ceramic or seamless flooring. Modular carpet is acceptable in classrooms needing acoustic dampening.
   D. Resilient Flooring: Chemical-use laboratories, glass wash or other areas where liquids are used or stored shall have watertight flooring. Provide seam sealed sheet vinyl or linoleum flooring or equivalent with at least a 4-inch continuous cove. Flooring material to be compatible with the chemicals or other materials to be used or stored and to be a tested and recognized flooring material for the anticipated use.
   E. Modular carpet (carpet tiles) should be used. No wall-to-wall carpet shall be installed. The number of transitions from hard to soft flooring shall be minimized. Avoid installing carpet on concrete below grade or on basement floors.
   F. Color will be determined on a case by case basis; however, attempts should be made to coordinate the existing color scheme. Extra materials overage of 2-5% will be provided. Materials should require minimum maintenance and should comply with industry cleaning standards methods.
   G. No raised flooring floor coverings.
   I. Polished or stained concrete in public areas shall be considered.
   J. Flooring choices must take into consideration traction and slip-resistant properties to minimize incidents.
Section 10300 – BATHROOM ACCESSORIES

PART 1 – GENERAL

1. REQUIREMENTS
   A. Floor drain.
   B. Ceramic or Seamless floor.
   C. Keyed hot water hose bib under sink.
   D. Wall-mounted partitions, preferred.
   E. Isolation valves.
   F. Architect to show location, elevations, and correct size of bathroom accessories on plans.
   G. Built-in dispensers will not be allowed

2. BATHROOM EQUIPMENT (to be supplied by Facilities Services or Contracted Service Provider as appropriate):
   A. Toilet seat cover dispenser, white #710 ½ fold.
   B. Paper towel dispenser, single-fold -- Fort Howard 567-01.
   C. Dispenser, soap – GJ5150; special order (3 week lead time) through Coastwide (541-926-3289).
   D. Roll towel dispenser, -- Fort Howard 565-53.
   E. Tampon dispenser, RT 30, HST 25v.
   F. Dispenser, sanitary 8” pad, NSIE #8-H.
   G. Sanitary can – garbage step-on lid, white, plastic liner.
   H. Toilet paper dispenser, roll – GP53771; special order (3 week lead time) through Coastwide (541-926-3289).
Section 10500 – INTERIOR SIGNS

PART 1 – GENERAL

1. REQUIREMENTS
   A. OSU has an interior sign system that is consistent with all new and remodeled campus buildings constructed since 1991.
   B. This sign system is manufactured by Innerface Architectural Sign Systems; 5320 Webb Parkway; Lilburn, GA 30047, Phone (800) 445-4796, FAX (770) 279-1327. The signs are a vandal resistant system, meet existing ADA regulations and OSU requirements for graphic clarity. Sign colors are left up to the building design team, however the size, shape and style will remain consistent with other interior building signage.
   C. The use of self-luminous exit signs containing radioactive material is prohibited unless specifically approved by Environmental Health & Safety (EH&S).
   D. All signage will follow the ADA Accessibility Guidelines for Buildings and Facilities (ADAAG) section 4.30.

2. TYPES OF SIGNS
   A. Room Hazard Signage
      01. Utilize Module 8.11 (wall mount) to accommodate an 8.5” x 11” insert; inserts to be provided by Environmental Health & Safety (EH&S).
      02. Signs to be mounted at each room entrance
      03. Signs to be 49” high (to sign bottom) on door knob side and below room number signage
   B. Emergency Evacuation Sign
      01. All campus buildings over one story high shall have building evacuation signs posted on every floor. The signs shall be posted at all stairway and elevator landings and immediately inside all public entrances to the building. The insert for the holder shall conform to the following criteria to comply with state regulations:
         a. Show floor plan for the level on which it is placed. Should be easy to see immediately by someone entering that floor of the building.
         b. Place signs no more than 4 feet above finished floor.
         c. Make sign’s lettering at least 3/16 inch high in a sans-serif font. The words shall be in sharp contrast to the background and easy to read.
         d. Include emergency procedure information for the physically disabled.
         e. Indicate the locations of exits and fire alarm pull stations.
         f. If there are elevators on the floor, state they are not to be used during emergencies.
g. Other pertinent information may be added to the sign, such as location of fire extinguishers, hazardous material spill kits or emergency preparedness equipment.
Section 11050 – FUME HOODS
PART 1 – GENERAL

1. REQUIREMENTS FOR RENOVATION

A. Building-wide

01. Each hood or local exhaust system used to control exposure of humans to hazardous chemicals, radioactive materials, or other detrimental materials must be approved at the pre-design phase and after installation by Environmental Health & Safety (EH&S).

02. Hoods shall be of the latest design, good quality, and produced by a reputable manufacturer. A list of acceptable hood models is maintained by EH&S.

03. Auxiliary air hoods that have the makeup air supplied at the hood face shall not be used.

04. Ductless hoods shall not be used for protection against chemical or radioactive materials.

05. Hood shall be constructed of appropriate materials resistant to chemicals and heat, and compatible with the anticipated use.

06. Exhaust velocity at the hood face will be DESIGNED to 120 linear feet per minute (LFPM) at a sash height of 18 inches above the lower air foil.

07. Exhaust velocity at the hood face will be a minimum of 100 LFPM at a sash height of 15 inches above the lower air foil.

08. Each hood must have an electronic flow indicator that is visible to the hood user. Monitor type must allow for two-point calibration without changing hood flow. Calibration of the flow monitor will be performed during room balancing.

09. Hood exhaust shall be separate from building exhaust systems except in hazardous (H occupancy) areas requiring minimum ventilation rates. In this case, the hood exhaust can be used as part of the required exhaust volume.

10. Hoods used for perchloric acid, high levels of radioactive isotopes, high hazard carcinogens, pathological materials, or large quantities of flammable liquids shall be exhausted separately from general laboratory fume hoods.

11. Hood exhaust ducts shall be negatively pressurized within the building.

12. Exhaust stack height must be a minimum of 16 feet above the standing surface at the fan location. If a major accessible portion of the building within 50 feet is higher, the stack must extend 16 feet above the standing surface of the HIGHER portion.

13. No diversion caps (e.g., “china hat”) are allowed on hood stacks.

14. Booster exhaust fans in hood exhaust ducts shall not be used inside the building envelope.
15. Backflow prevention devices shall not be installed in ducts as the only means to prevent reverse airflow.

16. Hood filters will not be used unless absolutely required.

17. Filter boxes will be located to allow safe and efficient access for filter change, and design will allow for safe bag-in/bag-out procedures.

18. Specific approval for hood filter applications must be obtained from Environmental Health & Safety.

19. An adjustable damper must be provided in the individual branch duct serving each hood. It should be located such that the hood user cannot change the setting.

20. Room balance and room-to-room balance shall be maintained throughout operating range of hoods.

21. Outside air supply will be adjusted relative to exhaust air to make up for hood exhaust.

22. When there are multiple hoods in a building use make-up and heat recovery systems and/or variable volume exhaust systems, where practicable, to maintain energy efficiency.

23. A building-wide system shall monitor and control building static air pressure.

24. Hood interior lighting is to be uniform within the work cavity, as available from manufacturer.

25. Light fixtures to be accessible and maintainable externally to the hood cavity.

26. Light fixture type is to be T-8 energy efficient fluorescent type with electronic ballast.

27. A label at the Motor Control Center will identify which room(s) the fan services.

28. A label on fan unit will identify all room numbers of fume hoods served.

29. Identification labels are to be indelible, non-fading and installed on the north side of exterior housings whenever possible.
1. **REQUIREMENTS**

A. **Motor Bearing Protection:** Motors connected to variable frequency drives (VFD) shall have their bearings protected from the effects of metal removal caused by current flow. Protection shall be any of the following methods:
   01. Externally applied electrical shunt between the motor frame and shaft. Shaft Grounding Systems or approved.
   02. Electrically insulated bearings rated for the mechanical and electrical application. Electrical resistance shall be sufficient to prevent current flow, including current flow from "skin effect", induced by VFD.

B. All electric motors shall be high efficiency motors, 3 horsepower and larger to be 3 phase motors rated for inverter duty.

C. All 7.5 HP motors and larger shall use soft starts or variable frequency drives to start the motor, except for continuous use motors (motors that run at 100% - exception on approval of the OSU Electric Shop).

D. All starters shall use standard heaters, to determine motor current and overload trip conditions. (Exceptions: for phase failure and over/under voltage conditions, electronic overloads may be permitted on approval of the OSU Electrical shop.)

E. **Self-protection and Reliability Features:**
   01. Input transient protection by means of surge suppressors.
   02. Snubber networks to protect against malfunction due to system voltage transients.
   03. Notch filter to prevent operation of the controller-motor-load combination at a natural frequency of the combination.
   04. Loss of Phase Protection.
   05. Reverse Phase Protection.
   06. Under- and Over-Voltage Trips.
   07. Over-temperature Trip.
   08. Short Circuit Protection.
      a. **Automatic Reset/Restart:** Attempt 3 restarts after a controller fault or on the return of power to the system following an interruption and before shutting down for manual reset or fault correction. Provide for restarting during deceleration without damage to the controller, motor, or load.
      b. **Power interruption Protection:** Prevent motor reenergizing after a power interruption until the motor has stopped.

F. **Programming:**
   01. The operator shall have the ability to program drive with a computer link e.g. RS-232 or approved.
   02. A back-up program and software shall be provided.
03. Toshiba, Cutler Hammer, ABB, Square D, and GE are approved manufacturers for all motor starter, soft starts, and VFD’s. All drives will be supplied with manufacturer’s approved magnetic bypass.

04. OSU personnel are to be provided appropriate levels of on-site training for new equipment or new technology.
Section 11150 – FLAMMABLE AND CORROSIVE STORAGE CABINETS

PART 1 – GENERAL

1. REQUIREMENTS
   A. Flammable storage cabinets must be UL listed and/or NFP: A approved.
   B. Flammable storage cabinets are not required to be ventilated. If cabinet is to be vented, it must be ducted into the fume hood exhaust system above the fume hood trim damper.
   C. Corrosive chemical storage cabinets (acids and bases) require venting.
Section 11200 – BIOLOGICAL SAFETY CABINETS

PART 1 – GENERAL

1. REQUIREMENTS
   A. All biological safety cabinets shall meet the specifications within the most recent edition of the National Sanitation Standard 49 – Class II (Laminar Flow) Biohazard Cabinetry.
   B. The following biological safety cabinet manufacturers are currently approved for campus:
      01. Baker, Nu-Aire, and Forma or equal. Manufacturer’s specifications for specific model types shall be submitted to OSU EH&S for pre-approval. The University’s Representative (Project Manager) must acquire pre-approval from OSU EH&S for any “equal” substitution.
      02. Biosafety cabinet face velocity shall be maintained at no less than 100 fpm at all times during operation.
      03. Each cabinet shall be equipped with one front mounted magnahelic gauge indicating the differential pressure across the filter.
      04. The noise level as measured 12 inches in front of the cabinet and 15 inches above the work surface shall not exceed 67 dBA.
      05. All biosafety cabinets must be tested per National Sanitation Foundation (NSF) Standard 49 or manufacturer’s specifications after installation. The University’s Representative should forward the testing results to OSU EH&S for review.
   C. Class II Type B biosafety cabinets must be installed on a dedicated exhaust system.
   D. Exhaust in-place HEPA filters must be of the bag-in/bag-out type.

2. CLASSES AND TYPES OF BIOLOGICAL SAFETY CABINETS
   A. Class II Type A1 cabinets (formerly designated Type A)
      01. Maintain minimum average inflow velocity of 100 fpm (0.5 m/s) through the work access opening;
      02. Have HEPA filtered downflow air that is a portion of the mixed downflow and inflow air from a common plenum (i.e., a plenum from which a portion of the air is exhausted from the cabinet and the remainder supplied to the work area);
      03. May exhaust HEPA filtered air back into the laboratory or to the environment through an exhaust canopy; and
      04. May have positive pressure contaminated ducts and plenums that are not surrounded by negative pressure plenums.
      05. Type A1 cabinets are not suitable for work with volatile toxic chemicals and volatile radionuclides.
   B. Class II, Type A2 Cabinets (formerly designated Type B3)
01. Maintain a minimum average inflow velocity of 100 fpm (0.5 m/s) through the work access opening;
02. Have HEPA filtered downflow air that is a portion of the mixed downflow and inflow air from a common exhaust plenum;
03. May exhaust HEPA filtered air back into the laboratory or to the environment through an exhaust canopy; and
04. Have all biologically contaminated ducts and plenums under negative pressure or surrounded by negative pressure ducts and plenums.
05. Type A2 cabinets used for work with minute quantities of volatile toxic chemicals and tracer amounts of radionuclides required as an adjunct to microbiological studies must be exhausted through properly functioning exhaust canopies.

C. Class II, Type B1 Cabinets
01. Maintain a minimum average inflow velocity of 100 fpm (0.5 m/s) through the work access opening;
02. Have HEPA filtered downflow air composed largely of uncontaminated recirculated inflow air;
03. Exhaust most of the contaminated downflow air through a dedicated duct exhausted to the atmosphere after passing through a HEPA filter; and
04. Have all biologically contaminated ducts and plenums under negative pressure or surrounded by negative pressure ducts and plenums.
05. Type B1 cabinets may be used for work treated with minute quantities of volatile toxic chemicals and tracer amounts of radionuclides required as an adjunct to microbiological studies if work is done in the direct exhausted portion of the cabinet, or if the chemicals or radionuclides will not interfere with the work when recirculated in the downflow air.

D. Class II, Type B2 Cabinets (sometimes referred to as “total exhaust”)
01. Maintain a minimum average inflow velocity of 100 fpm (0.5 m/s) through the work access opening;
02. Have HEPA filtered downflow air drawn from the laboratory or the outside air (i.e., downflow air is not recirculated from the cabinet exhaust air);
03. Exhaust all inflow and downflow air into the atmosphere after filtration through a HEPA filter without recirculation in the cabinet or return to the laboratory; and
04. Have all contaminated ducts and plenums under negative pressure or surrounded by directly exhausted (nonrecirculated through the work area) negative pressure ducts and plenums.
05. Type B2 cabinets may be used for work with volatile toxic chemicals and radionuclides required as adjuncts to microbiological studies.

E. Class III Cabinets (Glove Boxes)
01. A totally enclosed, ventilated cabinet of leak-tight construction. Operations in the cabinet are conducted through attached rubber gloves. The cabinet is maintained under negative air pressure of at least 0.50 in. w.g. (120 Pa). Downflow air is drawn into the cabinet through HEPA filters. The exhaust air is treated by double HEPA filtration or by HEPA filtration and incineration.

02. A glove box may also be required for special applications using highly toxic, extremely reactive or regulated carcinogens.


3. SPECIALTY HOODS AND LOCAL EXHAUST/SNORKEL HOODS

A. General

01. Histology hoods, specimen hoods, and other local exhaust specialty hoods require a minimum operating face velocity of 100 fpm with a range of 100-120 fpm.

02. An audible/visual flow alarm may be required depending on intended use.

B. Placement

01. Locate biological safety cabinets at least six feet from doors and high-traffic areas and away from open-able windows, fume hoods, or other draft producing laboratory equipment. Locate so that air supply/exhaust diffusers do not affect airflow at the BSC face (laminar diffusers preferred). If more than one OSC will be installed, situate BSCs across from each other rather than adjacent.

02. Provide at least 12 inches of clearance above the BSC for testing and decontamination of HEPA filters. Set six inches out from the rear wall to allow for cleaning and adequate air return.

03. Biological safety cabinets that are hard-ducted or connected by a thimble connection to the ventilation system must be designed so the duct work does not interfere with air flow or block access to the exhaust filter for testing of HEPA filter integrity.
Section 12500 – Site Furnishings

PART 1 - GENERAL

1. REQUIREMENTS
   A. The products identified herein are the preferred products for placement on OSU campus. Substitutions may be made provided the vendor, contractor, designer, etc receives written approval from the Campus Planning Manager for the suggested substitution.
   B. The paint color for all furnishing, regardless if substitution is granted, is to be:
      01. OSU Black – Paint: Sherwin Williams Tricorn Black # 6403-23028; 50% gloss. Powder coat: Cardinal BK78 Black.
      02. OSU Orange – PPG # 90-313 – “Safety Orange”.
   C. The approved list for site furnishings shall be provided to the designer/architect/engineer from the OSU Project Manager.
   D. Cast in place retaining walls/seat walls and benches must be chamfered with grooves, for sufficient depth installed on all edges, to deter skateboards.
      01. Continuous surface/edge without skate deterrent must not exceed 4’.
   E. For monument signs refer to Section 32250
   F. All site furnishings will be designed with an appropriately engineered footing, where required.
   G. At a minimum there shall be a trash receptacle and recycling bin at every entry to the building.

2. EXTERIOR SIGNAGE
   Oregon State University requires an effective system of visual communication that projects a uniform institutional identity, while at the same time integrating well with the present and future campus environment. OSU shall be requested, designed and installed by Facilities Services. The following requirements identify how exterior signage will be applied to the OSU main campus.
   A. Monument signs are considered the main building identification and will only include building name, abbreviation and street address.
      01. Minimum setback for primary identification signs from the curb face shall be two (2) feet.
      02. Minimum separation between primary identification signs shall be 100 feet.
   B. Directional Signs provide direction to parking lots, buildings, and athletic and/or event facilities within a specific location and include the following requirements:
      01. Minimum clearance for these signs located above a pedestrian walkway shall be 10 feet. If a directional sign is attached (such as building, light post, etc.):
         a) If the attached sign projects more than 6 inches, the minimum clearance above a pedestrian walkway shall be 7 1/2 feet;
b) If the attached sign projects more than 1 foot, the edge of the sign face closest to the building shall not project more than 6 inches;
c) No attached sign shall project more than 8 feet from the building face.

02. No direction signs are to be attached to any historic building. (Refer to the OSU Historic Preservation Plan Design Guidelines.)

C. Banners must be mounted on dual arms to a campus light pole.
D. Exterior signs within the historic district must comply with City of Corvallis Land Development Code Chapter 2.9 – Historic Resources. Installation of exterior signs within the historic district to be coordinated with Campus Planning.
Section 12550 – APPROVED SITE FURNISHINGS LIST

PART 1 – GENERAL

1. REQUIREMENTS

Oregon State University requires an effective system of visual communication that projects a uniform institutional identity, while at the same time integrating well with the present and future campus environment. OSU shall be requested, designed and installed by Facilities Services. The following requirements identify how exterior signage will be applied to the OSU main campus.

A. Monument signs are considered the main building identification and will only include building name, abbreviation and street address.
   01. Minimum setback for primary identification signs from the curb face shall be two (2) feet.
   02. Minimum separation between primary identification signs shall be 100 feet.

B. Directional Signs provide direction to parking lots, buildings, and athletic and/or event facilities within a specific location and include the following requirements:
   01. Minimum clearance for these signs located above a pedestrian walkway shall be 10 feet. If a directional sign is attached (such as building, light post, etc.):
      a. If the attached sign projects more than 6 inches, the minimum clearance above a pedestrian walkway shall be 7 1/2 feet;
      b. If the attached sign projects more than 1 foot, the edge of the sign face closest to the building shall not project more than 6 inches;
      c. No attached sign shall project more than 8 feet from the building face.
   02. No direction signs are to be attached to any historic building. (Refer to the OSU Historic Preservation Plan Design Guidelines.)

C. Banners must be mounted on dual arms to a campus light pole.

D. Exterior signs within the historic district must comply with City of Corvallis Land Development Code Chapter 2.9 – Historic Resources. Installation of exterior signs within the historic district to be coordinated with Campus Planning.

This list represents the approved models for site furnishings that may be placed on the OSU campus.


C. Benches:
01. Campus Standard Bench
   b. Each bench should have 3 frame members.
   c. Wood members will be Alaska Yellow Cedar, clear and free of checks and splits. The size of wood members will be one 2 inch (minimum for durability) x 3 inch x 6 feet long, surfaced 4 sides, eased edges.
   d. Fasteners will be galvanized carriage bolts, 1/2 inch diameter with blank round head, and galvanized washers and acorn or cap nuts.

D. Bicycle Racks
01. OSU Campus Standard Bike Racks
   a. 10-foot long Hoop-Style, radius pipe bending, tubular steel Bike Rack. Black powder coated finish; non powdercoat steel requires frequent painting of racks.
   b. Available at Radius Pipe Bending Co.; Prairie Road, Junction City, OR 97448.
   c. All racks to be welded to 2” channel iron base rails. Embedded racks are prohibited.
   d. Specification:

E. Covered Bicycle Racks
01. Signpost: A Unistrut Telespar Quick punch 2” 14 gauge square tubing with two 1/4” x 24” 12 gauge perforated galvanized anchor tubing. The anchor shall not extend more than 4” 2”, (2” anchor left exposed per manufacturers installation recommendation for both single and double breakaway anchors) above finish grade.

F. Street Signage
01. OSU Campus Standard Post: 2” x 2” x 10’, 14 gauge, galvanized steel, quick punch, painted OSU standard site furnishing colors.

G. Monument Sign Size
01. There are (3) sizes for OSU Monument signs. The size of the sign is determined by its location in proximity to the OSU campus boundary as defined by the OSU Campus Master Plan.

02. Monument Signs outside the OSU Boundary: These signs will be visual vehicular traffic where speed may exceed 50 miles per hour. Prior to sign construction a sign permit must be submitted to the City of Corvallis for approval.

03. Monument Signs within the OSU Boundary: These signs are within the OSU campus boundary, but outside of Sector C as identified in the OSU
Campus Master Plan. The City of Corvallis’ Land Development Code identifies an OSU sign exemption boundary, and monument signs within the OSU boundary may fall outside of the City of Corvallis OSU Sign Exemption Area.

04. Monument Signs in Sector C: This location typically has high-pedestrian traffic and less vehicular traffic. Roads within Sector C are OSU-owned and maintained. Monument signs will decrease in scale by 50% of Monument Signs outside of the OSU Boundary, and 25% less for Monument Signs within the OSU Boundary. This location is within the OSU Sign Exemption Area and construction and sign placement can proceed with no required sign permit.

H. Walkway Recycle Bins
01. Outdoor recycle bins should be placed where trash receptacles are planned in landscape design. Outdoor two-section recycle bins hold two Rubbermaid 23 gallon slim jims, have full height internal partition and are constructed as per the following drawing.

I. Construction Sign Specification
01. EH&S has requested the following language be added to the sign:

If you have questions or concerns regarding this construction area, please contact the Facilities Services Work Coordination Center at 541-737-2969.
For after-hours safety concerns, please contact the Department of Public Safety at 541-737-3010.
OSU TYPICAL JOB SIGN

CHILD CARE CENTER

PROJECT ILLUSTRATION
1' - 10" × 1' - 1"

ARCHITECT
LASSO & MILLSДЕLEWIS, LLC
CORVALLIS, OREGON

STRUCTURAL
ENGINEER
DAVIE DUMBERZI STRUCTURAL INC
BEND, OREGON

MECHANICAL
PLUMBING
PORTLAND, OREGON

ELECTRICAL
ENGINEER
HARTLEY ELECTRICAL CONSULTANTS
PORTLAND, OREGON

INTERIOR DESIGN
HOISTS & RODRIGUEZ DESIGN
CORVALLIS, OREGON

LANDSCAPE ARCHITECT
HOPE & BALEY
PORTLAND, OREGON

GENERAL CONTRACTOR
STAYWOOD CONSTRUCTION
BEND, OREGON

PROJECT MANAGEMENT
OREGON STATE UNIVERSITY
FACILITIES SERVICES

MATERIALS

WHITE FIELD

3/4" MDO PLYWOOD

SOLID BLACK LETTERS (TYP)

BLACK 2X2 TRIM

4X4 POSTS PAINT BLACK

GROUND
Section 12600 – ERGONOMIC FURNISHINGS

PART 1 – GENERAL

1. REQUIREMENTS
   A. Stationary workstations in the office/laboratory setting should provide adequate surfaces for ergonomic arrangement of the computer keyboard/pointing device, monitor, and document/work holders.
   
   B. Stationary workstations shall follow good ergonomic principals providing height adjustable work surfaces, openings adequate for leg and knee clearances and sufficient overhead space to allow adjustments to vertical equipment placement. In particular, care shall be given when designing fixed workstations for public contract work activities, such as cashiering, customer service counter and pharmacy.
   
   C. These workstations shall be:
      01. Less than 30 inches wide and adjustable for either seated or standing work.
      
Section 13050 – LABORATORY DESIGNATED EATING AND DRINKING AREAS

PART 1 – GENERAL

1. REQUIREMENTS
   A. For all new laboratory buildings and major laboratory remodels, accommodations should be made to provide clean spaces that are designated as safe eating and drinking areas.
   B. Designated eating and drinking areas should be physically separated from any location where laboratory chemical, biological or radioactive materials are used or stored.
      01. Physical separation can be accomplished by providing a door that prevents direct access between a designated eating/drinking area and a material use or storage location.
      02. The designated area must also be under positive pressure to the material use or storage location and be labeled as a clean space.
      03. A designated eating and drinking area could include but not be limited to a separate common lunch or break room per laboratory suite or floor OR personal office spaces that are separate from material use and storage locations.
      04. Eating areas should be large enough to accommodate the expected number of employees in each laboratory area that it will serve.

2. REGULATIONS AND STANDARDS
   A. OAR Chapter 437, Division 2, Subdivision Z
   B. OSU Campus Policy, Biosafety Manual
Section 13100 – SPECIALTY USE AREAS

PART 1 – GENERAL

1. REQUIREMENTS
   A. Specialty use areas can include laser rooms, high radioisotope use or biosafety level 3 or animal biosafety level 2 or 3. Due to their complex nature, design requirements for specialty use areas should be discussed with EH & S to determine specific needs. Design requirements will vary depending on user activity and the nature of work.
Section 13150 – INTERIOR STORAGE

PART 1 – GENERAL

1. REQUIREMENTS
   A. OSU Buildings must have at least on 600 sq. ft room for general building storage.
   B. 20 amp electrical outlet.
   C. Environmentally controlled for general building use.
   D. A door that opens into a hallway.
Section 13200 – CUSTODIAL CLOSETS

PART 1 – GENERAL

1. REQUIREMENTS
   A. Multi-story buildings must have at least one 150 sq. ft. room for supply storage (in addition to requirement B) with 48 linear feet of shelving.
   B. Remaining floors require a minimum size -- 75 sq. ft. per floor with a minimum of 24 linear feet of shelving.
   C. Floor type or wall mount type slop-sink with anti-siphon valve and clean out.
   D. 20 amp electrical outlet.
   E. A door that opens into a hallway.
Section 13300 – LOBBIES AND ATRIUMS

PART 1 – GENERAL

1. REQUIREMENTS
   A. Lobbies or atriums, with glass walls more than one story high, need to have approved access for window cleaning and all maintenance.
   B. Interior access into the atrium and within the atrium shall accommodate at a minimum a 32 inch wide high lift that extends 26 feet.
   C. The finish floor shall be constructed with materials to support the weight of at a minimum a 32 inch wide high lift that extends 26 feet.
   D. Within the Historic District, no more than a one story glass wall is permitted.
   E. The glass wall shall be at a minimum 24” above final grade.
Section 13400 – RESTROOMS

PART 1 – GENERAL

1. REQUIREMENTS
   A. Floor drain.
   B. Ceramic or Seamless floor.
   C. Keyed hot water hose bib under sink.
   D. Wall-mounted partitions, preferred.
   E. Isolation valves.
   F. Architect to show location, elevations, and correct size of bathroom accessories on plans.
   G. Built-in dispensers will not be allowed.
   H. In addition to the required restrooms per applicable building code requirements, a unisex, restroom shall be design to meet the Universal Design Standards (Section 1.5, General Requirements).
   I. Other accommodations will include a changing table for infants.
   J. There will be a minimum of one single stall restroom per building. If only one restroom is designed, then it shall be located on the first floor of the building.
   K. All restrooms must meet at a minimum ADA guidelines, and OSU best practice and reviewed by the Commission for Students and Individuals with Disabilities (COSID) as coordinated by the project manager.
Section 14050 -- Elevators

PART 1 - GENERAL

1. REQUIREMENTS

   A. All elevators must be non-proprietary.
   B. Elevators shall not require any specialized tools or equipment for operation unless such tools or equipment are provided with installation.
   C. All freight and passenger elevators operating within a building served by a back up power source shall be served by the back up power source.
   D. Fire recall needs to comply with current IBC.
   E. All new buildings shall provide back up power to at least one passenger elevator. Should the building include a freight elevator, then a disconnect shall be installed to allow for manual operation of the freight elevator.
PART 1 – GENERAL

1. PROTECTION REQUIREMENTS

A. All spaces in the building must be fully protected by fire sprinklers. This requirement includes all spaces below suspended ceilings and above suspended ceilings where combustible materials are or are intended to be located. Plastic piping, telephone cabling, and plastic ductwork are examples of combustibles. All equipment must be UL listed and in the latest edition of the Factory Mutual (FM) Approval Guide.

B. In addition to the requirements of NFPA-13, the rulings and interpretations of the local Fire Marshal and the requirements of OSU must be incorporated into the design.

C. The use of self-luminous exit signs containing radioactive material is prohibited unless specifically approved by Environmental Health & Safety (EH & S).

2. REFERENCES


B. NFPA 13- Installation of Sprinkler Systems.

3. IDENTIFICATION

A. Provide labels and flow direction arrows on mains and cross mains every 20 feet.
Section 22050 – DOMESTIC PLUMBING

PART 1 – GENERAL

1. REQUIREMENTS
   A. Domestic Water System - System Requirements
      01. Reliability
          a. Adequate volume and pressure of water must be available at all
times. On-site pressurization should be considered if the city
supply is not reliable. Prior to the start of design work, contact
the City of Corvallis Water Department to determine their
requirements and pressures.
      02. Capacity
          a. System capacity shall be based on peak flow demand rates of the
plumbing system, make-up to HVAC equipment, and process
water requirements.
      03. Pressure
          a. A minimum domestic pressure of 35.0 psig is required at the most
remote use points.
          b. If the public system cannot furnish this, provide booster pumps.
          c. Maximum water pressure within a building should not exceed
80.0 psi.
          d. Provide multiple pressure-regulating assemblies with a full line
size bypass with isolation valves.
          e. Coordinate the location for easy maintenance.
      04. Design velocities
          a. To assure a quiet piping system, design velocities shall not exceed
those noted below. Piping sized according to the velocities above
still must not exceed the allowable pressure drops specified in the
Uniform Plumbing Code, per the current Oregon amendments.
          b. Max. velocity
             1. Mains mechanical rooms: 10 ft. per sec.
             2. Mains and branches in other areas: 8 ft. per sec.
      05. Routing
          a. Route site fire and water lines to avoid other utilities, vaults, and
trees.
          b. Coordinate routing with the landscaping plan to verify that no
piping is within ten feet of any new tree and outside the drip line
of any existing trees.

2. BUILDING SYSTEM
   A. Risers and mains
01. For ease of maintenance, locate risers and mains at or near an exterior wall in an accessible location, such as a mechanical equipment room, storage room, or custodial room.
   a. A main shut-off valve shall be installed on the riser before any branch take-off.
   b. Pipe runs below the building floor slab shall be avoided, except for short branch lines serving “island” fixtures.

02. In multi-story buildings, locate a shut-off valve on the branch feeding each level.
   a. In addition, provide sectional valves for each self-contained or special purpose area, to permit a localized shut-down without affecting other parts of the system.
   b. Provide shut-off valves for each toilet room.
   c. Provide an access door in the men’s toilet room with the shut-off valves for both toilet rooms.

B. Backflow prevention

01. All industrial water, such as lines labs, HVAC equipment, cooling water, or other water make-up systems to equipment shall have a pressure-reducing type backflow preventer (RPBP) located in an accessible location.
   a. A floor sink or other approved fixture shall be nearby to receive piped discharge from the RPBP.
   b. Back-flow protected lab water shall be identified differently from that serving domestic purposes, such as drinking fountains, kitchens, and rest rooms, etc.

02. Kitchen equipment with chemical injection systems (ie. dishwashers, hood wash systems, beverage systems) require a pressure-reducing type backflow preventer (RPBP) located in an accessible location. A floor sink or other approved fixture shall be nearby to receive piped discharge from the RPBP.

03. All potable building supply water shall be protected by two (2) backflow preventers (BFP), installed in parallel to allow for testing or repair of the device without shutting off the building’s water supply. Provide unions or flanges on both sides of the device.

04. Provide a bypass around each backflow prevention device to allow for service and maintenance.

C. Water hammer protection

01. A sealed chamber-type, maintenance free, water hammer arrestor shall be installed upstream of all solenoid valves, flush valves, water mixing valves or other quick-closing valves.
   a. The size, quantity, and location are to be as recommended by the manufacturer of water hammer arrestors.
   b. Simple air-chamber type units are not acceptable.
D. Trap primers
01. Trap primers shall be provided to protect the trap seal of infrequently used fixtures (generally floor drains).
   a. A single trap primer may be used to serve more than one fixture. A manifold provided by the trap primer manufacturer shall be provided. Provide access for inspection or locate trap primers exposed.
   b. Provide a shut-off valve on the water supply line to the primer.
   c. Locate trap primers in an easily accessible location.

E. Water heating
01. Provide steam to hot water generators for domestic hot water.
02. Specifications:
   a. The hot water temperature at any fixture shall not exceed 110 deg. F, as per plumbing code. Generate water at temperatures necessary to attain 110 deg. F at taps. Provide a recirculating system controlled by an aquastat. Special use areas such as kitchens and certain labs may require higher temperatures.
03. Selection of water heater capacity shall be based on the recommendations of the ASHRAE Handbook for Hot Water Systems or on other standard engineering practices.
04. Use the Uniform Plumbing Code for sizing pipe.
05. Some areas or equipment may require higher temperatures than the 140 deg. F, recommended above, such as cafeterias, kitchens, etc. In such cases, a separate heater or local booster heaters of appropriate capacity shall be used.
06. Use of electric instantaneous units may be used at remote isolated locations. Preferred manufacturers.
   a. Controlled Energy Corporation, Powerstar, Powerstream, or Ariston with a minimum five year warranty.

F. Fixtures
01. Fixtures shall be selected for the specific function. Where possible, water saving features should be employed, particularly in high use areas.
02. Fixtures shall be a water conservation type, as required by code.
03. Provide fixtures in accordance with Americans with Disabilities Act Guidelines (ADAAG). Where applicable building code requirements are more stringent, those code requirements shall be followed.
04. Material shall be the best quality, easy to clean, with surfaces smooth and resistant to chipping, cracking, and discoloration.
05. Water closet, lavatory, and urinal shall be of white, vitreous china.
06. Sinks (coffee bar, break area) shall be 18 gauge, type 304 stainless steel, unless specifically requested otherwise.
07. The custodial sink shall be cast stone or stainless steel.
08. Faucets, hose bibs, and flush valves in valves in toilet areas shall be chrome-plated brass.

09. Floor drains and floor sinks are generally cast iron with a polished bronze heel proof grating.

10. Provide sink and shelving adjacent to the cooling tower chemical treatment area.

11. Drinking fountains will be the "high-low" dual use type, one at standard height and one at ADA height. A minimum of one drinking fountain per floor should be lower "wheelchair" height and locate on the accessible route of travel. Provide refrigerated fountains only where cold domestic water temperature at the point of service is 75 deg. F or higher. Refrigerated fountains should be installed on a timer or tied to building management systems to prevent running during unoccupied hours.

G. Piping materials

01. Use Type L copper for all domestic cold and hot water, and recirculated hot water piping and all water piping down stream of RP devices.

H. Valves

01. Select valves for the appropriate function:
   a. Gate valves or butterfly valves or ball for shut-off or sectionalizing service, globe valves for flow modulation.
   b. Specialty valves shall be employed where appropriate, such as check valves on a pump discharge, pressure regulating valves for equipment requiring lower-than-available system pressure, solenoid valves, etc.
   c. Flanged or threaded end valves are preferred.
   d. Locate valves in accessible locations, not more than six feet above the floor, if frequently used, and with a union on the downstream side of threaded end valves.

02. The specifications shall require that the Contractor is to furnish to the OSU Project Manager four copies (one framed) of an “as-built conditions” diagram for each mechanical equipment room, showing a piping diagram and the location of the main shut-off valves for gas, fuel oil, hot and cold water, the fire sprinkler main, etc.
   a. The diagram shall be simple, easy to follow, and with valves highlighted or shown prominently.
   b. Provide each valve with a brass disc not less than 1-1/4” diameter engraved with numbers, piping service, and normal operating position (i.d. NO, NC) corresponding to valves shown on diagrams.
   c. Fasten discs to valves with #14 brass wire or #16 brass jack chain.

03. Consult with the OSU Project Manager to determine location and quantity of isolation and sectionalizing valves for all liquid systems.

04. Galvanized piping shall not be used in any water system.

I. Insulation
01. Insulation is required for all hot water piping, cold water and industrial cold water piping.

02. Insulate horizontal portions of rain water piping above ceilings or finished soffits in areas where there is a possibility of condensation.

03. Provide flexible molded vinyl insulation kit on exposed waste and supply piping below ADAAG lavatories and sinks.

J. Accessories

01. Pipe line accessories such as unions, pressure or temperature test plugs, flow sensors, gauges, flexible connectors, etc. shall be employed as appropriate to assure a well-functioning, easy-to-maintain system.

02. Expansion joints or expansion loops shall be installed on long, straight runs to compensate for thermal expansion of the pipe whenever the calculated expansion is +/- 1/8 inch or more. Spacing and location shall be based on the maximum probable temperature fluctuation and the thermal coefficient of the pipe material.

K. Supports

01. For parallel pipe runs, trapeze-type supports shall be spaced to suit the smallest pipe in the group. Spare room for 20% future pipe lines should be reserved.

02. Hanger spacing shall also be coordinated with the supporting steel overhead. Hangers shall be of sufficient strength to support the pipes and contents plus 200 pounds. Metallic pipes shall not be in direct contact with hangers or the supporting structure.

03. Provide seismic bracing according to SMACNA requirements.

3. SANITARY SEWER SYSTEMS

A. Design criteria

01. Capacity
   a. All calculations for pipe capacity shall be based on the current Plumbing Code. Cooling tower blowdown will also discharge into the sanitary sewer system.

02. Slope (pitch)
   a. Slopes of sanitary sewer lines within a building are set by code. Verify that design considerations are acceptable to local jurisdictions and obtain approval prior to proceeding with design work.

03. Tests
   a. Sanitary sewer systems are tested per code, generally tested at 10 feet of head for a period of 4.0 hours with no visible loss of water.
   b. The exceptions are pumped portions, which should be tested at 1 1/2 times the pump head.

B. Routing

01. Route site sanitary lines to avoid other utilities, vaults, and trees.
02. Coordinate routing with the landscaping plan to verify that no piping is within ten feet of any new tree and outside the drip line of any existing trees.

C. Material
01. Hubless cast iron or galvanized steel pipe is acceptable.
   a. Below-grade portions of piping shall be hubless plain-end cast iron piping to a point five feet beyond the exterior face of the building.
   b. Specify 4 band fittings above and below grade.

D. Freeze protection
01. The minimum depth of pipe cover must be three feet, or one foot below the frost line, whichever is greater.

E. Building sewer system
01. Vents
   a. Provide vents in accordance with code. To reduce the number of roof penetrations, collect vents in the ceiling or attic space.

02. Cleanouts
   a. In addition to code requirements, provide cleanouts at major pipe junctions. Avoid locations such as lobbies, conference rooms, private offices, or other special areas.

03. Floor drain system
   a. Provide traps and vent at all floor drains directly connected to the sanitary sewer. Pipe runs should be located between columns to avoid footing pressure zones.

04. Distribution of floor drains shall be:
   a. In mechanical equipment rooms at appropriate points to collect discharge or drainage from equipment.
   b. Near water heating equipment.
   c. In each toilet room.
   d. At each emergency shower.

4. STORM DRAINAGE SYSTEM
A. Design criteria
01. Rainfall intensity
   a. The system design shall be based on the 50-year storm rainfall intensity for the City of Corvallis or local code requirements, whichever is higher.

02. Slope
   a. Provide an engineering analysis to determine a pipe size, considering flow, velocity, and available fall. Design for pipe with space capacity.

03. Tests
   a. Same as the sanitary sewer system.

04. Routing
a. Route site storm lines so as to avoid other utilities, vaults, and trees.
b. Coordinate routing with landscaping plan to verify that no piping is within ten feet of any new tree and outside the drip line of any existing trees.

B. Building drainage system

01. Roof drains, overflows, gutters
   a. Cast iron or bronze roof drains shall be distributed to serve approximately equal areas.
   b. An overflow drain shall be located within five feet of each roof drain with the rim 2” above finished roof surface.
   c. Overflow drains shall be connected to an independent drainage system, discharging at a point visible from the outside.
   d. Discharge locations shall be selected so as not to spill or splash over or down the exterior walls of the building so as to avoid unsightly staining.
   e. Pipe sizing for the overflow pipe system is to be the same as for the roof drains.

02. Roof Drains: Provide minimum 4” diameter drainpipe wherever feasible to minimize obstructions. Provide cleanouts (and access panels for drainlines routed through walls, interior spaces, and outside the building. Provide removable scupper covers with sufficient flow to minimize leaf obstructions.

03. Rainwater leaders
   a. Materials for the roof drainage and overflow piping is to be identical.
   b. Hubless cast iron or galvanized steel pipe is acceptable. Vertical drops shall be located adjacent to exterior walls.
   c. Below-grade portions of piping shall be hubless plain-end cast iron piping to a point five feet beyond the exterior face of the building.
   d. Specify 4 band fittings above and below grade.
   e. One vertical leader may serve only one roof drain.
   f. Extend rainwater leaders below the grade and connect it to an on-site storm drainage system or run it to the site civil piping system.

04. Sump pumps
   a. For small, independently drained areas (area ways, ramps, loading docks), a small local sump and pump will be required if no gravity connection to the mains is possible.
   b. The simplest arrangement shall be employed, utilizing a small, cast-in-place sump with submersible pump(s). Sloping surfaces shall direct rainwater to the sump.
c. In areas where a build-up of rainwater is not critical, a single pump is acceptable. In other situations or as designated by local jurisdiction, duplex pumps shall be used.

d. Pumps shall be controlled by integral or separate level sensors.
   1. Duplex pumps are to have an automatic alternating arrangement.
   2. An additional level sensor shall be provided at all sumps to signal high liquid level alarm conditions.

e. An oil/water separator shall be provided prior to the sump pumps where required, as designated by the local jurisdiction.

5. NATURAL GAS SYSTEMS (FUEL GAS)
   A. Design criteria
      01. General
          a. Natural gas shall be considered the primary fuel for kitchen cooking equipment.

      02. Pressure
          a. The gas pressure is normally located by the seven-inch water column on the downstream side of the gas meter.

      03. Capacity
          a. The capacity of the system is the total connected load from all present and future use points.

      04. Piping
          a. The pipe above grade shall be:
             1. threaded or welded black steel where located inside a building
             2. galvanized steel where exposed to the weather.
          b. The pipe above grade, when exposed, shall be painted with paint suitable for corrosion protection.

   B. Valves
      01. Valves shall be readily accessible and located as designated by code and local utility company requirements.

      02. Provide valves at each capped stub out for future extension, and at each piece of equipment. Request the local utility company to provide a valve upstream of the gas meter.

   C. Accessories
      01. Provide a gas pressure regulator with a built-in internal relief and low-pressure cut-off, or for large demands, a gas pressure regulator with an internal relief and separate low-pressure cut-off.

      02. Vents shall be provided from each pressure regulator. Vents shall run independent and terminate outside the building at a location in compliance with code.
03. Provide pressure gauges with gauge cocks on the upstream and downstream side of each regulator and a separate low pressure cut-off to aid in checking the gas pressure.

D. Tests
01. Gas piping shall be tested with air at 100 psig for four hours with no loss in pressure.

E. Gas supply
01. Coordinate the location of the gas meter with Northwest Natural Gas Company.
02. Northwest Natural Gas Company has all known gas pipe lines documented.

6. BUILDING SYSTEM
A. Pressure
01. Piping within the building shall be sized and distributed at 6.5-7” water column, unless a higher pressure is required for the equipment.

B. Piping
01. All piping shall run above the slab, with branches connected to the top of mains. When necessary, due to structural conditions, piping may be installed in other locations with the permission of the local jurisdiction. Use welded fittings for pipe larger than two inches or for pressures 1.0 psig or greater.

C. Equipment connections
01. All connections to equipment shall terminate with a dirt tee and shut-off valve. Flexible connectors are not acceptable.

7. MANUFACTURERS
A. OSU maintains a stock of spare plumbing parts for most components on campus.
B. The table below lists preferred brand and manufactures for plumbing components.
C. The brand of company name listed is to be used as the basis of design for that component. Provide a list of alternate manufacturers to the OSU Project Manager for review with the OSU shops with the 100% design development documents. Provide a list of any changes or additions with the 95% construction document review.
<table>
<thead>
<tr>
<th>Domestic Water/Non-potable Water</th>
<th>Gas</th>
<th>Waste</th>
<th>Vent</th>
<th>Item</th>
<th>Brand or Company</th>
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<tr>
<td>Hot X</td>
<td>Cold X</td>
<td></td>
<td></td>
<td>Back-flow prevention devices</td>
<td>Febco</td>
</tr>
<tr>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td>Control Valves</td>
<td>Honeywell or Johnson</td>
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<tr>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td>Cross connection devices (preferred)</td>
<td>Febco</td>
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<tr>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td>Drinking fountains &amp; water coolers</td>
<td>Haws</td>
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<td>X</td>
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<td></td>
<td></td>
<td>Faucets Chicago Zurn</td>
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<td>X</td>
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<td>Faucets Delta</td>
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<td>Hose bibs, freeze-proof</td>
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<td>Lab fixtures</td>
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<td>Prime-Eze Water Saver Trap Primer</td>
<td>Jay R. Smith MFG. Co.</td>
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<td>Apollo</td>
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<td>Valves, ball - PVC</td>
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<td>Stockham/ Grinnel</td>
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<td>Water closet - flush valve</td>
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<td>Water closet – tank type</td>
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<td>Urinal</td>
<td>Kohler: Bardon, Stanwell, or Dexter</td>
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<tr>
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<td>Vent</td>
<td>Item</td>
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Section 22150 – SPECIAL SYSTEMS

PART 1 – GENERAL

1. COMPRESSED AIR
   A. General Requirements
      01. Verify with the OSU Project Manager the type and quality of compressed air required.
      02. OSU uses two types of compressed air systems: clean lab air and building air. Verify the type of air required with the OSU Project Manager.
   B. Lab Air System
      01. The compressed air system shall include the following:
          a. Air or water cooled one or two stage rotary screw type oil-free air compressor.
          b. An air dryer.
          c. An air receiver (located between the compressor and dryer).
          d. A filtered intake to the compressor.
          e. Particulate filters.
          f. Activated Carbon Filters.
          g. Copper piping system cleaned for oxygen service.
          h. Preferred manufacturer: Quincy Northwest.
      02. Once through cooling water is not acceptable on water cooled units. Provide an integral heat exchanger and a cooling fan.
      03. “Oil-free” compressors, which depend on various seals to keep oil out of the air, or those equipped with oil filters located after the compression chambers, may be acceptable. Consult with the OSU Project Manager. Provide a receiver with a by-pass upstream of the dryer.
      04. Air dryers are to be either refrigerated type or the desiccant heatless, reactivated dual tower type. Verify with the OSU Project Manager the desired dew point (-40 deg F. -100 deg. F.) and select the appropriate dryer. Locate dryers as close as possible to the point of use.
      05. Size the air intake filter for 150% of the compressor flow rate.
      06. Provide final particulate filters upstream and downstream of the dryer with a rating of 0.1 micron absolute for particle removal.
      07. Install a “coalescing” filter upstream of the receiver tank and particulate filter downstream of the dryer. Use Type 304 stainless steel housings. Install these devices in parallel with the gauges and isolation valves.
   C. Building Air System
      01. The compressed air system shall include the following:
          a. Air or water cooled one or two stage rotary screw type oil flooded air compressor
          b. A air dryer
          c. A air receiver (located between compressor and dryer)
d. A filtered intake to the compressor

e. Particulate filters

f. Coalescing filters

g. Copper piping system

h. Preferred manufacturer: Quincy Northwest.

02. Once through cooling water is not acceptable on water cooled units. Provide integral heat exchanger and cooling fan.

03. Air dryers are to be either refrigerated type or the desiccant heatless, reactivated dual tower type. Verify with the OSU Project Manager the desired dew point (-40 deg F, -100 deg F) and select the appropriate dryer. Locate dryers as close as possible to the point of use.

04. Size the air intake filter for 150% of the compressor flow rate.

05. Install “coalescing” filter upstream of the receiver tank and particulate filter downstream of the dryer. Use Type 304 stainless steel housings. Install these in parallel with the gauges and isolation valves.

D. Piping

01. Lab Air System

a. ASTM 280 ACR Type L copper above grade, Type K below grade; wrought copper fittings, 15% silphos silver solder for OFA and Nitrogen. Piping must be installed while maintaining a continuous inert gas (argon or nitrogen) purge during the entire installation period.

b. Identify all compressed air piping per general requirements.

c. Cleaning of piping.

1. The most important single requirement for the process gas piping systems is that they are suitable and capable of conveying a gas from the source to use point with no contamination.

2. Order all pipe material, fittings, etc., to be cleaned by the manufacturer for “oxygen usage”, charged with nitrogen, and sealed at the ends prior to transportation.

3. Each pipe length and fitting is to be individually inspected on arrival at the job site for integrity of the sealed ends and for physical injury (such as bends or flat spots). Pipes with lost seals or physical damage are to be re-cleaned or rejected.

4. Acceptable pipes are to be stored in a clean, safe location.

5. Quantities of pipe cleaned at any one time shall not exceed that which can be installed within the same working days. No pipe may be installed if the plastic bags on the ends of the pipe are not “puffed up”, which indicates a loss of the N2 charge.
6. Pipes, valves and/or fittings which do not comply with the cleaning standards (i.e. which show contamination at specified stages of the cleaning process) must be rejected and removed from the site.

02. Building Air System
   a. Type L copper above grade, Type K below grade; meeting ANSI 11.1, wrought copper fittings, brazed.
   b. Identify all compressed air piping per general requirements.

E. Valves
01. Lab Air System
   a. All valves for the oil free air systems shall meet these specifications:
      b. Non-lubricated.
      c. Cleaned for “oxygen usage” at the factory.
      d. Packaged and sealed individually in heavy duty polyethylene bags with a nitrogen charge.
      e. Pressure rated for a minimum of 1.5 times working pressure.
      f. Inspected prior to installation.
      g. Have an extension at each end (except flanged valves).

02. Building Air System
   a. Ball valves shall have a (3) piece design to permit servicing without cutting the pipeline.
   b. Check valves shall be spring loaded.
   c. Provide ball type shutoff valve and female connection on outlet of valve for connection by user. Verify with the OSU Project Manager exact requirements.
   d. Provide isolation valves at each floor, at each lab, and at each point of use.

2. LAB VACUUM SYSTEM
   A. General Requirements
      01. Use belt drive air cooled or water cooled duplex rotary vane or hook and claw type units. Once through cooling water is not acceptable.
      02. Provided make-up water to the closed system from an isolated industrial cold water source.
      03. Cooling system provided as part of the unit complete with all necessary pumps, heat exchanger and controls to maintaining cooling water flow rate.
      04. Maintenance drain valves and drain tubing is to be included in the pump housing and heat exchanger.
      05. System to include factory controls for unit staging.
      06. Preferred manufacturer: Quincy.
      07. Lab vacuum discharges shall be a minimum of 16 feet above the roof line.
B. Piping
01. Type L copper above grade; Type K below grade; wrought copper fittings, soldered.
02. Identify all compressed air piping per general requirements.
03. Use of schedule 80 PVC with solvent welded joints may be allowed in certain cases. Contact the Project Manager for approval.
04. Identify all vacuum air piping per general requirements.

C. Valves
01. Ball valves shall have a (3) piece design to permit servicing without cutting the pipeline.
02. Provide a ball type shutoff valve and a threaded female connection on outlet of valve for connection by user. Verify with the OSU Project Manager exact requirements.
03. Provide isolation valves at each floor, at each lab, and at each point of use.

3. GAS SYSTEMS
A. General
01. The quality of the specialty gas systems to be delivered should be suitable for the intended use.
02. The OSU Project Manager will provide a list of gasses required on the project and the piping materials to be used.
03. If extending an existing system the materials and cleanliness specifications shall match existing system. Only at the directive of the OSU Project Manager should variations from existing systems be made.
04. Medical gas system piping shall be designed and installed per NFPA 99.

B. Piping
01. Where gas systems will be carried in copper piping use the above requirements for lab air systems.
02. Where gas systems will be carried in stainless steel piping:
   a. Special cleaning requirements must be followed (see below for detailed description).
   b. Acceptable materials for gas systems, unless requested otherwise are:
      1. Type 316 stainless steel tubing
      2. Valves
      3. All valves for the cleaned dry air and Nitrogen systems shall be:
         3.B.02.b.3.1 Non-lubricated
         3.B.02.b.3.2 Pressure rated for a minimum of 1.5 times working pressure
         3.B.02.b.3.3 Inspected prior to installation
3.B.02.b.3.4 Have an extension at each end (except flanged valves)

c. Valves
   1. Ball valves shall have a swing-out center to permit servicing without cutting the pipe line.

03. Identify all vacuum air piping per general requirements.
04. Provide isolation valves at each floor, at each lab, and at each point of use.

C. Accessories and supports
01. The body material of pipe line accessories and specialty valves, such as pressure regulating valves, flow monitoring devices, etc., must match the material of the piping system, and internal parts shall be compatible with the particular gas.

D. Cleaning of piping
01. The most important single requirement for the gas piping systems is that they are suitable and capable of conveying a gas from the source to use point with no contamination.
   a. Order all pipe material, fittings, etc., to be cleaned by the manufacturer, charged with nitrogen, and sealed at the ends prior to transportation.
   b. Each pipe length and fitting is to be individually inspected on arrival at the job site for integrity of the sealed ends and for physical injury (such as bends or flat spots). Pipes with lost seals or physical damage are to be re-cleaned or rejected.
   c. Acceptable pipes are to be stored in a clean, safe location.
   d. Quantities of pipe cleaned at any one time shall not exceed that which can be installed within the same working days. No pipe may be installed if the plastic bags on the ends of the pipe are not “puffed up”, which indicates a loss of the N2 charge.
   e. Pipes, valves and/or fittings which do not comply with the cleaning standards (i.e. which show contamination at specified stages of the cleaning process) must be rejected and removed.

4. CHEMICAL SYSTEMS
A. Acid resistant drainage piping, if required, shall be FUSEAL for interior piping and Duriron for exterior piping.
B. Duriron exterior piping shall extend to the manhole outside the building.
C. Chemical drains shall run independently of the building system to a point outside the building before connecting to the building sewer.

5. DEIONIZED WATER SYSTEM
A. Consult with the OSU Project Manager to select the type of reverse-osmosis (RO) unit to be used.
B. Steam powered or electrically operated distillation units are not to be used.
C. Use membrane filters rated for industrial service.
D. Distribution piping:
   01. Shall be 80 CPVC piping with no dead ends.
   02. Shall include a continually recirculating system to provide necessary cleanliness.
E. Piping shall be properly flushed, cleaned, and sanitized before being placed into service.
F. Provide isolation valves at each floor, at each lab, and at each point of use.
Section 22200 – EMERGENCY PLUMBING FIXTURES

PART 1 – GENERAL

1. REQUIREMENTS
   A. These criteria set OSU campus standards for emergency shower and eyewash equipment to comply with the regulations set forth in the most current applicable OAR.

2. EMERGENCY EYE WASH
   A. This equipment must meet the performance and installation requirements the most current American National Standards Institute (ANSI).
   B. All campus laboratories that use substances described above must have at least one emergency eye or eye/face wash located within the laboratory and as close as possible to the hazard.
      01. Hand held drench hoses are not considered eyewash units. They may be used in addition to equipment, which is described as meeting the ANSI standard. In some cases, a sink mounted eyewash and a drench hose may be installed in lieu of a combination eyewash/safety shower.
      02. Consult OSU EH&S for review and approval of this configuration.
   C. Approved emergency eye or eye/face wash units are Haws 7611 or Guardian G1805 (laboratory unit – install at sink), Haws 7000BT or Guardian G1750PT (Barrier Free), Haws 7656WC or Guardian GBF 1735DP (recessed), or equal. The approved units must be:
      01. Supplied by domestic water.
      02. Readily visible and accessible to the laboratory or work site. The unit should be located as close to the hazard as possible and cannot be blocked by building structures, cabinets, supplies or equipment.
      03. Regulated to provide a spray force of three to six gallons per minute at 30 psi.
      04. Mounted such that the water nozzles are 33 inches to 45 inches from the floor level; height should comply with the current Americans with Disabilities Act (ADA) requirements.
      05. Mounted so that spray nozzles, when activated, are no more than 18 inches from the counter front when located above work counters or benches.
      06. Provided with an activation device, such as stay open ball valve, that allows the user full movement of both hands after the valve is turned on.
      07. Identified with a highly visible sign.
      08. Drain will be plumbed to sanitary sewer.
      09. No electrical outlets within 6 feet unless GFI protected.
      10. Indoor units are not required to deliver tempered water. Units installed outdoors or in adverse climates may need to be tempered. The need for
tempered water shall be reviewed and approved by OSU EH&S during the design phase.

3. **EMERGENCY SHOWERS**
   A. Emergency Showers must be a combination unit that meets the requirements of current ANSI standards. The unit must be installed and located so both the shower and eyewash can be used at the same time by one person. Approved eyewash/emergency shower units are Haws 8346 or Guardian G1909 HFC (GBF1909 Barrier Free), Haws 8355WC (recessed), Guardian GBF2150 (recessed), or equal. The approved units must be:
   01. Supplied by domestic water.
   02. Readily visible and accessible to all occupants of the laboratory or work site. They cannot be blocked by building structures, cabinets, supplies or equipment.
   03. Adequately supplied with potable water to meet the requirements of each component. The shower must be able to deliver a minimum of 30 gallons per minute. The diameter of the water pattern of the shower measured 60 inches above the surface on which the user stands must be a minimum of 20 inches. The center of the spray pattern shall be located at least 16 inches from any obstruction.
   04. Supplied by a minimum iron pipe size of 1 inch.
   05. Installed with a stay open ball valve.
   06. Installed so that the shower head is not less than 82 inches nor more than 96 inches from the surface on which the user stands.
   07. Identified with a highly visible sign.
   08. Eyewash component drain must be plumbed to sanitary sewer.
   09. Located so as not to pose an electrical shock hazard. No electrical outlets within 6 feet unless GFI protected.
   10. Indoor units are not required to deliver tempered water. Units installed outdoors or in adverse climates may need to be tempered. The need for tempered water shall be reviewed and approved by OSU EH&S during the design phase.

4. **LOCATION OF EMERGENCY EYE WASH AND/ OR SHOWER**
   B. A combination eyewash/emergency shower may be located outside the laboratory area provided an approved eyewash is located in the laboratory.
   C. The combination unit must be located so that travel distance is no more than 10 seconds with no obstructions and only one door to pass through to reach the unit. Note: Emergency eyewash or eye/face wash shall be plumbed to sanitary sewer or sink-mounted.
   D. OSU EH&S will make final determination on selection of “equal” equipment to ensure the equipment meets current ANSI standards.
Section 23000 – GENERAL HVAC REQUIREMENTS

PART 1 GENERAL

1. HEATING AND COOLING LOAD CALCULATIONS
   A. Heating and cooling design loads for the purpose of sizing HVAC systems shall be determined in accordance with one of the procedures described in the latest edition of the ASHRAE Handbook of Fundamentals or equivalent computation procedures. The engineer shall furnish copies of applicable HVAC design calculations for review, along with periodic progress drawings.
   B. Outdoor and indoor summer and winter design temperatures used in the building load calculations shall be as follows for the Corvallis campus:
   D. Summer Outdoor Design for Laboratory Buildings: 96°F. db and 67°F wb.
   E. Summer Outdoor Cooling Tower Design for Classroom Buildings: 92° F. db and 72 °F wb.
   F. Summer Outdoor Cooling Tower Design for Laboratory Buildings: 92° F. db and 72 °F wb.
   G. Summer Outdoor Air Cooled Condenser Design ≤ 10 tons 95° F.db, ≥ 10 tons 105° F. db.
   H. Summer Indoor Design Office: 76 ° F at the work station. No Humidification.
   I. Summer Indoor Design Classroom: 76° F. No Humidification.
   J. Summer Indoor Design Lab 73° F verify with the OSU Project Manager (PM). No Humidification.
   K. Winter Outdoor Design: 17° F, Wind @ 15 mph.
   L. Winter Indoor Design Office: 68°F at the work station. No Humidification.
   M. Winter Indoor Design Lab: 68° F at the work station. No Humidification.
   N. Winter Indoor Design Classroom: 68° F at the work station. No Humidification.
   O. Summer/Winter Indoor Design for other rooms as directed by the PM.

2. BUILDING ENVELOPE REQUIREMENTS
   A. Design criteria listed below shall be used unless directed otherwise by the PM.
   B. The proposed type of building envelope construction shall be designed using thermal transmittance values (U value), which comply with the State energy Code requirement for thermal design.
   C. Equipment Loads
      01. General offices: 0.5 watts per sq.ft.
      02. Classrooms: 0.5 watts per sq.ft. or actual occupant load, with each occupant having a laptop computer, times 50%.
      03. Labs: based on actual equipment load plus 20%.
      04. Copy rooms: based on actual equipment load.
      05. Computer rooms: based on actual equipment load plus 20%.
      06. Corridors, walkways lobbies, etc.: None.
07. MDF rooms: based on actual equipment load.
08. IDF rooms: based on actual equipment load.
09. The PM will provide equipment loads for specific spaces when applicable.
10. When no specific data is available, use connected equipment electrical load (FLA) data with a 50% diversity factor.

D. OCCUPANCY LOADS
02. Use actual planning data plus 10%. Refer to ASHRAE values of 250 BTUH per person.
03. General office: One person per 80 sq.ft.
04. Conference rooms: One person per chair plus 20%.
05. Labs: Base on one person per lab station.
06. Classrooms: Base on one person per seat.

E. LIGHTING LOADS
01. Minimum lighting loads based on NEC Table 220.12.
02. When a lighting designer is included as part of the project team base lighting loads on actual room by room lighting loads designed by lighting designer.

F. MINIMUM OUTSIDE AIR REQUIREMENTS
01. Minimum requirements based on latest edition of ASHRAE Standard 62 or the Mechanical Code.

G. NOISE CRITERIA
01. Open office space: RC 30-40.
04. Classrooms maximum: RC 35.
05. Laboratories: RC 35-45.
06. Halls, corridors, and lobbies maximum: RC 40.
07. Toilet and storage rooms maximum: RC-45.
08. Video Conference Rooms maximum: RC-25.

H. Provide for review a list of all pipe and duct systems with a brief justification of insulation and thickness, or of no insulation if none is specified.

I. Include all field insulated equipment on the list.

3. WATER SYSTEM REQUIREMENTS
A. General
01. Projects having total cooling requirements exceeding 50 tons of refrigeration should be designed around a central chilled system.
02. Hydronic systems design shall ensure that valves, control fittings and piping are of alloys which shall not deteriorate when subjected to the water treatment chemicals and are optimum for the piping and heat exchanger service. Provide a test port on discharge side of all pumps.
03. Locate mains and shutoff valves in hallways and corridors not in occupied rooms. Valves to be located within 18 inches of the main.

04. Consider routing main lines on the first floor to serve the first and second floors and mains located on the third floor to serve the third and forth floors of the building.

05. All hydronic systems shall be flushed of foreign materials, chemically cleaned, flushed, and filled with the proper chemically treated water before being put into service.

06. Water meter on make-up water line, psi regulator, safety relief, proper filters, Aqua Pure H1P748 (2 each).

4. CHILLED WATER SYSTEMS

A. The primary-secondary pumping system arrangements for variable flow are to be used whenever possible.

B. Multiple chillers are to be connected in parallel on the primary loop with each chiller served by a dedicated primary pump.

C. Primary pump redundancy, if required, shall be provided by cross-connection lines with manual isolation valves and a stand-by pump.

D. Secondary pumping redundancy shall be provided with a stand-by pump.

E. Provide variable flow pumping schemes for secondary chilled water distribution loops.

F. The primary loop piping shall incorporate a centrifugal air separator, an expansion tank, and a water treatment one-shot feeder system.

G. The primary loop piping to each chiller shall be provided with a flow measurement device such as a Venturi meter or Annubar unit, pressure gauges, industrial quality thermometers and thermowells and “Pete’s Plug” test points. Similar instrumentation shall be installed on secondary supply piping circuits.

H. The make-up water assembly to the primary loop shall include a gate valve, strainer, pressure reducing valve, pressure relief valve, gate valve, and union, in that order. A valved by-pass line shall be provided around the make-up water assembly for initial system filling and emergency use. Provide ball valves in lieu of gate values for sizes 3-1/2” and smaller.

I. Chilled water system design

J. Design chilled water systems using schedule 40 black steel pipe on larger sizes and type K copper for smaller sizes.

K. Fittings can be either, soldered, welded, flanged, threaded, or Victaulic type connectors depending on the pipe size.

L. Chilled water piping systems

01. Pressure drop: 4 ft. w.c. per 100 ft.

02. Maximum velocity

03. Mains (equipment rooms): 10 ft. pr sec.

04. Mains and branches (other areas): 5 ft. per sec

M. Chilled water system design temperature
01. Chilled water: 16 - 20°F temperature difference

5. HEATING WATER SYSTEM

A. Two types of piping and equipment arrangements shall be used.
02. A one heat exchanger system shall have a pair of pumps connected in parallel, each sized for full load and located downstream of the heat exchanger. One pump shall be a spare and they both shall pump into the primary loop.
03. If two heat exchangers are used, they shall be piped in parallel and connected to a common suction header connecting the pumps.
04. Connect the centrifugal type air separator and expansion tank to the suction side of pumps.

B. Size single heat exchanger systems for the load. Size multiple heat exchanger systems so that each heat exchanger is sized for 75% of the load.

C. Provide a water treatment one-shot feeder system and make-up water system for the heating water system. The make-up water assembly shall be the same as for chilled water.

D. The primary loop piping to each heat exchanger shall be provided with a flow measurement device such as a venturi meter or annubar unit, pressure gauges, industrial quality thermometers and thermowells and “Pete’s Plug” test points. Similar instrumentation shall be installed on secondary supply piping circuits.

E. Hot Water System Design
01. Design heating water systems using schedule 40 black steel pipe on larger sizes and type K copper for smaller sizes.
02. Fittings can be either, soldered, welded, flanged, threaded, or depending on pipe size.
03. Hot water piping systems
04. Pressure drop: 4 ft. w.c. per 100 ft.
05. Maximum velocity
   a. Mains (equipment rooms): 10 ft. per second
   b. Mains and branches (other areas): 5 ft. per second
   c. Hot water system design temperature
      1. Heat Exchangers: 40 - 60°F temperature difference
06. Main coils: 20°F temperature difference
07. Re-heat / fan coils: 10°F temperature difference

6. CONDENSER WATER SYSTEM

A. Condenser water systems shall be designed with a pump and cooling tower for each chiller or with multiple (at least two) pumps located to discharge to a common pipe manifold with piping redistributed to each chiller. The designed
system shall to minimize life cycles costs to the maximum extent practical while emphasizing energy efficiency.

B. Tower systems designs shall consider the following criteria:
08. Water filtration.
10. Open circuit versus closed circuit cooling towers.
11. Sound and noise with respect to surroundings.
13. Capacity control utilizing variable frequency drives. Consider valves to proportionally control the water flow through a by-pass line to the tower basin when chillers are to be utilized and condenser water temperatures could be below 65 deg. F.
14. Vibration isolation, including upper limit stops.
15. Location of pumps and piping to ensure flooded suction on the pumps to prevent possible cavitation.
16. Basin and make-up water heaters.
17. Fire resistance of the tower components.
18. Control of the tower water flow through the chillers as they are cycled on and off.
19. Electric heaters or steam coils in the basin, for freeze protection.
20. Insulate and heat trace exposed cooling tower condenser piping.

C. Condenser water system design
01. Design condenser water systems using schedule 40 black steel pipe.
02. Fittings can be either welded, flanged, threaded, or Victaulic type connectors depending on pipe size.
03. Provide a minimum of 20% extra tower capacity (BTUH, Flow, CFM) for future growth.
04. Provide VFD for capacity control.
05. Cooling tower piping systems
   a. Pressure drop: 4 ft. w.c. per 100 ft.
   b. Maximum velocity
   c. Mains equipment rooms: 10 ft. per sec.
06. Condenser water design temperatures
   a. Design dry bulb: 92° F.
   b. Design wet bulb: 72° F.
   c. Entering water temperature: 90°F.
   d. Leaving water temperature: 80°F.

7. DIRECT EXPANSION REFRIGERANT
A. Systems may be:
01. Single package for single zone applications.
02. Single package for multi-zone-zone application.
03. Split system air-cooled condenser/evaporator for cooling air or water.
04. Split system water-cooled condenser/evaporator for cooling air or water.

B. Systems shall be used where the lifecycle is cost effective. If the system exceeds 50 tons, air cooled chillers may be considered for single unit with one per air handler for air handlers up to 400 tons. One air cooled chiller for multiple air handlers up to 50 tons each. Obtain approval from the PM prior to designing the system incorporating such features.

C. Direct Expansion Refrigerant System
   01. Design refrigerant systems using type K copper.
   02. Fittings to be copper to match piping, and soldered using a nitrogen purge.
   03. Size is based on manufacturer’s recommendations.

D. Decommissioned refrigerant containing equipment shall display a weather resistant label clearly noting the removal of all hazardous materials, e.g. refrigerant, coolant, used oil, or any other hazardous material removed from unit.

8. LABELING AND IDENTIFICATION
   A. Pipe and Duct Labeling

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<th>Classification</th>
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<td>Flammable or Explosive</td>
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<tr>
<td>Chemically Active or Toxic</td>
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<tr>
<td>Materials of Inherently Low Hazard</td>
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<td>Fire Quenching Materials</td>
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B. Identification of Concealed Valves and Equipment

01. Affix a color coded “dot” to walls or ceilings wherever valves or other equipment are concealed. The colors shall be as follows:

<table>
<thead>
<tr>
<th>Identification</th>
<th>Color</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fire Protection</td>
<td>Red</td>
</tr>
<tr>
<td>Domestic/Non Potable CW</td>
<td>Green</td>
</tr>
<tr>
<td>Domestic/Non Potable HW</td>
<td>Yellow</td>
</tr>
<tr>
<td>HVAC Valving &amp; equipment</td>
<td>Blue</td>
</tr>
<tr>
<td>HVAC Fire, Smoke, or Combination Fire/smoke dampers</td>
<td>Red</td>
</tr>
<tr>
<td>Plumbing Cleanouts</td>
<td>Black</td>
</tr>
<tr>
<td>Lab piping</td>
<td>Purple</td>
</tr>
</tbody>
</table>

C. Identification of Equipment, Pipes, and Ducts

01. All plumbing, heating, air conditioning, piping, automatic temperature control equipment (excluding thermostats and relays), and distribution systems shall be labeled. Electrical switches and starters for mechanical equipment shall also be labeled.

02. Equipment

03. Equipment labels shall be black face plastic laminate with white engraved lette fring 3/16" high or larger, and shall be attached securely.

04. Equipment nameplates shall include the following information at a minimum:
   b. Capacity specified at designed operating conditions.
   c. Actual capacity as balanced at site operating conditions.
   d. Area or zone served.
   e. All new installations of evaporator coil housing and condenser units shall have tags that states who installed the unit, a warranty contact phone number and warranty date, start to finish.

9. PIPING

A. All valves within the building, regardless of size and location, shall have brass tags at least 1" by 3" in size and 0.051 inches thick. Lettering on the tag shall be engraved or stamped at least 3/16 inch high and match the valve numbers shown on the plans.

B. Valve tags shall be connected to valve stems by steel rings and include the following minimum information:

01. Plan Identification
02. Normal Position
03. Duty
04. Area Served
05. Valve Type
C. Heating Water Valves, Steam Valves, and all Valves located in the secondary (low pressure) side of HTW Heat Exchangers shall include the Manufacturer, Size, Grade, and Pressure-Temperature service rating.

D. Valve Tag Directory: Include tag number, location, exposed or concealed, service, valve size, valve manufacturer, valve model number, tag material, and normal operating position of valve. Include valve tag directory in the Operation and Maintenance Manuals and framed under glass on wall of mechanical room.

E. All piping systems shall be properly identified with labels and signs indicating direction of flow and fluid. Identification shall be specified to have identification as outlined in the ASME(ANSI) Standard and current NFPA requirements. Provide a list of each system being installed with the appropriate name and label colors in the specifications.

F. Comply with OSPSC Section 1003(r) regarding identification of non-potable piping systems.

G. All accessible piping shall be color coded and identified with wording and arrows every 20 feet on straight runs, at each riser, at each junction, at each access door, adjacent to all valves and, flanges, on both sides of floor and wall penetrations and where required to easily identify the medium transported.

H. Provide a trace wire for locating and identifying underground piping systems in the future.

I. Provide marker tape one foot above the top of underground piping over the entire length of the pipe.

10. AIR SYSTEM REQUIREMENTS

A. General

01. This section’s purpose is to establish standards of quality and utility for the mechanical components. The engineer’s task is to utilize equipment that provides the best value and lowest lifecycle cost while conforming to these standards.

02. The quality of items not covered in these standards shall be of the same general level and be subject to the same tests of value as those that are included.

03. Select items made by established manufacturers who have demonstrated the capability to provide replacement parts and service as may be required. The quality of the manufacturer’s local representation is very important.

04. Analyze manufacturers’ designs for inherent maintenance qualities, as well as adequate access doors, fasteners, and other accessories, which will facilitate maintenance.
11. EQUIPMENT ACCESS AND LOCATION
A. Ease of operation, maintenance and repair, and safety of personnel are primary considerations for the design and installation of all items. Design for a minimum of 4 feet of clearance all around major items such as boilers, chillers, pumps, air handlers and fans unless the manufacturer’s recommendations or code requirements are greater.

B. No equipment shall be installed in locations that will prevent future removal without major disruptions to the building or its contents. All equipment selected shall be designed for and provided with access doors and other accessories to address the requirements of this section. Connecting systems such as ductwork, piping, and electrical conduit shall be located so they do not obstruct access to the equipment service points.

C. Provisions shall be made to allow easy access for hoisting heavy or cumbersome equipment onto elevated mechanical spaces.

D. Critical wear components such as bearings, fan shafts, couplings, and belts shall be easily replaceable. Frequent service items shall be convenient; for example, easy access to filters and extended lubrication fitting.

E. Equipment shall be designed so access doors, panels, guards, and similar items can be removed and replaced without special tools, so they are sturdy enough not to sustain damage under normal use and care.

F. Provisions shall be made to provide a penthouse enclosure for rooftop equipment, when deemed suitable by the OSU Project Manager.

12. SOUND AND VIBRATION
A. Consider all appropriate sources of concern including radiated energy, energy transmitted through connecting items such as supports and electrical conduit, and energy transmitted through ducts, pipes and the fluids carried in them.

B. Select equipment and specify isolators and attenuators to eliminate undesirable sound and vibration levels. Obtain approval for the design criteria from the OSU Project Manager. If the design criteria is not established by a acoustical consultant use the following specifications:

01. Vibration: Eliminate vibration which will be detrimental to the structure, its contents, or the activities taking place within the structure, or which would be annoying to the occupants.

02. Sound: The operating systems should conform to the recommendations listed in the latest edition of the ASHRAE Handbook.

03. Documentation: Provide documentation, for all office, conference room, classrooms, labs, and mechanical equipment areas showing actual sound levels at the project’s close-out.

13. SEISMIC REQUIREMENTS
A. HVAC systems, equipment, and parts shall meet or exceed current applicable requirements for seismic resistance specified by codes, regulations, or agencies
having jurisdiction.

14. VARIABLE SPEED/FREQUENCY DRIVES
   A. Drives and motors shall be specified to be provided by the same vendor to provide single source responsibility.
   B. Shaft to frame voltage difference shall be specified to be 3 volts or less to reduce the potential of bearing pitting to a minimum.
   C. Shaft grounding or bearing isolation shall be provided as directed from the OSU Project Manager.
   D. See Electrical section for additional requirements.

15. BELT DRIVES
   A. Specify multi-belt, adjustable speed drives rated at 150 percent of motor horsepower for constant speed motors which are 15 horsepower and smaller.
   B. Specify fixed pitch drives rated at 150 percent of motor horsepower for constant speed motors larger than 15 horsepower.
   C. Adjustable pitch drives shall operate at or near the midpoint range of adjustment when the equipment is balanced to the specified performance.
   D. Belt drives shall have fully enclosed guards. Outdoor guards shall be of solid metal construction; indoor guards shall be of expanded metal set in angle iron frames. Guards shall be constructed in two pieces to allow for belt and sheave adjustment without disturbing the guard supports. Specify 4” diameter tachometer holes with pivoted cover plates at each shaft. Guards shall comply with applicable codes.

16. ELECTRIC MOTORS
   A. Electric motors shall have sufficient starting torque to start and drive the equipment load to which they are connected. Motors shall be of the premium-efficiency type conforming to the latest State Energy Code requirements.
   B. Provide insulated motor bearings or shaft grounding on motors connected to variable frequency drives.
   C. Motor enclosures shall be:
      01. Drip-proof for general use.
      02. Totally enclosed, fan-cooled (TEFC) for wet or exterior use.
      03. Totally enclosed, air over (TEAO) for cooling towers.
   D. Motor voltages shall be:
      01. 1/2 HP or less: 120V, 1 phase.
      02. ¾ HP or greater: 460V, 3 phase.
   E. See Electrical section for additional requirements.
17. **BEARINGS**  
A. Bearings shall be selected for a minimum of 200,000 hour or L-10 life expectancy, 400,000 hour preferred.

18. **WEATHER PROTECTION**  
A. Products installed exposed to the weather, moisture, or other potentially damaging conditions shall have their joints effectively sealed to prevent intrusion of moisture or other unwanted substances. Consider the use of heater in control panels and other items that could experience internal condensation. Tops of cabinets and equipment enclosures shall be designed to prevent puddling of liquids.

19. **EQUIPMENT SELECTIONS**  
A. Select the type of equipment best suited for the specified project requirements considering performance, flexibility, noise and vibration level, quality of construction, cost of ownership, and energy consumption.

20. **UNIVERSITY PREFERRED HVAC EQUIPMENT WITH STOCKED PARTS:**

<table>
<thead>
<tr>
<th>Equipment</th>
<th>Supplier 1</th>
<th>Supplier 2</th>
<th>Supplier 3</th>
<th>Supplier 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Air compressors</td>
<td>Quincy</td>
<td>PRV’s</td>
<td>Spence</td>
<td></td>
</tr>
<tr>
<td>Bearings</td>
<td>Fafnir</td>
<td>R.O.s</td>
<td>Culligan</td>
<td></td>
</tr>
<tr>
<td>BFPs</td>
<td>Febco</td>
<td>Radiator Thermostat</td>
<td>Danfoss</td>
<td></td>
</tr>
<tr>
<td>Condensate Pumps, Tanks</td>
<td>Paco</td>
<td>Refrigeration Compressors</td>
<td>Copeland</td>
<td></td>
</tr>
<tr>
<td>Couplings</td>
<td>Lovejoy</td>
<td>Utility Set and Skycap Fans</td>
<td>Pace</td>
<td></td>
</tr>
<tr>
<td>Motors, Pumps</td>
<td>Industrial Grade</td>
<td>Comp. Air Filters</td>
<td>Finite Filters</td>
<td></td>
</tr>
</tbody>
</table>
22. **AIR AND WATER BALANCING**

A. Systems testing, adjusting, and balancing is the process of checking and adjusting all the building environmental systems to produce the design objectives. It includes:

B. The balance of air distribution
C. Adjustment of system to provide design quantities
D. Electrical measurement
E. Verification of performance of all equipment and automatic controls
F. Air Balancers must be registered engineers in the State of Oregon and have at least 3 years of testing, adjusting, and balancing experience similar to that required for OSU’s project. The Balancing contractor and project supervisor shall be NEBB or AABC Certified.

G. NEBB: National Environmental Balancing Bureau
H. AABC: Associated Air Balance Council
I. Mark equipment settings, including damper control positions, valve indicators, fan speed control levers, and similar controls and devices, to show their final settings. Mark with paint or other suitable, permanent identification materials.

23. **PIPING MATERIALS**

<table>
<thead>
<tr>
<th>Chilled Water</th>
<th>Heating Water</th>
<th>Condenser Water</th>
<th>Steam</th>
<th>Condensate</th>
<th>Material</th>
</tr>
</thead>
<tbody>
<tr>
<td>X</td>
<td>X</td>
<td></td>
<td>X</td>
<td></td>
<td>ASTM A53 Schedule 40 black steel with ANSI B16.1 malleable iron fittings; ANSI B16.5 flanged fillings; ANSI B16.9 steel bevelweld fittings.</td>
</tr>
<tr>
<td>X</td>
<td>Certain locations; see note 1.</td>
<td>X</td>
<td></td>
<td></td>
<td>Steel grooved end fittings: Victaulic or Guston-Bacon full flow using vitaulic 07 or Guston-Bacon #105 gasket for 500 psi service.</td>
</tr>
<tr>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
<td>ASTM B88 Type L copper above ground with ASSI B16.22 wrought copper fittings with 95%-5% tin-antimony solder joints.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>X</td>
<td>ASTM A53 Schedule 40 black steel with 150 pound rated valves and fitting; ANSI B16.3 malleable iron threaded fittings; ANSI B16.5 flanged fittings; ANSI B16.9 steel bevelweld fittings.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>X</td>
<td>ASTM A53 Schedule 80 black steel with 150 pound rated valves and</td>
</tr>
</tbody>
</table>
Chilled Water | Heating Water | Condenser Water | Steam Condensate | Material
---|---|---|---|---

fitting; Joints <2” threaded except welded in shafts or inaccessible spaces ANSI B16.3 malleable iron threaded fittings; ANSI B16.5 flanged fillings; ANSI B16.9 steel bevel welding fitting. Joints >2-1/2” ANSI B16.25 belvelweld, ANSI B16.5 flanges, or B16.11 socket weld.

Note 1: Steel grooved and fittings allowed on heating water systems in exposed areas only. Maximum of 180 degree F. water temperature.

24. MANUFACTURERS

A. Piping

<table>
<thead>
<tr>
<th>Chilled Water</th>
<th>Heating Water</th>
<th>Steam</th>
<th>Item</th>
<th>Brand or Company</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Moved to Section 23125, Steam Distribution.</td>
<td></td>
</tr>
<tr>
<td>X</td>
<td>X</td>
<td>X</td>
<td>Control Valves</td>
<td>Honeywell or Johnson</td>
</tr>
<tr>
<td>X</td>
<td></td>
<td></td>
<td>Cross connection devices (preferred)</td>
<td>Febco</td>
</tr>
<tr>
<td>X</td>
<td>X</td>
<td></td>
<td>Thermostatic control valves and stats</td>
<td>Danfoss</td>
</tr>
<tr>
<td>X</td>
<td></td>
<td></td>
<td>Trap</td>
<td>Armstrong 800</td>
</tr>
<tr>
<td>X</td>
<td></td>
<td></td>
<td>Trap (floats &amp; thermostats)</td>
<td>Hoffman</td>
</tr>
<tr>
<td>X</td>
<td>X</td>
<td>X</td>
<td>Rising stem valves</td>
<td>Stockham/ Grinnel</td>
</tr>
<tr>
<td>X</td>
<td>X</td>
<td>X</td>
<td>Valves, ball</td>
<td>Apollo</td>
</tr>
<tr>
<td>X</td>
<td>X</td>
<td>X</td>
<td>Valves, brass ball</td>
<td>Gem</td>
</tr>
<tr>
<td>X</td>
<td>X</td>
<td>X</td>
<td>Valves, gate</td>
<td>Nibco</td>
</tr>
<tr>
<td>X</td>
<td>X</td>
<td>X</td>
<td>Valves, pressure</td>
<td>Watts</td>
</tr>
<tr>
<td>X</td>
<td>X</td>
<td>X</td>
<td>Valves, pressure regulating</td>
<td>PRV Spence</td>
</tr>
<tr>
<td>X</td>
<td>X</td>
<td>X</td>
<td>Valves, rising stem valve</td>
<td>Stockham/ Grinnel</td>
</tr>
</tbody>
</table>
B. Air Handling Equipment
   01. Fans - general: Barry Blower, Twin City, Greenheck, Peerless, Cook.
   02. Fans – Fume Hoods: Plasticare
   03. Central Station Air Handling Units: Hunt Air, LogicAir, Haakon.
   04. Package Rooftop Air Handlers: Carrier, Trane McQuay.

C. Chilled Water Equipment
   01. Chillers: Carrier and Trane.
   02. Pumps: Bell & Gossett, TACO, PACO.
   03. Inline pumps Bell & Gossett Series 60 or 80.

D. Cooling tower: Baltimore Air Coil, Evapco. Provide a sewer deduction meter for cooling tower make-up water. Meter specifications found in Section 33050 – Meters.

E. Heating Water Equipment
   01. Steam to hot water heat exchangers: Aerco, Armstrong, Patterson-Kelley.
   02. Direct buried steam and condensate piping: Rovanco, Thermacore.
   03. Condensate Pumps: PACO, Bell & Gossett maintenance free type
   04. Water Treatment: Chem Aqua.
   05. Steam meter information is found in section 33050 - Meters.

25. FUEL BURNING EQUIPMENT – PARTICULATE EMISSIONS
Particulate matter emissions from any fuel burning equipment installed, constructed, or modified after June 1, 1970 must not exceed 0.1 grains per standard cubic foot, corrected to 12% CO₂ or 50% excess air. "Fuel Burning Equipment" means a device that burns a solid, liquid, or gaseous fuel, the principal purpose of which is to produce heat or power by indirect heat transfer. Particulate emissions for backup emergency generators is ≤ 0.1 grain/ft³ (for new sources) or ≤ 0.2 grains/ft³ (for existing sources).
Section 23050 – Air Side Systems

PART 1 - GENERAL

1. DUCT DESIGN

   A. Duct Sizing Criteria

      01. Air Systems

         a. Volume dampers shall be provided in all supply air branch ducts and at all supply air outlets. Volume dampers shall not be placed upstream of VAV terminal units. Supply air duct systems shall be designed with care and considerations to minimize the overall system pressure drop.

         b. Low Pressure Supply Return or General Exhaust

            (1) Maximum pressure drop: 0.10 inches w.c. per 100 ft.

            (2) Maximum velocity:

               a) Supply Diffuser run out: 500 fpm.

               b) Return or exhaust grille run out: 600 fpm.

               c) Branch duct above ceiling: 1750 fpm.

               d) Mains in mechanical rooms or shafts: 2,000 fpm.

               e) Exposed mains: 1,450 fpm.

      c. Medium Pressure Supply

         (1) Maximum pressure drop: 0.35 inches w.c. per 100 ft.

         (2) Maximum velocity:

            a) Branch to terminal unit: 2,200 fpm.

            b) Round branch above ceiling: 3,000 fpm.

            c) Rectangular branch above ceiling: 1,750 fpm.

            d) Round main in mechanical rooms or shafts (above 35,000 CFM): 3500 fpm.

            e) Rectangular main in mechanical rooms or shafts: 2,500 fpm.

            f) Exposed round mains: 2,600 fpm.

            g) Exposed rectangular mains: 1,450 fpm.

   B. Kitchen Exhaust

      01. Ductwork and exhaust systems (serving Type I or Type II kitchen hoods) shall be designed and constructed per NFPA requirements.

      02. Ductwork serving a Type I hood will be constructed from stainless steel, pitched back to the hood with condensate drains, fire sprinklers, access doors at changes in direction, and separate from any other exhaust systems.

      03. Dishwasher exhaust will be constructed from aluminum or stainless steel.

      04. Hood exhaust fans shall be approved specifically for this application and shall meet the requirements of the local authorities having jurisdiction and NFPA.
05. Locate supply and exhaust grills away from exhaust hoods to prevent air being discharged from effecting hood performance.
06. Provide makeup air systems, per State Energy Code.
07. Minimum velocity for duct design: 1,500 fpm.
08. Maximum velocity for duct design: 2,500 fpm.

C. Lab Exhaust Duct Design
01. Ductwork for lab exhaust systems shall be constructed from stainless steel duct, pitched back to the hood and be separate from any other exhaust systems.
02. VAV lab exhaust systems using Phoenix Controls are preferred for new construction where there are multiple exhaust hood in a building. See #9 Variable Air Volume (VAV) Systems.
03. Locate supply and exhaust grilles away from exhaust hoods to prevent air being discharged from effecting hood performance.
04. Hood stacks will be a minimum of sixteen feet above the standing surface at the point where service personnel will stand to work on the equipment or perform other tasks.
05. Stacks located on sections of buildings within fifty feet of taller section of the building will be constructed as if they were on the taller section (ie., sixteen feet above the standing surface of the taller section).
06. Other physical arrangements may be suitable with equipment that is designed for outside dilution air, high discharge velocities, and higher effective stack height. Such systems will be reviewed and approved on a case-by-case basis by EH & S. In no case will physical stacks terminate LESS than 6.5 feet above the standing surface.
07. Maximum pressure drop: 0.35 inches w.c. per 100 ft.
08. Recirculation of any laboratory hood exhaust is prohibited.

D. Maximum velocity
01. Mains 2500 fpm
02. Branches 1500 fpm
03. Minimum stack exit velocity 3,000 fpm

2. ROTATING EQUIPMENT
A. Do not locate rotating equipment above hard ceilings

3. DUCT SEALING
A. Seal all low and medium pressure metal supply exhaust and return ductwork, per SMACNA Class A standards using either adhesive, gaskets, or tape systems.

4. DUCT PRESSURE TESTING
A. Test all ductwork slated to operate at ≥ 4 inches water gauge.
B. Randomly test three sections of medium and three sections of low pressure ductwork slated to operate at \( \leq 4 \) inches water gauge.

5. DUCTWORK CONFIGURATION
   A. Utilize spiral round duct wherever possible for low velocity.
   B. Utilize rectangular where round duct will not fit.
   C. For medium velocity, mains and branches utilize flat oval ducts where round ducts will not fit.
   D. Utilize rectangular ductwork where flat oval sizes are not available for supply ducts.
   E. For return and exhaust ducts utilize round where possible and rectangular otherwise.

6. ZONING
   A. Provide exterior zones around the perimeter of the building and interior zones for the remainder of the area.
   B. Perimeter zones to be a maximum of 15 foot deep.
   C. Corner rooms having two different exposures shall be made a separate zone if practical.
   D. Meeting and conference rooms shall be made separate zones.
   E. Other specific zoning requirements will be provided by the PM.
   F. Terminal Unit Area of Coverage:
      01. Maximum exterior zone size: 1,000 sq.ft.
      02. Maximum interior zone size: 1,800 sq.ft.

7. DUCT LAYOUT
   B. Indicate the desired layout on the Construction Drawings using double lines to delineate ducts to scale; use standard symbols.
      01. Show items such as dampers, lining, turning vanes, extractors, splitters, air flow measuring stations, and other features required for good control of air.
      02. Indicate round ductwork where possible.
      03. If rectangular ductwork is used, specify radius turns where possible.
   C. Keep the duct aspect ratio at 3 to 1 or less where possible, but not over 5 to 1 unless approved by the OSU Project Manager. Arrange the layout to avoid items that pass through ductwork unless absolutely necessary. When penetrations occur, specify an airfoil section around them.
   D. Coordinate the location of ducts with other building features such as columns, ceilings, conduit, piping and lighting fixtures. Position ductwork to allow for the removal of, or access to, filters, terminal box coils or controls, lighting fixtures, fire dampers and other similar items.
E. Ductwork design: To design the system, consider noise, pressure drop, the type of system, the type of duct material, vibration, drumming, fire and smoke control, and any other factors that may affect sizing.

F. Hangers and supports
   01. The type and size of hangers and support shall follow ASHRAE and/or SMACNA recommendations. Seismic restraints where applicable shall be designed, specified and detailed as recommended in SMACNA’s "Guidelines for Seismic Restraints in Mechanical Systems". Spring or other resilient supports shall be used in hangers where sensitivity to vibration is a problem. Coordinate with the other design disciplines when specifying or designing the duct support and hanger locations.

G. Dampers
   01. Manual and automatic opposed blade volume control dampers, back draft dampers, inlet vanes, and fire and smoke dampers shall be shown in duct layouts where required. Provide adequate room around shafts for fire/smoke damper sleeves.
   02. Where possible, select 100 percent free area fire and smoke dampers that have their entire assemblies approved by the Underwriters' Laboratories and any governmental agencies having jurisdiction.
   03. After completion of the duct layout, review the design for proper arrangement and for adequacy of the volume dampers to ensure ease of initial balancing and of rebalancing to accommodate future modifications.

H. Cleaning
   01. Specify that duct systems are to be wiped down, vacuumed, or blown clean with compressed air before installation, and that all ductwork is sealed with plastic after cleaning and during assembly to keep ducts clean. All ductwork shall be shipped sealed to the job site and kept sealed until construction is complete. Store ductwork out of the weather at all times.
   02. The return duct system shall be kept sealed at all times during construction to keep it clean. If heat is required in the building prior to finish of construction 100% outside air shall be used.
   03. Require the contractor to provide and install a new, complete set of clean filters shortly before final acceptance.
   04. Fans shall be operated with construction filters installed, at full air volume for 24 to 48 hours after installation.

I. Special requirements
   01. Supply and return ductwork
      a. Use galvanized sheet metal spiral round, rectangular, and flat oval ductwork, in that order, unless special conditions dictate use of other materials. Use pressure and/or velocity criteria to select gauge thickness according to the ASHRAE Guide or SMACNA.
02. Exhaust ductwork
   a. Ducts must convey ambient temperature or heating exhaust, smoke and grease from kitchen hoods, moisture, abrasives, and other exhaust air streams that are not acids or caustics. Use the following materials for these exhausts:
   b. Specify the gauge for galvanized sheet metal as recommended in the ASHRAE Guide or SMACNA. Ductwork for kitchen exhausts and abrasives shall have material thickness as recommended in the references.
   d. Dish Washing Exhaust: Use 304 stainless steel material for moisture latent air streams. Pitch ductwork to dish washing hood or to duct mounted drains.

03. Fume exhaust ductwork
   a. Ducts conveying corrosive air streams must be designed with materials compatible with use. The type of ductwork to be used is subject to OSU Project Manager review.
   b. Design for maximum pressures developed by the exhaust system with a 25% safety factor.
   c. See the systems below for a partial list of recommendations;
      1. Heat Exhaust - Galvanized steel
      2. Acid Exhaust - Stainless steel
      3. Solvent Exhaust - Stainless steel

8. LABELING
   A. All accessible ductwork shall be color coded and identified with wording and arrows every 20 feet on straight runs, at each riser, at each junction, at each access door, adjacent to all valves and, flanges, on both sides of floor and wall penetrations and where required to easily identify the medium transported.
   B. Smoke dampers shall be permanently identified on the exterior by a label with letters ½ inch in height reading: Fire Damper, Smoke Damper, or Fire/Smoke Damper, as appropriate. The label will be constructed from same material as equipment nameplates.
   C. Terminal Units: Mark all terminal units with a grease pencil so that the markings can be easily read from the most likely viewing position (i.e., catwalk, through the ceiling below, etc.).

9. VARIABLE AIR VOLUME (VAV) SYSTEMS
   A. VAV systems shall be used for administration and general office areas including lobbies, cafeterias, and meeting rooms, unless otherwise approved by the Project Review team and directed by the PM.
   01. VAV air handling systems must be capable of stable operation over a wide air quantity range. The selection and arrangement of terminal units
shall minimize modification required to accommodate changing tenant configurations.

02. Terminal units shall also be capable of stable operation over a wide control range.

03. VAV terminal units serving perimeter zones shall be provided with hot water heating coils.

04. Supply and return fans serving VAV systems shall be provided with a variable frequency drive to varying the air volume in response to system pressure.

05. VAV terminal units may be allowed to go to shut-off where applicable or go to a minimum setting. Zone controls shall be designed to maintain required minimum ventilation rates.

06. VAV re-heat terminal units shall close to 40% or greater as required for ventilation prior to re-heat.

07. Recirculation of any laboratory exhaust is prohibited when using a VAV system for lab hood exhaust.

B. Recirculated air systems equipped with an economizer cycle shall be capable of supplying 0-100% outside air.

C. Air economizer systems shall be used whenever practical. Provide both dry bulb and enthalpy controlled economizers.

D. For conditions under which economizer systems are not required and shall not be used, reference ASHRAE/IES Standards 90.1-1989.

E. Constant volume systems shall be used for areas requiring constant air flow and areas with constant exhaust requirements.

F. Insulation – refer to Section 23155 – Ductwork Insulation
Section 23055 – AIR SIDE EQUIPMENT

PART 1 – GENERAL

This section’s purpose is to establish standards of quality and utility for the mechanical components. The engineer’s task is to utilize equipment that provides the best value while conforming to these standards.

1. AIR HANDLING UNITS
   A. Consider both blow-through and draw-through types of air handling units. Use extreme care in the design of draw-through type air handlers utilizing economizers to assure adequate air mixing prior to the coils and the control sensors.
   B. Use variable speed/frequency drives as the means of providing air handling equipment volume control.
   C. Basic equipment requirements
      01. Specify units complete with fan section, coil section and mixing filter box section. Sections shall be combined as required and mounted on a structural steel base, complete with accessories.
      02. Access doors shall be provided for all fan, coil, filter, and mixing box sections. Doors shall be gasketed to ensure air and water tightness with viewing window in fan section.
      03. Provide perforated metal liner over insulation on the inside of the cabinet.
      04. Provide internal lighting in each section wired to a common switch.
      05. Roof-mounted units shall be complete with factory fabricated roof curbs shipped knocked down for bolted assembly at the site. All curbs shall have seismic bracing complying with local seismic codes. The air handler subbase shall be full bearing on, and self-flashing to the curb. The curb substructure shall be constructed to provide a level surface for mounting the curb. All coil piping, condensate drains, and electrical conduit shall be routed inside the unit casing and within the perimeter of the roof curb with no exposed piping on the roof.
      06. See the Controls section of this document for control requirements. Factory mounted controls on package units are not acceptable.

2. FANS
   A. Select most efficient type of wheel and analyze the sound power levels in each octave band.
   B. Special fans include fiberglass-reinforced, plastic, stainless steel, and other special metals for acid, caustic, and other corrosive exhausts. Avoid coatings when possible. Use non-sparking aluminum wheels or all-aluminum fans for kitchen hoods and solvent fume exhausts.
C. Use variable speed/frequency drives for capacity control.

D. Basic equipment requirements
   01. Centrifugal Fans
       a. Fans shall have all-steel housing, Class I or II construction. After assembly, fans shall be statically and dynamically balanced at operating speed.
       b. Fans shall be tested in accordance with AMCA Standard 21067 and shall have evidence of this certification permanently affixed to units.
       c. Fans of manufacturer’s standard construction shall be finished with primer and enamel finish in manufacturer’s standard color.
       d. Single inlet fan housings shall be specified with a 1/2” diameter threaded drain fitting at the low point of the fan scroll.

3. FILTERS: THE FOLLOWING FILTERS AND ACCESSORIES SHOULD BE SPECIFIED AND SHALL MEET THE FOLLOWING MINIMUM CRITERIA:
   A. Air handling units shall be equipped with both pre and final filters.
   B. Pre-filter (panel type)
      01. The pre-filter shall be listed as Class 2 by the Underwriters’ Laboratories.
      02. Filters shall have an average efficiency rating of 25-30 percent (MERV 6-7) by the ASHRAE Standard 52-76 test method using atmospheric dust.
   C. Final-filter (extended media type)
      01. Specify replaceable, factory-assembled filter elements of fine-fibered, all-glass media.
      02. The replaceable media filters shall be held by a permanent gasketed holding frame with retaining clips to maintain a positive pressure seal between the frame and the replaceable filter element.
      03. The average efficiency of the filter shall be either 60-65% (MERV 13), 80-85% (MERV 14) or 90-95% (MERV 15) efficiencies, depending on area of service.
      04. Filters shall be Underwriter’s Laboratories listed (Class I or Class II, according to system requirements).
   D. Air filter gauge
      01. Provide a gauge across each filter bank.
   E. Discuss the level of filtration required with the OSU Project Manager.

4. SOUND ATTENUATORS
   A. General
      01. When sound attenuators are used, specify the maximum acceptable calculated sound levels for particular locations. Rectangular low pressure drop units are preferable. Use medium or high pressure drop units or round units only when the others cannot be applied.
02. Select units with a dynamic insertion loss at least 3 dB less from generated noise level in all eight octave bands.

B. Basic equipment requirements
01. Outer casings shall be in accordance with ASHRAE Guide recommendations for high pressure ductwork. Casings shall not vibrate audibly during normal operation of the air handling system.
02. The acoustically absorptive filler material shall be made from an inorganic fiberglass-like material. The material shall be inert, vermin-and moisture-proof, and impart no odor to the air.
03. The filler material shall be incombustible and shall not exhibit more than the following fire hazard classification values when tested in accordance with standard ASTM E84, NFPA 255, or UL 723 test methods:
   a. Flame spread: 25.
   c. Smoke developed: 0.
04. Acoustical ratings shall be determined by the “duct-to-reverberation room” method in accordance with ASTM Specification E477. Airflow and pressure loss data taken in accordance with AMCA procedures shall be obtained from the same silencer used for acoustic performance tests.
05. Calculate pressure losses carefully, particularly the inlet and exit losses.
06. Coordinate the installation location of attenuators with the manufacturer-recommended installation guidelines.

2. COILS
A. General
01. Heating and cooling coils shall be aluminum-finned copper tube with fin spacing no tighter than 10 fins per inch. Coils may be used for cooling, dehumidifying, and heating air and should meet the requirements of the Air Conditioning and Refrigeration Institute (ARI). Coil capacity ratings shall be certified in accordance with ARI Standard 410-72.
02. Specify coils with vents and drains.
B. Basic equipment requirements
01. Coils shall be drainable.
02. Coil tubes shall be seamless copper. Avoid the use of turbulators.
03. Coil fins shall be aluminum surfaced continuously across the entire coil width with full fin collars for maximum fin tube contact. Fins shall be mechanically bonded to tubes.
04. Size dehumidifying coils so maximum face velocity will not exceed 500 FPM to prevent moisture carryover.

3. DIFFUSERS, REGISTERS, AND GRILLES
A. Select all air outlets with consideration for air throw pattern, drafts, noise and compatibility with architectural requirements. Call for factory applied baked enamel or other suitable finish and coordinate the color with the architect.

B. Unit sizing is based on air being introduced at 20 deg. F. temperature differential and being diffused at the 5 ft. level to a velocity not greater than 50 FPM and a temperature differential not greater than 1.5 deg. F.

C. Units selected will not exceed design sound level for the space served.

4. TERMINAL UNITS

A. Units shall be pressure independent and electrically or pneumatically actuated. Specify clearance for access and removal of components.

B. Specified variable volume terminal units shall meet the following minimum criteria:

01. Terminals shall be pressure independent and capable of resetting the air flow between a preset maximum and minimum as determined by the space thermostat, regardless of changes in system air pressure. The terminal air valve shall return to the minimum air flow setting on loss of the control signal, unless otherwise specified.

02. Each variable volume terminal shall be factory set for the maximum and minimum level air quantity shown in the terminal schedule.

03. The casing shall be constructed of coated steel meeting SMACNA or ASHRAE Standards. Internal insulation shall meet the requirements of NFPA Bulletin 90-A and UL 181.

04. Terminals shall be complete with factory furnished and installed actuators and accessory controls.

05. ll terminal hot water heating coils shall be furnished by the terminal manufacturer and shall be internally mounted in the casing at the factory. Coils shall be of the slip-in type, removable from the side. The design shall provide even air distribution across the coil face to ensure optimum coil performance. Use electric reheat coils only with permission of the Project Review Team.

06. Terminal units must be capable of stable control over a wide turn-down ratio. Terminal units shall be sized and arranged to facilitate the relocation of process cooling loads with minimum disruption to the HVAC system.

07. Provide 5-feet of lined sheet metal discharge ductwork for units below 1,500 cfm, and 10-feet long for larger units prior to the first duct takeoff. Provide Mylar facing over insulation to allow for cleaning.

C. The quality of items not covered in these standards shall be of the same general level and be subject to the same tests of value as those that are included.

D. Select items made by established manufacturers who have demonstrated the capability to provide replacement parts and service as may be required. The quality of the manufacturer’s local representation is very important.
E. Analyze manufacturers’ designs for inherent maintenance qualities, as well as adequate access doors, fasteners, and other accessories, which will facilitate maintenance.
Section 23120 – FLUID SYSTEMS EQUIPMENT

PART 1 – GENERAL

1. CHILLERS

   A. Provide chiller packages with centrifugal compressors, or screw compressors, and water cooled condensers.
   B. Design the chiller plant with at least two chillers if the total capacity is more than 400 tons. Size one chiller for 1/3 of the load and the other chiller for 2/3 of the load.
   C. Include equipment KW/Ton and APLV values in a selection criteria.
   D. Basic Equipment Requirements
      01. The equipment shall be furnished as a complete factory assembled package, including hermetically sealed compressor, variable speed drive and motor, evaporator, condenser, lubrication and purge systems, capacity controls, instrumentation and control panel, power and control wiring, refrigerant piping, full charges of R-123, R-134a, or R-22.
      02. The control package on the chiller must be capable of controlling chilled and condenser water pumps, the cooling tower, and interface to the building automation system via the BACnet or LON control protocols.
      03. Chiller room ventilation is required in accordance with the Uniform Mechanical Code. Include refrigerant sensors, control systems, and air handling equipment in any existing chiller rooms to be upgraded to bring them in full compliance with current codes.
      04. The equipment shall be rated in conformance with the latest ARI Standard 550-88 and shall conform to the latest ANSI/ASHRAE 15 Safety Code.
      05. The condenser and evaporator shall also conform to the ANSI B9.1 Safety Code for mechanical refrigeration and to the ASME Code for Unfired Pressure Vessels where applicable.
      06. Electrical components and assemblies shall bear the UL or ETL label, where applicable, and electrical requirements, including control requirements, must be coordinated with available utilities.
      07. The starter may be unit mounted or free standing, but shall be designed specifically for the characteristics of the chiller and shall be furnished with the chiller by the chiller manufacturer.
      08. The temperature control system shall be provided with interface devices and a terminal block to allow remote adjustment of the chilled water temperature set point.

   B. Performance requirements
      01. Equipment selection, including evaporator and condenser size and configuration, shall be based on the chilled water system requirements.
Coordinate the choice of chillers and system requirements to provide the optimum selection of equipment vs. flow rates, temperatures and temperature changes.

02. Provide computerized analyses from the manufacturer for at least three different selections. Data should include part load performance in kW/ton based on ARI 550 test conditions, including condenser water relief in 10% increments from 10% to 100% of machine capacity. Base selections on 0.0005 fouling factors for both the evaporator and condenser.

2. COOLING TOWERS
A. Specify that cooling towers shall not be filled until chemical treatment is operational and that only treated water shall be used in the system.
B. Isolate the cooling tower from all pipe flushing and cleaning operations.
C. Use only induced draft cross flow cooling towers located on the roof of the building. Forced draft cooling towers and cooling towers located at grade are not acceptable to OSU.
D. Towers shall be constructed of non-combustible materials.
E. Cooling towers to be selected for maximum efficiency at the selected operation point and are to be sized for an additional 20% capacity.
F. Equalizer connections between basins shall be specified on multiple open evaporative tower applications. Equalizer connections and piping between tower basins shall be separate from any other piping systems. Evaluate the impact of sound upon surroundings.
G. Basic equipment requirements
01. Cooling towers shall meet the following minimum criteria:
   a. The towers shall be factory assembled, induced draft, cross flow type with a vertical air discharge.
   b. The basin and casing up to the top of the fill shall be constructed of 304 stainless steel.
   c. The casing above the fill shall be constructed entirely from hot-dip galvanized steel panels supported by a hot-dip galvanized steel angle and channel framework, all finished inside and out with zinc chromatized aluminum. Consider fiber reinforced plastic and stainless steel construction.
   d. The basin shall have a connecting weir for equalization of water level and a by-pass connection. A brass, float-operated make-up valve shall be provided complete with a large diameter plastic float, arranged for easy adjustment. The float valve is to be sized for the worst possible conditions of basin fill rate.
   e. Basins shall be provided with provisions for a winter bypass to the sump when the system is expected to operate during winter conditions.
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f. Basins must have a bottom outlet with a strainer and an anti-cavitation device. Do not select a side outlet configuration.

g. Inlet louvers shall be of fiberglass or galvanized steel construction, and equipped with inlet screens.

h. The fill material shall be PVC and have a flame spread rating of 5 per ASTM Standard E84-77A and shall be impervious to rot, decay, fungus, or biological attack.

i. Drift eliminators shall be constructed of PVC and shall limit drift to less than 0.2 percent of the total water circulated.

j. Fans shall be a fixed pitch, heavy duty, cast aluminum, multi-blade type, protected by a fan guard and each driven though a gear box or power belt reducer by a TEAO (totally enclosed, air over), 1800 RPM, motor, ball bearing type designed specifically for cooling tower service. The motor shall be the high-power factor and high-energy efficient type and have non-fused disconnects located at the motor. The motor shall be furnished with special moisture protection windings, shafts, and bearings. The fan and shaft shall be supported by re-lubricatable ball bearings with special moisture seals, slingers, and housings designed to prevent moisture accumulation. Provide a vibration cut-out switch.

k. Access doors shall be provided on both sides of the tower for access to eliminators and the plenum section. Safety railing and a ladder shall be furnished with a tower unit requiring a fan and drive service above the fan deck, and shall meet OSHA requirements. Units capable of being serviced from within the unit shall be provided with an internal galvanized steel catwalk for service access.

l. Lubrication points are to be provided with piping or tubing extensions to readily accessible points and terminate with appropriate lubrication fittings.

m. Furnish electric immersion heaters or steam heaters (preferred), factory installed to prevent freeze-up conditions (where it is appropriate.) Include factory installed thermostats and controllers.

n. Furnish vibration isolator rails for vibration control. Consult with the sound consultant for requirements.

3. PUMPS

A. Specify single stage centrifugal pumps for water service.

B. Horizontal, base mounted, end suction pumps with a common forged or cast, steel base frame (not welded), are preferred for applications up to 1,000 GPM.

C. Horizontal or vertical split case pumps with a common steel base are preferred for applications larger than 1,000 GPM.

D. Select the pump motor horsepower for non-overloading conditions.
E. Small circulation pumps must be a maintenance free type.
F. Pipe mounted pumps must have a cast iron volute.
G. Basic equipment requirements
   01. All water service pumps shall be of bronze fitted cast iron with mechanical seals of the carbon-ceramic type.
   02. Impellers shall be bronze, enclosed, statically and dynamically balanced, and fitted to the shaft with a key and locked in place. Motors and impellers shall be easily removed without disassembling the piping.
   03. Specify 1,750 RPM motors. Avoid using 3,500 RPM motors. Motors shall be the premium-efficiency type. Pumps, coupling, and motors shall be factory installed.
   04. The pump shaft shall be fitted with a bronze sleeve and the bearing frame assembly shall be fitted with regreasable ball bearings.
   05. The end suction or split case pump and the motor shall be connected with a flexible coupler fitted with an OSHA approved coupling guard. The pump housing shall have gauge and drain tappings.

4. PUMP SUCTION DIFFUSERS
   A. Suction diffusers should be considered for all chilled and hot water system pumps with capacities up to 2,500 GPM.
   B. Basic equipment requirements
      01. The unit shall consist of an angle type body with inlet vanes and a combination diffuser-strainer-orifice cylinder with 3/16" diameters openings for pump protection.
      02. The orifice cylinder shall be equipped with a disposable fine mesh strainer which shall be removed after system start-up.
   C. A permanent magnet shall be located within the flow stream and shall be removable for cleaning.
   D. The unit shall be provided with an adjustable support foot to carry the weight of the suction piping.

5. EXPANSION TANKS
   A. Pressurized diaphragm type, pre-charged with air to the initial fill pressure of the system. The tank shall be ASME stamped and certified for 125 psi and 240 deg. F. Furnish horizontal tanks with saddles and vertical tanks with base mounts.

6. STRainers
   A. Specify strainers in all hot water, chilled water, steam, and condenser water systems. Provide manual blow-down valves for strainers in sizes 1 1/4" and larger. Provide Y-type strainers at water supply piping to all chilled water and hot water coils, upstream of all components except the last isolation valve. Size the mesh for service. Provide valving, and allow space to remove and clean the strainer basket or mesh.
B. Use Y-type strainers for up to 8" diameter. For larger sizes, use basket-type strainers.

7. WATER FLOW MEASURING STATIONS
   A. Use a pitot tube or Venturi type and specify stations complete with a portable readout meter. Locate the meter in the piping at a point where proper upstream and downstream distances are observed so that accurate readings can be obtained. Differential pressure taps for the meter readout shall be located on the horizontal centerline of horizontal pipes.
   B. Specify stations with shut-off valves and quick disconnects for the portable meter.

8. AIR SEPARATORS
   A. Specify air separators in all hot and cold water closed loop systems.
   B. Air separators shall be the centrifugal type complete with removable strainers, drains and support legs or brackets.
   C. Provide an automatic air vent with separator assemblies.

9. TEST PORTS
   A. Specify a "Petes Plug" to be installed in piping at the inlet and outlet of all water coils, heat exchangers, chillers, pumps, and at all ports of water coil temperature control valves.

10. WATER TREATMENT
    A. Water treatment systems shall be provided for all open circulated systems requiring a continuous supply of make-up water. The chemical treatment system shall be automatic in operation and shall continuously monitor and control pH, conductivity, and the corrosive tendency of the recirculated water. Chemicals shall come in a solid concentrated form and be specifically formulated for the water on the OSU campus.
    B. All closed loop chilled water and hot water circulating systems shall be provided with chemical feeders across the appropriate pumps.
    C. Basic equipment requirements
       01. Specify that system components are to be furnished by a single supplier. Components shall include, but not be limited to, the following:
           a. A pre-wired control and instrumentation panel mounted in a NEMA 12 enclosure with a key-lock door with a window.
           b. A water meter for monitoring make-up water quantity.
           c. An automatic bleed valve.
           d. Sensor assemblies.
           e. Chemical feed pumps (positive displacement type).
           f. Corporation stop and injection assemblies.
           g. Chemical feeding tubing.
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h. Solid concentrated chemical.

D. Acceptable manufacturers: Chem Aqua, or an equal.

11. PIPING
   A. Standards
      01. The piping systems shall be designed in accordance with the guidelines established by the latest edition of the ASHRAE Fundamentals Handbook.

12. QUALITY ASSURANCE
   A. Welders must be certified in accordance with the American Welding Society Standard Qualification Procedures.
   B. Refrigerant piping installers must be certified by the American Refrigeration Contractors Association Qualification Procedures.
   C. A factory trained representative of special items or systems must provide field instruction to the installers.

13. ROUTING
   A. The piping shall be routed as directly as possible and sloped for venting and draining. Where possible, use routing to accommodate thermal expansion requirements. Locate pipes, vales, and accessories to be readily observable and accessible for modification, maintenance, or repair, except when concealed in finished areas.

14. LAYOUT
   A. Piping runs, manifolds, and connections to equipment should be arranged so the operation and function of the systems and their components are easily understood.

15. CONNECTIONS TO EQUIPMENT
   A. Arrange pipe, valves and accessories for ease of operation and maintenance. Every item of equipment and every assembly such as pressure reducing stations and flow control/measuring stations shall be provided with isolation valves; a balancing valve equipped with a memory stop may be used as the downstream valve if appropriate. By-pass loops with balancing valves shall be provided where it is desirable to keep the system in operation during shutdown.
   B. Flexible connections shall be provided at equipment to allow for minor misalignment. Vibration elimination connections shall be provided where required. Rigid pipe supports shall be provided on the "outboard" side of flexible connections and vibration eliminators. Avoid strain on equipment.
   C. Provide clear access to all heat exchanger bundles of chillers, boilers, heat exchangers and coils for cleaning, removal or replacing individual tubes. Route connecting piping to clear access space or provide flanged connections to allow minimal removal of piping to gain clear access. In general, the clear access shall
be provided at one end only of the heat exchanger bundle.

16. THERMAL EXPANSION
   A. Where it is not possible to accommodate expansion and contraction by the
general routing of the pipe, expansion loops or expansion devices must be used.
   01. Take special care in providing for adequate expansion.
   02. Proper pipe guides are imperative at expansion loops and devices.
   03. Loops or flexible sections are preferred over mechanical joints.
   B. Locate properly designed anchors that control the way expansion occurs to
ensure the effectiveness of routing, loops, or devices and to prevent undesired
movement at connections to equipment, where pipes are close to structure, etc.
   C. See paragraph 10, calculations, in the Responsibilities of the Mechanical
Engineer section.

17. VENTING AND DRAINING
   A. Piping shall be pitched to allow for proper automatic venting of all system high
points and manual or automatic draining of all system low points. Use eccentric
reducers as required. Provide manual shut-off valves for maintenance of
automatic devices.
   B. Extend the vent or drain piping, if required, to allow installation of valves and
assemblies at convenient service locations. Extend vent discharge piping to a
safe location; extend drain discharge piping to a floor drain or other appropriate
location such as the condensate return system for steam traps.
   C. Provide vacuum relief’s at coils, heat exchangers, and other heat transfer devices
as required.

18. HANGERS AND SUPPORTS
   A. Specify hangers and supports with special considerations for vertical piping and
connections to equipment. Use vibration eliminating hangers for piping near
pumps, fan coil units, and other dynamic equipment for vibration-sensitive
applications.
   B. Provide seismic restraints to meet local codes. Use SMACNA Guide restraints
where applicable. Attachments to the building structure must be adequate and
shall be detailed and/or specified.
   C. Pipe, valves, and accessories "in-board" of flexible connections at vibration
isolated equipment must be supported from the equipment inertia base or
otherwise isolated with the equipment without putting undesirable stress on the
equipment.

19. SECTION VALVES
   A. In addition to local connections to equipment, provide piping systems with
isolating valves to facilitate maintenance and minimize the extent of the system
that must be shut down for repairs, modifications, or expansion. In general,
provide an isolation valve, ball, gate or butterfly, at all pipe header connections to eliminate total system drainage during future piping modifications.

B. The valve pressure rating must be a minimum of 1.5 times the working pressure of the system served.

20. MATERIALS
   A. Pipe valve fittings and accessories shall be of good quality. To ensure quality, specify piping by ASTM, AWWA, or other appropriate standard; specify ASME ratings for valves and list brand names as a standard; specify fittings by ANSI or another appropriate standard.
   B. All materials must meet applicable codes. Where standards may not be sufficient to ensure the quality desired, specify a brand name as a means of establishing the quality level. Whatever method is used, be specific. Include pipe joint materials and methods in the specifications.

21. CLEANING AND TESTING
   A. After installation, all systems shall be properly cleaned by flushing with an appropriate liquid or gas before installation of valves and final connections to the equipment. After flushing, closed heated and cooled water systems shall be cleaned by circulating a solution of trisodium phosphate or a similar agent before the final flush and fill. Untreated water and all cleaning and water treatment chemicals shall be approved by EHS by going through the OSU Project Manager.
   B. Isolate the cooling tower from all piping flushing and cleaning operations to prevent untreated water from entering the basin.
   C. Before their final acceptance all strainers, drip legs, and similar items shall be thoroughly cleaned.
   D. All tests must be observed by OSU’s Project Manager. In general, test systems at 1-1/2 times the highest system operating pressure for 24 hours.
   E. Any tank for chemicals which may enter the sewage system will be located so it can be easily charged and serviced.

22. DIRECT BURIED PIPING
   A. Minimum burying depth for all direct buried piping is 36 inches.
   B. Do not run within the drip line of existing trees.

23. DUCTWORK
   A. Refer to Section 23150
PART 1 – GENERAL

1. REQUIREMENTS
   A. The campus steam system operates at 60 psi saturated.
   B. Provide condensate pumps at each building.
   C. All systems components of the steam and condensate systems are to be rated to operate at a minimum of 150 PSI and meet all ANSI and ASME Codes and standards.

2. PIPING
   A. Design steam lines using schedule 40 black steel pipe.
   B. Fittings can be either welded, raised flanged, or threaded - depending on the pipe size.
   C. Design condensate return lines using schedule 80 black steel pipe.
   D. Fittings can be either welded, raised flanged, or threaded depending on pipe size.
   E. Include provision for expansion and contraction of steam and condensate lines to prevent noise.
   F. All piping delivering steam or condensate must be properly insulated according to the application.

3. TRAPS
   A. Armstrong and Mepco are the preferred brand traps.
   B. The following factors must be considered when sizing and typing steam traps:
      01. LOAD: The amount of condensate the trap must handle.
      02. APPLICATION: How the trap is used.
      03. SUPPLY: Modulated or constant supply.
      04. BACK PRESSURE: The pressure (or range of pressures) at the trap outlet.
      05. SUPPLY PRESSURE: The pressure (or range of pressures) at the trap inlet.
   C. When appropriate, expand capacity ratings to avoid using a larger, less efficient trap.
   D. In selecting traps, the maximum differential pressure can be used in the sizing calculation as long as the operating differential is at least 80% of the maximum differential. If the operating differential is less than 80% of the maximum differential, ensure the trap will provide adequate drainage at both the maximum differential and the operating differential.
   E. In applications where the operating differential has a range, the trap must be able to drain the calculated load at the minimum operating differential as well.
4. VALVES
   A. Select all valves and apurtenances at 1-½ x working pressure with 150 PSI minimum.
   B. Flanged valves must have a raised face and be provided with a Flexitallic gasket with cast steel bodies.
   C. Specify rising stem gate valves for all steam and condensate systems.
   D. Safety relief valves must be located and vented to prevent injury to personnel.
   E. Design in adequate maintenance access to all valves.
   F. Spence PRV's are preferred.
   G. Thermostatic controlled valves (such as Danfoss) shall be used in any place where convectors are installed (hot water or steam), or DDC modulating valves.

5. DIRECT BURIED STEAM PIPING
   A. Direct buried piping for steam and condensate piping to have metallic carrier pipe, insulation, one inch air space, and a metallic outer conduit with fusion bonded epoxy coating. *Product based on Rovanco Hi-Temp Conduit for below ground applications or Perma – Pipe ESCON-A ®FERRO-SHIELD®. Provide cathodic protection for direct buried steam and condensate piping systems.
   B. Expansion Joints:
      01. Bellows type with stainless steel bellows.
      02. 150 psi working pressure.
      03. Preferred manufacturer – Hyspan.
      04. The mechanical engineer is responsible for the design and coordination of the steam and condensate supports and anchoring system.

6. VAULTS
   A. Provide vaults in the direct buried steam system where there are devices that need maintenance.
   B. Size vaults for adequate access for installation, maintenance, operation, and removal of components.
   C. Include a sump pump and a ladder.
   D. Provide waterproof coating on exterior of vaults.

7. METERING
   A. All buildings shall be metered for both steam and condensate.
   B. Steam and condensate meter equipment, installation and application details are specified in Section 33050 – Meters.
Section 23155 – DUCTWORK INSULATION

PART 1 – GENERAL

1. REQUIREMENTS
   A. Provide for review a list of all pipe and duct systems with a brief justification of insulation and thickness, or of no insulation if none is specified.
   B. Include all field insulated equipment on the list.
   C. As a minimum insulation thickness to meet the requirements of the State Energy Code.

2. MATERIALS
   A. The insulation and jacketing shall be resistant to moisture and mold and shall be resistant to damage or deterioration under the service intended. Materials shall meet the smoke and flame spread ratings required by the governing codes.
   B. Closed cell plastic insulation is preferred on refrigerant piping and cold equipment.

3. EXPOSURE
   A. Surfaces, which will operate within 10 deg. F of the ambient dew point, shall have a vapor barrier over the insulation.
   B. Surfaces better than 90 deg. F shall be insulated as required to protect personnel and/or conserve energy.
   C. Insulation exposed to weather or to physical damage shall have suitable protection.
   D. Aluminum jackets secured with aluminum bands on 12" centers with longitudinal seams lapped and turned down shall be installed on all piping exposed to weather. Provide similar protection at all valves, fittings, and flanges.

4. SERVICE
   A. Insulation shall be installed such that service and maintenance points such as valve handles, access doors, pressure and temperature fittings, lubrication fittings, and strainers remain accessible without disturbing the insulation.
      01. Vapor barrier jackets shall be sealed at locations to prevent the intrusion of moisture.

5. PIPING
   A. Use factory made PVC covers at fittings, flanges, and all other irregular shapes for which they are available.
      01. Specify structurally rigid insulation sections at all hangers and supports to prevent damage to the insulation and jackets.
      02. Size hangers and supports to go outside the insulation.
03. Provide steam traps 1” and over with snap on insulation. See Section 23125 for additional steam system insulation requirements.

6. DUCTWORK
   A. Provide a vapor seal design at strap or rod hangers and a thermal conduction barrier at trapeze hangers and supports.
   B. Require extra erosion protection at the upstream edge of duct lining sections such as a sheet metal flashing.
   C. Internally lined ductwork
      01. Internally lined ductwork shall be avoided, except when used for sound attenuation or when used in areas where external insulation is subject to damage (such as mechanical rooms).
      02. Where internal insulation is used provide Mylar facing to allow cleaning.
      03. Provide perforated liner over internal insulation inside mechanical units.
   D. Access will be provided at elbows, turning vanes, and locations where debris collects.
   E. Other sound isolation is anticipated when the insulation is external.
   F. Use a maximum of six feet of flexible ductwork on diffuser and grille run outs.

7. EQUIPMENT
   A. Coordinate insulation and equipment specifications to be sure that the required insulation is field applied if equipment is not factory insulated.
   B. Equipment such as chilled water pumps or heat exchangers which must be completely insulated shall be provided with boxed insulation which is designed and marked so it can be removed and replaced without destroying the utility and appearance, except for repairs needed on the jacket.
Section 25050 – BUILDING CONTROLS AND INSTRUMENTATION

PART 1 – GENERAL

1. REQUIREMENTS

A. DESIGN
   01. Throughout this design guide, manufacturers/installers are referred to as the contractor.
   02. Currently approved manufacturers/installers:
       a. Siemens Building Technologies Inc.
       b. Johnson Controls Inc.
       c. Alerton
       d. Other manufacturers may be approved if they can demonstrate interoperability by manipulating and controlling the other vendor’s devices. The demonstration must occur prior to the of the schematic design portion of the project.
   03. The Energy Management System (EMS) shall be a distributed intelligent network (DDC) that is fully compatible with the Johnson M-5 Workstation or the Siemens Apogee Workstation or the Alerton BACnet system currently installed on the Oregon State Campus. Full compatibility is defined as a seamless ability to take full advantage of all network and DDC operating capabilities of the existing campus-wide EMS.
   04. Installation of the Siemens and Johnson systems is to be performed by the branch office. Installation by the Alerton system is to be performed by Environmental Controls Corporation.

2. CENTRAL EQUIPMENT AND OPERATING SYSTEM
   A. Each of the existing approved control systems has a central monitoring and control station located in the EMS Shop. These are the primary computers for each of the different control systems on campus. Each system is configured to perform all the data gathering and processing functions, communication with peripherals, and application packages. The control program provides for all operational needs, without requiring any program changes.
   B. Provide a new local workstation in each new building. Workstation to be capable of monitoring and manipulating all of the controls in the building and be able to access the systems in other buildings. This workstation does not take the place of the primary workstation in the EMS Shop.
   C. Portable Workstation
      01. Verify with the OSU Project Manager if a portable workstation is required.
02. The portable operator's workstation shall include all of the functions, capability, and software tools of the main workstation located in the EMS Shop.

03. The portable operator's workstation shall be a light weight laptop from a main stream supplier like Dell or Toshiba and be capable of operating third party software.

04. As part of the portable workstation package, provide all necessary field tools, testing cables and equipment necessary to work on the control devices in the field.

D. Consultant to specify that the local building computer workstation is to be provided to OSU prior to installation. OSU will load the Windows Operating System and OSU Network and security drivers. The computer will then be returned to the contractor for installation of control software.

3. ENERGY MANAGEMENT SYSTEM
   A. The energy management system shall operate under the control of one or more microprocessors/microcomputers with peripheral hardware and software configured to perform the following functions.
      01. The system shall be a fully modular family of programs, peripherals, and application packages designed specifically for building management, including energy management, HVAC control and monitoring, and controlled access.
      02. The system shall be capable of interfacing with the existing installed primary computer system located in the EMS Shop and shall allow for future expansion of both input/output points and processing/control functions and operating stations
          a. Specifically, it shall be easy to add components, including memory, peripherals, field devices, and software, to the system to expand the size of the scope of automation.
      03. Provide a minimum of 10% spare point capacity at each stand-alone cabinet.
   B. All materials and equipment used shall be standard components, regularly manufactured for this system and shall not be custom designed especially for this project. All systems and components shall have been thoroughly tested and proven in actual use.
   C. The EMS shall include full support for its compatibility with the system. In addition, the EMS shall use the latest product line offered by the EMS manufacturer.

4. REMOTE INPUT/OUTPUT DEVICES
   A. Sensors installed as part of this system shall meet the following minimum accuracy requirements:
      01. Temperature
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a. Space: 0.75F accuracy.
b. Outside air: 1.0F accuracy.
c. Chilled Water: 0.75F accuracy.
d. Heating Water: 2F accuracy.

02. Relative humidity: 5% of full scale accuracy.
03. kWh and kW demand: range suitable for site, 1% of full scale accuracy.
04. Pressure: range suitable for application, 2% of full scale accuracy.
05. Pressure switches: adjustable settings, 2% of full scale accuracy.
06. Sensors located outdoors shall have suitable weather shields to provide protection from wind, rain, solar effects and radiation from nearby buildings.
07. Water temperature sensors shall be immersion-type. All transducers shall be industrial-grade quality.
08. All equipment will be provided with manual overrides (H.O.A. Switches) and shall remain able to be manually overridden (Hand or Off position), but shall be set in the automatic position. Provide HOA in control panel at each air handling unit, exhaust fan, or pump start/stop function except where an MCC HOA is provided.

5. SOFTWARE: GENERAL
   A. The system shall be a user-programmable direct digital control system, utilizing P.I.D. (proportional-integral-derivative) algorithms for the control of all modulating equipment.
   B. The system shall support multiple users performing multiple tasks. System changes (add points, modify programs, etc.) shall be able to be performed while the system is on-line. Alarms shall be able to be printed while system changes are being made.
   C. The software shall include diagnostics to isolate component failures and verify system operation.
   D. If the most current version of the system’s graphic workstation software and programming tools already exists on the primary EMS Shop computer, the contractor is to be responsible for updating the graphic and software packages for incorporation of the new building’s controls on the primary computer in the EMS Shop.
   E. If the workstation software and programming tools are not the latest versions on the primary EMS Shop computer, the contractor is responsible for updating the primary EMS Shop computer software and programming tools to the latest version and the incorporation of the new building’s controls. In addition, each remote building computer on the contractor’s network is to be updated to show the new building’s control screen.
6. OPERATOR COMMUNICATION AND ACCESS

A. Graphical Software: Provide personal computer-based software that is compatible with a computer-vendor-supplied and supported, unmodified real-time disk operating system such as MS-DOS.

B. The software shall provide, as a minimum, the following functionality:
   01. Graphical viewing and control of environment.
   02. Scheduling and override of building operations.
   03. Collection and analysis of historical data.
   04. Definition and construction of dynamic color graphics.
   05. Editing, programming, storage and downloading of controller database.

C. Software for the workstations shall provide for a windowed approach.

D. Provide functionality to allow for any analog point value to be displayed as an individual dynamic display window for use as a convenient control and diagnostic tool. The display window shall include the following information as a minimum:
   01. Point name.
   02. Point description.
   03. Set point.
   04. Current value.
   05. Range of values.
   06. High and low limit set points.

E. All values shall be displayed in both text and symbolic form, such as an analog bar, gauge or other standard measurement device.

F. Provide the capability to control any point from a dynamic graphic display.

G. Provide a graphical spreadsheet-type format for simplification of time-of-day scheduling and overrides of building operations. Provide the following spreadsheet graphic types as a minimum:
   01. Weekly schedules shall be provided for each building zone or piece of equipment with a specific occupancy schedule.
   02. Zone schedules shall be provided for each building zone as previously described.
   03. Monthly calendars for a 24-month period shall be provided to allow for simplified scheduling of holidays and special days in advance. Holidays and special days shall be user-selected with the pointing device and shall automatically reschedule equipment operation as previously defined on the weekly schedules.

H. Provide trending capabilities that allow the user to easily monitor and preserve records of system activity over an extended period of time. Any system point may be trended automatically at time-based intervals or changes of value, both of which shall be user-definable. Trend data may be stored on hard disk for future diagnostics and reporting.
   01. Trend data report graphics shall be provided to allow the user to view all trend point data.
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a. Provide additional functionality to allow any trended data to be transferred easily to an off-the-shelf spreadsheet package such as Microsoft Excel.

02. A collection schedule function shall be provided to automatically collect trend data.

03. Setup individual trending logs that record usage data every 15 minutes for the building electrical, steam, natural gas, condensate, domestic water, chilled and heating water flow, inlet and outlet temperatures and BTU. See Section 33050 for metering requirements.

04. Provide additional functionality that allows the user to view trended data on trend graph displays: Displays shall be actual plots of both static and real-time dynamic point data.

I. A full screen, forms based point editor and programming function shall allow for point additions, deletions, changes, program modification and creation and point and program storage. This program shall be similar to a word-processing format such that full documentation of program changes may be available. This program shall provide the user with the capability to insert full English narratives to describe the control program. Search, insert, find, cut and paste functions shall allow for quick program modifications.

J. Provide a general purpose graphics package which shall allow the user to quickly and easily define or construct color graphic displays.

K. Provide the capability to backup and store all system databases on the PC hard disk. While the PC is on-line without disrupting other system operations.

L. Provide context-sensitive help menus to provide instruction appropriate with the operation and applications currently being performed.

M. Multiple user security levels shall be provided to allow for various degrees of system access and control.

01. The workstation shall be provided with a keg element display that records log-ons, log-offs, TOD overrides, alarms and alarm acknowledgments.

02. Provide a 500 element circular buffer for recording purposes.

03. Key element reports may be filtered by operator name and may be run for a user-defined time interval.

7. SUMMARIES AND LOGS

A. The system shall be provided with a log function. This function shall provide the system operator with a means of requesting a single point, all points in a given system, or all points in the building.

B. The system shall have the capability of generating the following reports as a minimum:

01. Program Summary: Upon operator request, the system shall output a programmed start/stop, time summary. This summary shall contain all
points, their associated programmed start/stop times and the respective
days of week.

02. Limit Summary: An Analog Limit and Differential Summary shall be
provided that details the high and low limits and limit differentials for all
analog points, or all analog points within a unique building system.

03. System Log: A System Log shall be provided which contains the point
status of all points specified by operator input.

04. Trend Logs: Trend Logs shall provide a means of producing a hard copy
printout of points selected by the operator on a periodic time basis to
form a trend log. The operator shall have the ability to add or delete
points and select the reporting time interval.

05. Alarm Summary: An Alarm Summary report shall be printed automatically
each day. This shall contain all alarms for that day, any previous open
alarms and acknowledgement of alarms.

8. ENERGY CONSERVATION APPLICATION PROGRAMS
A. Scheduled Start/Stop: The scheduled start/stop program consists of starting and
stopping equipment based on the time of day and day of week.
B. Optimized Start/Stop: The scheduled start/stop program described is refined by
automatically adjusting the equipment operating schedule in accordance with
space temperature and outside air temperature. In the scheduled start/stop
program, the HVAC system is restarted prior to occupancy to cool down or heat
up the space on a fixed schedule independent of outside air and space
conditions.
C. Enthalpy Control: The enthalpy cycle uses outside air to reduce the building's
cooling requirements when the enthalpy of the outside air is less than that of the
return air.
D. Chilled Water Reset: Based on system requirements, the chilled water
temperature shall be reset upward until the space with the greater cooling
requirement is JUST satisfied.
E. Heating Water Reset: Based on system requirements, the heating water
temperature shall be reset downward until the space with the greater heating
requirement is JUST satisfied.
F. Supply Air Reset: For HVAC systems in a cooling mode, this program shall reset
the discharge temperature upward until the space with the greater cooling
requirement is JUST satisfied.
01. When humidity control is required, the program shall prevent the cooling
coil discharge temperature from being set upward when the maximum
allowable humidity is reached.
02. On applicable air handling units, supply air temperatures shall be reset as
appropriate during morning startup to minimize heat-up or cool-down
periods prior to scheduled occupancy.
G. A night purge cycle is required.
H. A building warm-up cycle using 100% return air is required.
I. Use a state of the art variable air volume system with direct digital control at each terminal unit.
J. Each enclosed space designed for continuous occupancy (ie. classroom, lab, etc.) will be served by at least one separate VAV device, and will have its own temperature sensor.

9. MONITORING AND ALARMS
A. The system shall automatically and continuously monitor and record the values of all inputs points, and the status of all controlled equipment. In the event of the following conditions, an alarm message is to be generated and displayed at the operator’s terminal and an audible alarm started.
   01. If a binary output point changes state without a command.
   02. High and low alarm for analog points.
   03. Field device failure, as sensed by a binary input point.
   04. Manual override of controlled equipment.
B. The alarm display shall include a description of the alarm condition and its source. An alarm condition shall be displayed until the operator acknowledges it. The operator ID shall be recorded of an operator who acknowledges the alarm.

10. WIRING
A. All equipment shall be installed by skilled electricians and mechanics, who are properly trained and qualified for this work, and who shall be in accordance with governing codes.
   01. All wiring between the automation system and sensors and control devices including any power wiring of devices and necessary conduit shall be provided.
   02. Labeling: All wiring and tubing shall be labeled end to end with point address and point descriptor using mechanically printed permanent label.
      a. Label all pull boxes and junction boxes with permanent marker
      b. Plenum cable to be color coded for easy identification
   03. Transient protection of system power supplies, data communication lines, digital hardware and controllers shall be provided. This protection shall consist of surge arresters which shall provide a low impedance ground path for surge voltages and lightning.
   04. Equipment shall have a power ground.
   05. Communications and instrumentation systems shall have a separate single point ground in addition to the power ground.
   06. Communication and data lines shall have electrical shielding.
   07. Run all control wiring as follows:
      a. Mechanical Rooms: In conduit
      b. Exposed in building spaces: In conduit
      c. Concealed in building walls and hard ceilings: In conduit
d. Concealed in t-bar ceilings: Plenum rated cable supported every 5 feet with j-hooks.

08. Run all wiring and conduit parallel to building lines.
09. Terminate all conduit with end protectors.
10. Provide strain reliefs where plenum cable enters junction boxes, pull boxes, and cabinets.

11. SUPERVISION AND CHECKOUT:
   A. This process shall be conducted by factory-training engineers and technicians directly employed by the contractor.
   B. OSU will review of the controls shop drawings concurrently with the engineers review.

12. ACCEPTANCE TESTING
   A. An acceptance test in the presence of the commissioning agent and or the engineer shall be performed. This test shall include, but not be limited to:
      01. Complete verification of transmission media operation.
      02. Cross-check of each sensor and control point.
      03. Final calibration of the sensor.
      04. Verification of failure mode operation.
      05. Verification of program loading/unloading capability.
      06. When the system performance is deemed in accordance with these specifications, it shall be accepted and placed under warranty.

13. TRAINING
   A. The contractor shall provide full instruction to the owner's designated representatives in these procedures during the start-up and test period. These instructions are to be conducted during normal working hours. The instruction shall consist of hands-on at the job site. Training on the functional operation of the system shall include:
      01. Operation of equipment.
      02. Programming.
      03. Diagnostics.
      04. Failure recovery procedures.
      05. Alarm formats.
      06. Maintenance and calibration.
      07. Trouble shooting, diagnostics, and repair instructions.
   B. Additional training shall be provided off campus at the manufacturer’s facility. The manufacturer is to include the cost of the training as part of their bid. The manufacturer will conduct a 1-week of certification course training for two students for a total of 80 hours.
14. INSTRUMENT AIR COMPRESSOR
   A. The duplex air compressor must be sized to operate no more than 33% of the time. The unit must be sized to operate at a low piston speed and low temperature to minimize oil vaporization and carryover. Provide an automatic lead/lag selection.
   B. The receiver must be ASME labeled with a pressure gauge, a relief valve, and an automatic drain. The size to require no more than 10 starts per hour of an individual compressor.
   C. Provide a refrigerated dryer to assure a 39 °F dew point.
   D. Air piping;
      01. Exposed: hard drawn copper or single tube polyethylene in a protective raceway, or multi tube polyethylene with vinyl jacket.
      02. Concealed above ceiling: single tube polyethylene in a protective raceway, or multi tube polyethylene with vinyl jacket.
      03. Buried: hard or soft drawn copper tubing or polyethylene tubing in a metal conduit.

15. CONTROL POWER
   A. Provide a duplex outlet at each building’s automation system panel.
   B. Each outlet must be on a dedicated circuit feed from the life safety power system.
   C. Feed all global controllers, critical air handling unit controllers, chillers and boiler controllers, from the Life Safety Power System.

16. FIRE ALARM INTERFACE
   A. When required, interface the building automation system to the fire alarm system.
   B. Interlock the fire smoke dampers to the fire alarm system such that scheduled fan shutdown does not trigger the fire alarm.
   C. On new building or major remodel projects the control contractor is to be contracted directly to the general contractor, not the mechanical sub-contractor.
Section 25100 – FIRE ALARMS

PART 1 – GENERAL

1. REQUIREMENTS
   A. Oregon State University maintains a Security “Central Station” in Cascade Hall. The receiver make and model numbers are FBII, CP-220, and there is a primary and a back up.
   B. Any fire alarm equipment installed for OSU shall be compatible to these receivers and capable of communicating in either 4+2 or Ademco PID format.
   C. OSU Telecom will install two dedicated phone lines for the fire alarm auto-dialer with a six-week lead-time. No modifications or changes to existing or functioning fire alarm system will occur without first notifying our dispatcher at Cascade Hall.

2. DESIGN
   A. Fire alarm systems shall be of the addressable type with a minimum total of 225 addressable points upon installation of the new fire panel or Central Processing Unit.
   B. Operational voltages shall be 24 volt D.C. and with minimum 24 hour back up.
   C. Approved addressable fire alarm systems shall be: Simplex, and Edwards. (HOUSING CURRENTLY SPECS EDWARDS ONLY.)
   D. Fire alarm systems shall meet all code requirements of NFPA 70, NFPA 72, City of Corvallis, and the Corvallis Fire Department.
   E. Fire alarm systems shall be designed by a NICET IV engineer, Electrical Engineer, or by a State of Oregon Electric Supervisor whose primary workload is designing and installing fire alarm systems.

3. WIRING METHODS
   A. Wiring for fire alarm systems shall be a minimum of ¾ inch trade size electrical metallic conduit. An exemption shall be made for a single run of conduit going to a single device and shall be ½ inch electrical metallic tubing. These conduit runs shall comply with the electrical specifications of these design criteria.
   B. Junction boxes and device boxes shall be a minimum of a standard 4-inch square by one and one quarter-inch deep two-gang box.
   C. If a shielded or unshielded fire alarm cable is used in the conduit runs and junction boxes, a single cable shall be sized for conduit and box fill as a number 6 AWG THHN, single conductor cable as per NFPA 70. If single conductor wire is used, the size shall be as specified by the fire alarm manufacturer or a minimum size of #16 THHN. The conduit and box fill can then be calculated on the wire gauge size of the actual conductor used.
   D. Conductors/cables entering and exiting junction boxes, device boxes NAC panels and fire panels shall be labeled as to function and circuit number.
E. If splicing is required in junction boxes, wire nuts are acceptable if accomplished in a workmanlike manor. (HOUSING REQUIRES TERMINAL STRIPS FOR SPLICES IN JUNCTION BOXES.)

F. On major remodeling projects requiring additional fire protection beyond the capacity of the existing fire panel, the existing system shall be replaced by a new system control panel and devices incorporating the whole system within one panel, i.e. NO add-on or patch panel(s) to existing fire system. An LCD annunciator shall be required at the “Fireman’s entrance.”

4. PROGRAMMING DEVICES AND PANELS
   A. Each initiating device (Smoke detectors, heat detectors, pull stations, duct detectors, etc…) shall have its own unique addressable device number.
   B. All smoke detectors shall be photoelectric. Ionization devices will not be allowed.
   C. All smoke detectors shall be set to a minimum @. 2.5% obscurity. If the device is adjustable to a higher obscurity, the highest setting shall be set upon installation.
   D. Heat detectors only will be allowed in mechanical rooms, and other areas that are not usually inhabited. Heat detectors shall be set at no less than 180 degrees F. and have a rate of rise device. Heat detectors shall also have a unique address, either at the device itself or an addressable module installed on a “dumb” detector.

5. DUCT DETECTORS
   A. Smoke duct detectors shall accomplish a fan shut down and fire damper closure upon tripping. Only the associated Supply Fan and Return fan units that the detector serves shall be involved with the shut down.
   B. Duct detectors shall be addressable and shall “ring in” as duct detector trouble, not alarm.

6. ELEVATOR LOBBY AND HALLWAY FIRE/SMOKE DOORS
   A. Only elevator recall smoke detectors in alarm shall close an adjacent elevator fire/smoke door. A smoke detector in one elevator lobby will not close any other fire smoke door. Elevator Lobby smoke detectors shall accomplish elevator recall as specified by the elevator inspector.
   B. A hallway fire/smoke door shall be closed only by the nearest smoke detector in alarm on either side of the fire/smoke door.

7. ANNUAL FIRE INSPECTION
   A. A newly installed fire panel shall be stickered by the installer with date of final test and technician’s name.
   B. The fire panel will be tested by the installer between 11 and 12 months after acceptance by the customer. Any shortcomings of the installed system shall be
corrected by the installer as warrantee work.

8. FIRE/SMOKE DAMPERS
   A. Individual running over current protection and an individual disconnecting means shall be provided for each fire/smoke damper motor, even though the motor may be impedance protected. The fuse shall be sized for 125% for non-impedance protected motors and 200% for impedance-protected motors.
   B. The combination over current device and disconnecting means shall be located within 6 feet of the fire/smoke damper motor.
   C. The combination over current/disconnect shall be either an Littlefuse #LSSY, for one Edison-base fuse and one single pole toggle switch sized for a 4-inch square junction box, or an Littlefuse #LSSU device for one Edison-base fuse and a single pole toggle switch sized for installation in a single gang handy box. The mechanical contractor shall purchase and provide these devices; the electrical contractor shall be responsible for installing these over current/disconnect devices.

9. SPARE AND INCLUDED FIRE ALARM SYSTEM DEVICES
   A. The contractor shall include spare devices in the quote. The number shall be as specified, unless the percentage specified is greater than the percentage of the installed devices.
      01. Three or 5% of installed smoke detectors.
      02. Three or 5% of installed heat detectors.
      03. Three or 5% of installed relay modules.
      04. Three or 5% of installed signal modules.
      05. One or 10% of installed duct detectors with smoke detectors.
      06. Two or 20% of installed door holding mechanisms.
      07. Three or 5% of installed pull stations.
   B. 10: Unit Pricing for Horns, Strobes, and pull stations shall be provided should these devices need to be added to the design.

10. FIRE SYSTEM PRINTER
    A. A printer shall be provided and installed adjacent to the fire panel.

11. SMOKE DETECTOR ACTIVATION
    A. The activation of any system smoke detector shall initiate an Alarm Verification operation, whereby the panel will reset the activated detector and wait for a second alarm activation.
    B. If, within one (1) minute after resetting, a second alarm is reported from the same or any other smoke detector, the system shall process the alarm as described previously. (The time period for Alarm Verification reset shall be programmable from 1 to 60 seconds.)
C. If no second alarm occurs within the Alarm Verification time window, the system shall resume normal operation.
D. The Alarm Verification operation shall occur only on smoke detector alarms.
E. Other activated initiating devices shall be processed immediately.
F. The Alarm Verification operation shall be selectable by device, not just by ZONE.

12. OTHER SYSTEMS AS PART OF FIRE ALARM SYSTEM
A. No other system shall be included with a fire system (i.e. no EMS (Energy Management System), building, management, or security systems to be part of or included with the fire alarm system, except in OSU Housing with OSU Housing Departmental approval.

13. DEVICES IN EXTERIOR AREAS
A. Fire alarm devices installed in non-environmentally controlled areas/rooms, shall be rain proof/water tight.

14. ACCESSIBILITY OF RELAYS/MODULES
A. All addressable modules/relays connected to fire smoke duct detectors shall be accessible at floor level or at a maximum height of 6’ ladder accessibility.
Section 26050 – ELECTRICAL

PART 1 – GENERAL

1. REQUIREMENTS

A. The architect, the Owner, the OSU Electrical shop will review clean power needs and decide on the requirements for each project at an early stage in the design.

B. The Owner prefers a design which includes two switches feeding two banks of transformers for buildings requiring significant quantities of clean power.

  01. One bank will have 277/480 V. secondary, (the "dirty power' bus) and will feed the following equipment:
      a. All HVAC equipment.
      b. Variable speed drivers.
      c. Elevators.
      d. Other building services equipment.
      e. 277 V. fluorescent lighting.

C. The second transformer bank, usually smaller, will have 120/208 V. secondary, and will feed only "clean power" panels.

  01. No equipment likely to produce electrical noise should be fed from the clean power panels.
  02. Provide one or more dry type step-down transformers fed from the dirty power bus to supply 120 V. house service power.
  03. Supply a suitable number of 120/208 V. house service panels.
  04. UPS (Uninterrupted Power Supply) with minimum 5 minute battery back-up for computer load, unless backed up by a generator set.

D. Benefits from this arrangement:

  01. Smaller main transformer sizes and lower interrupting rates for the secondary equipment result.
  02. Maximum isolation for the clean power bus is provided.
  03. Further isolation transformers and clean power equipment are usually not necessary.

E. Requirements for this arrangement:

  01. More transformer space is required.
  02. Two 4160 V. feeds are needed instead of one.

F. Emergency generators are not to be installed inside buildings or near outside air supply openings, or on top of roofs.

  01. Emergency generators shall be the backup power of choice instead of emergency lighting containing batteries.
  02. All building sump pumps will be designed to be on back-up generator power.
  03. All passenger elevators and freight elevators in research buildings shall be designed to be on back-up generator power.
04. Provide phase loss protection in main electrical service equipment for all new buildings.

2. SERVICE ACCESS
   A. Service will be from the campus loop.
      01. Investigation for necessary capacity is required.
   B. Provide new service when the campus loop is not adequate

3. ACCESS PANELS
   A. Refer to Section 08300 – Access Panels
      01. Particulate filters

4. CONSTRUCTION
   A. Provide an effectively grounded system for computer installation.
   B. Effectively grounded means intentionally connected to earth through a ground connection or connections of sufficiently low impedance and having sufficient current-carrying capacity to prevent the buildup of voltages which may result in undue hazard to connected equipment or to persons.
   C. Sufficiently low impedance is such that for all system conditions, the ratio of zero-sequence reactance to positive sequence reactance \( \frac{X_o}{X_1} \) is positive and less than 3, and the ratio of zero-sequence resistance to positive sequence reactance \( \frac{R_o}{X_1} \) is positive and less than 1.
   D. Electrical power may have to be conditioned for certain laboratories, which will be designated.
   E. Distribution panels shall only serve the resident floor or level and have three or more 3/4"diameter EMT stub-up spares, ending in an adequately sized, accessible junction box.
   F. Minimum panel size, 100 Amp. (Exceptions to be reviewed by the OSU Electric Shop).
   G. Panel feeders shall be sized to the panel, not the load.
   H. Breakers:
      01. All electrical panels should have 50% spare breaker acceptable panel spaces, at the end of construction, to enable future expansion with commensurate ampacity capacity. (70% fill allowed for 277/4808 volt lighting panels.)
      02. "Breaker Acceptable" means no drilling or threading will be necessary to add circuit breakers.
      03. Local distribution panels shall have snap-in or bolt-on breaker capability.
   I. Conductors:
      01. Copper conductor shall be used throughout the building for secondary conductors.
      02. Aluminum conductors may be used for primary high voltage only to the building transformer.
03. All other wiring to and throughout the building must be copper.
04. The entire electrical power distribution should have a five (5) wire system, the fifth wire being the low-impedance ground, one neutral, and three power conductors for three-phase power.

J. Neutral wire
01. Neutral wire must be copper and no smaller than the phase conductor (AWG).
02. Neutral wire to be one size AWG of the phase conductor for all circuits to computer room panels and all panels serving sizeable non-linear loads.

K. A separate isolated, dedicated electrical system for computer power shall include color coded devices (i.e. orange or blue receptacles).

L. Piercing type or push/stab in wire connections not acceptable.

M. All low voltage cable not under the responsibility of telecommunications shall be in/on cable tray, D rings or metal raceway. Metal raceway 3/4” minimum and LV cable to be run at right angles to building.

N. Office space: No more than two offices on one circuit.
O. Lab space: No more than four outlets per circuit. (If lab is greater than 400 sq.ft., set a panel in the room.)

P. Service and Distribution equipment shall have copper bus only.

Q. Service and feeders must be sized minimum 25% greater than Article 220 NEC.

R. All general purpose convenience outlets on generator power must be dedicated.

S. All conduits for branch circuits shall contain ground wire.

T. Flexible conduit:
01. Must be metallic.
02. May be used only where no other non-flexible conduit can be reasonably installed.
03. Not to exceed 8 ft. in length, unless fished into inaccessible spaces.
04. For manufactured assembly fixtures whips above suspended ceilings from junction boxes.

U. Conduit fill for branch circuitry must not exceed 20%, size for THW.

V. All exterior conduit containing conductors must be buried a minimum of 30”.

W. All electrical lines 30V or greater shall be installed a minimum of 30” below grade.
01. If conflicting utilities or other design constraints prevent installation at this minimum depth, the portion of the conduit installed at less than 30” shall be covered in finished concrete.

X. All concrete covering electrical conductors shall be dyed red and shall have a smoothly troweled surface. [This is particularly important when covering conductors carrying high voltages].

Y. Conflicting and/or adjacent utilities shall be protected from encasement within the protective concrete covering. If encasement is unavoidable due to proximity of the conflicting utility, the adjacent utility shall be sleeved in a protective PVC piping of sufficient diameter and length to allow for future removal and
replacement without disturbing the concrete encasement.

5. ELECTRIC METERS
A. Refer to Section 33050 – Meters cross reference with final number and section.

6. ELECTRICAL EQUIPMENT
A. Electrical Permits are required for any alteration, extension or new circuit. A copy of the permit shall be forwarded to OSU and signed by the electrical supervisor of record.
B. Electrical equipment, for which parts are stocked.

<table>
<thead>
<tr>
<th>Item</th>
<th>Brand or Company/Design Criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wireway</td>
<td>Wiremold V-700 wire way V2400 Plugmold 4000 &amp; 6000 Divided &amp; Undivided</td>
</tr>
<tr>
<td>Conduit and Raceway</td>
<td>All metallic; no MC Cable or IMC conduit allowed</td>
</tr>
<tr>
<td>Flex Conduit</td>
<td>Min. size 1/2 inch ground wire required in all flex conduit.</td>
</tr>
<tr>
<td></td>
<td>Flex Conduit allowed only for: light fixture pigtails in accessible ceilings; interior motor,</td>
</tr>
<tr>
<td></td>
<td>vibrating or moveable equipment connections; fished in stud walls not exceeding 8’0” in length;</td>
</tr>
<tr>
<td></td>
<td>liquid tight in all damp or wet locations.</td>
</tr>
<tr>
<td>Tele-power poles</td>
<td>30 TP Series Tele-power poles</td>
</tr>
<tr>
<td>Distribution System</td>
<td>Cutler Hammer, Siemens, G.E., Square D</td>
</tr>
<tr>
<td>Panels: breakers, hinged covers</td>
<td>Panels with copper bus and full or solid neutral bus and breakers</td>
</tr>
<tr>
<td>Motor Starters</td>
<td>Allen Bradley, Cutler Hammer, GE, Square D, Toshiba</td>
</tr>
<tr>
<td>Fire Stop and Caulk</td>
<td>Specified Technology Inc.; Spec Seal; 3M firestop</td>
</tr>
<tr>
<td>Standard Receptacles: 20 amp, 5352 Series</td>
<td>Hubbell, Bryant, Leviton</td>
</tr>
<tr>
<td>Lighting Switches: 20 amp, 277V, spec grade</td>
<td>Hubbell, Bryant, Leviton</td>
</tr>
<tr>
<td>Safety &amp; disconnect switches - heavy duty</td>
<td>Cutler Hammer, G.E., Square D</td>
</tr>
<tr>
<td>Support Struts and Channels</td>
<td>Kindorf</td>
</tr>
<tr>
<td>Fluorescent Fixtures</td>
<td>Columbia or Lithonia Parabolic type with T-8 lamps and high frequency electronic ballasts for</td>
</tr>
<tr>
<td></td>
<td>parallel operation. Earthquake wires required - opposite corners of fixture in drop ceilings.</td>
</tr>
<tr>
<td>Fluorescent tubes</td>
<td>Low mercury 22.8mg 32 watt energy saver types OSRAM/Sylvania ECCO, Phillips Alto series or GE</td>
</tr>
<tr>
<td></td>
<td>Ecolux</td>
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<tr>
<td>Item</td>
<td>Brand or Company/Design Criteria</td>
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<tr>
<td>Fluorescent U-bend</td>
<td>OSRAM/Sylvania, Phillips, GE</td>
</tr>
<tr>
<td>Compact Fluorescent</td>
<td>OSRAM/Sylvania, Phillips, GE</td>
</tr>
<tr>
<td>Halogen Lamp</td>
<td>OSRAM/Sylvania, Phillips, GE</td>
</tr>
<tr>
<td>High Pressure Sodium</td>
<td>OSRAM/Sylvania, Phillips, GE</td>
</tr>
</tbody>
</table>
Section 26150 – LIGHTING

PART 1 – GENERAL

1. REQUIREMENTS
   Lighting design shall use an appropriate combination of natural, area and task lighting with security type lights where necessary to meet appropriate Illuminating Engineer Society (or similar) recommendations. Efforts should be made to minimize electricity consumption from lighting by striving to reduce footcandle levels. Lighting should fit task-area requirements only. General-area lighting is to be selected at a lower intensity to accommodate access and non-critical sight needs.
   A. All lighting will be provided with disconnecting means in acceptance with current years NEC.
   B. Facilities Services requires replacement pricing for both ballasts and lamps, to be supplied at the design phase of the project. (Design lighting projects to lamps currently in OSU Stores inventory.) The use of self-luminous exit signs containing radioactive material is prohibited unless specifically approved by Environmental Health & Safety (EH&S). This is for estimation of long-term maintenance costs. This applies to capital construction projects. For smaller projects, the PM can specifically request the service when asking the consultant for their cost proposal.

2. FLUORESCENT LIGHTS
   A. Dimming control systems to be reviewed and approved by OSU electrical shop.
   B. Reduced harmonic electronic ballasts, parallel wired for operation of one or two type T-8 lamps, shall be used wherever fluorescent lights are installed, except where special dimming ballasts are necessary.
   C. Lamps are to have low mercury content equal to or better than Philips Lighting "ALTO".
   D. Warranty: (See 4.B.01)
      01. **Lamp system warranty:** Four foot T8 lamps and ballasts shall be warranted up to 3 years (3 years for 24,000 hour lamps), from the date of substantial completion of the project. Lamps shall have an 85 CRI index, maintain a 24,000 hour warranty and have a 2,850 lumens specification.
      02. **Lamp warranty:** See fluorescent mortality curve for normal lamp mortality. Defective lamps or lamps failing at a higher than normal rate shall be replaced after a factory inspection determining the cause of failure or defect.
   E. Worldwide Color standards: Color coordinates shall follow the proposed IEC/ANSI color standards regardless of the country of manufacture. Campus standard is 41K.
F. Cathode construction: The lamp shall contain cathodes designed for specific operation on United States ballast operating systems (instant rapid, programmed start) regardless of country of manufacture.

G. ANSI standards: Lamps shall comply with applicable ANSI standards.

H. See the end of this section for information on parking lighting and historic fixtures.

I. Areas under construction shall have temporary lighting for nighttime.

J. SL to add language to ease the maintenance requirement. All interior light fixtures shall be accessible by a step ladder, 10’ or less, placed in accordance with OSHA standards or one of the following:
   01. A permanently installed means of access.

K. A building specific means (supplied by the project) of access (platform lift, etc.) stored in a readily accessible location on site and in place, at the completion of the project. All exterior lights shall be accessible by means currently owned by OSU without damage to buildings or plantings. Exterior lights must be installed an operated to prevent “uplifting” into the night sky, as per the Campus Master Plan.

L. Fixtures incorporating lamps other than those listed in the Electric Equipment Table shall not be used unless a written request to waive this requirement has been approved by the OSU Project Manager and OSU Electric Shop.
   01. For unique lamps and ballasts, 10% or 10 each, lamps and ballasts, whichever is greater, to be added to the OSU Stores inventory by the project. This is to be available at the time of the more gooder substantial completion.
   02. Fixtures that require use of proprietary lamps and do not allow use of lamps from other manufacturers are not allowed.

M. All recessed can light shall be 120 volt and have self ballasted lamps (10% lamps to be added to the “Stores” inventory by the project.)

N. T-8 fluorescent lighting systems shall utilize high performance ballasts and lamps, meeting Energy Trust of Oregon specifications for High-Performance T-8 Lighting Systems.

3. LIGHTING CONTROLS
   A. Automated lighting controls that minimize electrical lighting use are required in all areas
   01. Exceptions may be submitted to OSU Electrical Shop for review.

4. ELECTRONIC BALLAST
   A. Performance Requirements
   01. Ballast Factor: Ballast factors at nominal voltage shall be as follows:
      a. Standard ballasts - 0.90 ballast factor.
      b. PLUS ballasts - 1.2 for 2 lamp ballast.
c. Flicker: Ballast shall operate lamps at a frequency above 20 KHz and lamps shall have no detectable flicker.
d. Power Factor: Ballast shall have input power factor above 97% when used with primary lamp type.
e. Harmonic Distortion: Ballast shall have Total Harmonic Distortion (THD) of 20% or less when used with primary lamp type.
f. Current Crest Factor: Lamp current crest factor shall be 1.7 or less.
g. Ballast Efficacy Factor (BEF): The relative light output per watt consumed shall be equal to or greater than a CBM certified electromagnetic ballast for the same application.
h. Lamp Life: The ballast shall provide lamp starting conditions and parameters consistent with lamp manufacturers recommendations and shall provide full rated lamp life under normal conditions.
i. Circuitry: The ballast circuit shall operate lamps in parallel, such that if one lamp fails, others will remain lit.
j. Starting Method: Ballast shall match lamp usage for maximum efficiency.
k. Starting Temperature: The electronic ballast shall provide for a minimum lamp starting temperature of 0°F to 50°F depending on the ballast model and installation conditions.
l. Ballast Output: The ballast output shall be protected against lamp rectification or shorted output leads.
m. Case Temperature: The ballast shall have a maximum case temperature rating of 70°C.
n. Internal Protection: The ballast shall have internal protection to prevent catastrophic failure.

5. PRODUCT SPECIFICATION
   A. Regulatory Requirements
      01. UL, CSA and CBM listing: The electronic ballast shall be Underwriters Laboratories (UL) listed, Class P, Type 1. CSA and CBM certified (where applicable).
      02. EMI / RFI: Ballast shall meet FCC standard for EMI/RFI (FCC 47CFR Part 18 Non-consumer), ensuring suitability for both commercial and industrial installations.
      03. Efficiency Standards: Ballast shall comply with all applicable state and federal efficiency standards.
      04. Transient Protection and Harmonic Distortion: Ballast shall comply with applicable ANSI and IEEE standards for harmonic distortion and line voltage transient protection.
      05. Sound Rating: Ballast shall have audible noise rating of Class A.
   B. Other
01. **Warranty:**
   a. The manufacturer shall provide a written warranty against defects in material or workmanship, including replacement, for 5 years from date of substantial completion of the project and include a nominal replacement labor allowance.
   b. If the lamp and ballast are covered by a combination lamp/ballast warranty; covered ballasts shall carry a five year warranty, from the date of installation, plus an additional year if the lamps are replaced with the same type, and kind, at time of relamp, and include a nominal replacement labor allowance.
   c. Covered lamps shall carry a 2½ year warranty (3 years for 24,000 hour lamps), from date of the more gooder substantial completion installation. Lamps shall have an 85 CRI index maintain a 24,000 hour warranty, and have 3000 lumens specification.

6. **PARKING LIGHT FIXTURE**
   A. Architectural Lighting ALR 182 or KIM CCS, 21” diameter, multi-tap ballast, 150w HPS, 20’ round tapered steel pole, light gray color.
      01. Fixture: PC> Size: diameter – 23”.
      02. Light source: HPS = J1, 150W. Voltage: multi-tap transformer.
      03. Optics: Type 5.
      04. Mounting arrangement: 2” Tenon fitter.
      05. Color: gray.
      06. Options: Slip-fit fixture arm.

7. **HISTORIC LIGHT FIXTURE**
   A. See the Campus Master Plan for down lighting requirements
   B. Visco Series A
      01. Cast iron base, 12’ tapered, fluted steel pole, (14’-2” plus or minus 1” to lamp centerline),
      02. Multiap ballast,
      03. 70w HPS Mogul base lamp with two piece polycarbonate globe,
      04. Prismatic Glass Refractor 4685 Type III optional reflector, band, finial, and downlight reflector/louver.
      05. Available through Valley Iron and Steel Co. (VISCO) 29579 Awbrey Lane, Eugene, Oregon 97402-9639, Phone (541) 688-7741.
      06. Shall be painted “OSU Black”: Sherwin Williams “Tricorn Black”, 6403-23028; 50% gloss.
      07. Lay out must be in straight lines adjacent to walkways.
      08. Must have 24” radius concrete collar (see diagrams).
09. Provide an extra conduit for future capacity at every fixture. Extend conduit beyond footing and adjacent concrete so it can be easily accessed in future.

**NOTE:** FOR CONDUIT, ANCHOR BOLTS AND FOOTINGS REFER TO ELECTRICAL DRAWINGS AND DIVISION 16.
Section 31050 – EARTHWORK

PART 1 GENERAL

1. REQUIREMENTS
   A. For all earthwork, the designer shall include provisions for utilizing geotextile fabric, and overexcavation for times when conditions warrant.
   B. All aggregate baserock, asphalt, and other materials are to be specified in accordance with the latest version of the “City of Corvallis Standard Construction Specifications”.
   C. Pea gravel is not permitted as bedding or fill material, unless required by product manufacturer guidelines.
   D. All baserock under asphalt and concrete paving sections should be ¾”-0”, and specified for compaction to a minimum 95% of ASTM D1557.
   E. All layers of baserock shall be compacted at a maximum depth of 12-inches.
   F. The designer needs to include provisions in the specifications requiring the Contractor to coordinate for special testing, including compaction tests, asphalt placement, and concrete placement.

2. EROSION CONTROL
   A. Erosion control shall be installed in accordance with the City of Corvallis Land Development Code, and be approved by the OSU Project Manager prior to the commencement of any grading.
   B. All erosion control information shall be clearly indicated on plans and specifications and designed in a manner consistent with all applicable code requirements.
   C. The Contractor is responsible to apply and obtain an erosion control permit from the City of Corvallis prior to commencing any grading activities on the project site. The City approved permit shall be obtained from the City of Corvallis and provided to the OSU Project Manager prior to the beginning of construction.
   D. The designer/engineer/architect is responsible to determine if a NPDES 1200 – C permit is required for the project. Permit application to be coordinated by Project manager.
   E. All erosion control measures required for a NPDES 1200 – C permit shall be indicated on an Erosion Control Measures drawing which is to be prepared by the designer/engineer/architect, and included in the plan set.
   F. The designer/engineer/architect shall coordinate the preparation of the Erosion Control Measures drawing with the OSU Project manager.
   G. The DEQ NPDES 1200-C permit shall be obtained prior to commencing any grading activities on the project site.
   H. Termination of the NPDES 1200-C permit will be the responsibility of Project Manager.
3. **GRADING**  
   A. The contractor is responsible to apply for and receive a grading permit from the City of Corvallis, and submit a copy to the OSU Project Manager prior to the commencement of any grading on the site.
Section 31150- IRRIGATION

PART 1 - GENERAL

1. REQUIREMENTS
   A. An automated underground irrigation system shall be designed and installed for all planted areas.
   B. All irrigation systems shall be institutional quality and be centrally controlled using components compatible with Rainbird Maxicom.
   C. 4” min PVC Sleeves are required under all hard surfaces, to enclose all mainlines laterals, and control wires. Sleeves shall extend one foot beyond edge of pavement to link all planting areas.
   D. Separate irrigation metering connected directly to city service line shall be provided.
   E. Deduct metering on the domestic service line is prohibited.
   F. Design velocity shall not exceed 5 feet per second.
   G. All irrigation systems shall be designed according to Irrigation Association current standards.
   H. A water audit performed by an Irrigation Association IA) Certified Landscape Irrigation Auditor, conducted in accordance with the current IA audit standards for all new, as well as existing, irrigated zones shall be completed. An audit report shall be approved by the OSU Landscape Manager or designee.
      01. The report must provide complete database information for programming of Maxicom 2 Central Control System per Section 1.3

2. IRRIGATION EQUIPMENT
   A. Irrigation Heads
      01. Spray heads
          a. Rainbird, 1800 series, Hunter MP Rotator,
          b. Mid size, gear drive, Hunter I-20 SS low angle and short radius, Rainbird 5000.
          c. Large turf areas, Hunter I-20 SS or I-25 SS Series stainless steel.
             1. All spray heads installed with flex pipe, rotors installed with PVC swing joint assemblies
      02. Drip systems shall be installed only where institutional spray systems are impractical, due to design constraints or other factors as approved by OSU Landscape management.
          a. When used, they must be Rainbird brand dripline with automated stainless steel filtration system.
   B. Electric Control Valve
      01. Type: Rainbird PEB/PRS series.
      02. Zone Isolation valve: unionized brass angle globe valve.
      03. All control valves shall have isolation valves and downstream unions.
04. Sub main isolation valve: brass resilient seat gate valve

C. Pipe
01. Schedule 40 PVC only.
02. Mainline depth 18"-24".
03. Lateral depths 12"-18".
04. No gasketted pipe or compression couplings are permitted
05. Provide supplemental air to minimum 125PSI pressure test to ensure no loss of pressure in 4 hour test period

D. Control Wire
01. UF 14 AWG minimum.
02. A unique pair of spare wires shall be installed from the controller to each valve.
03. Unique spare control wire to each valve, BLACK.
04. Spare common wire shall be installed from the controller and looped at each valve, YELLOW.
05. Locate wire, UF 16 AWG. minimum, spliced with waterproof connectors-BLUE.
06. Control wires to be spliced with waterproof connectors only in valve boxes.
07. Master valve shall have independent circuit
08. Provide ohm readings verifying continuity of all control wires, including spares.
09. Provide waterproof circuit numbers at termination of all control wires, including spares.

E. Valve Boxes
01. Pentek or Carson of suitable size. (T-top lids green in turf and brown in shrubs).

F. Backflow Preventer
01. FEBCO 805Y 850-U with ball valves and unions for easy removal and service in underground valve box

G. Central Control Components
01. All systems must be compatible with Rainbird Maxicom and must include flow sensing and master valve controls.
02. All irrigation control assemblies shall be UL listed.
03. Pedestal control cabinet bases shall be cast in place concrete per PCC requirements. Pre-cast bases must be installed per manufacturer’s specifications.

H. Controllers
01. Rainbird, ESP-SAT.

3. IRRIGATION COMMISSIONING
A. All irrigated landscape areas shall:
01. Have a Landscape Irrigation Audit performed by a certified Landscape Irrigation Auditor, certified and in good standing with the Irrigation Association (IA).

02. The auditor shall be retained by the University and shall be independent of all contractors associated with the project.

03. The audits shall be conducted in accordance with the current edition of the IA’s Landscape Irrigation Auditor’s Handbook.

04. The results of the audit shall be provided to the University in a report acceptable to the University and shall be signed by the Auditor.

05. All existing adjacent irrigated landscape zones impacted by construction activities shall be included in the irrigation audit.

06. A completed audit in compliance with these provisions is required before the University will issue a Letter of Substantial Completion.

B. The minimum efficiency requirements to be met in the audit are 55% distribution uniformity for all fixed spray systems and 70% distribution uniformity for all rotary systems.

01. All zones not meeting these minimums shall be corrected by the irrigation installer and retested to meet these specifications. Compliance with this provision is required before OSU shall accept the audit report.

C. Pre audit equipment review shall note any installation errors, necessary repairs, performance deficiencies and problems, etc., The review shall also include verification of the installation and operation of all Maxicom equipment, flow sensors, master valve, telecommunication paths, connectivity to the central computer, etc. Any deficiencies shall be corrected by the installer before the commissioning audit shall begin.

D. The auditor shall be responsible for collecting the following information:

01. The data necessary to calculate precipitation rates (zone areas, flow rates), note and record soil types, root depths, sun exposure, slope and plant material characteristics for each zone.

02. Perform catchcan tests of each zone and mark corresponding catchcan location on the as built irrigation drawing. Shrubs zones precipitation catchcan measurements are to be taken before planting.

03. Measure flow rates, static and dynamic system pressures, and record catchcan quantities and locations for each zone.

E. The audit report shall include:

01. The marked up drawing of the system design showing as built conditions.

02. The drawing shall show the station numbers, station locations, sprinkler head locations, head types, nozzle size, and distance between sprinkler heads.

03. This drawing shall be provided to the auditor by the installation contractor prior to field precipitation measurements being collected.

04. Installer shall also provide imported soil texture analysis reports and locations and depth of soil placed in each zone.
05. Pressure readings per station, catch device readings and locations, distribution uniformity for individual stations, precipitation rates per station, and full database information for programming Maxicom II ET based central control software.

06. Include a Maxicom data summary spreadsheet for client input including, Maxicom Flo-Manager and Flo-Watch zones for proper scheduling.
Section 32100 – LANDSCAPE

PART 1 – GENERAL

**Designer must be familiar with Oregon State University Policy & Guidelines for Campus Landscape Development.**

The historic campus core of Oregon State University is known as one of the most significant public landscapes in the State. Its organization, harmony of materials, and maturity give it a sense of substantial quality. Maintaining this quality takes consistency in approach and sensitivity to what makes the campus great.

The University’s core campus is based on a plan created in 1909 by the renowned Olmsted Brothers of Boston, whose designs include Central Park in New York and Stanford University. Their plan for the University provides a classic elegance that befits and encourages the academic activities occurring at Oregon State.

Campus streets provide the organizational framework within which the campus has developed. In addition to accommodating vehicular, pedestrian and bicycle circulation, they provide tree lined open space corridors through campus.

The form and organization of campus buildings, established by the 1909 Olmsted plan, provides a dignified simplicity which is integral to the character of the campus. Buildings reinforce the open space corridors and quadrangles through uniform setbacks and sufficient spacing between structures. Primary outdoor gathering places in the form of courts, plazas, and gardens are located near building entries.

The quadrangles provide the primary usable open space on campus. These large open lawn areas are defined by buildings and provide distinction to the campus. The quadrangles are strictly pedestrian oriented with walkways interconnecting building entries, linking to the campus street grid and connecting to other campus open spaces.

The current Campus Development Plan reestablishes the integrity of the Olmsted plan. It calls for further development of the University based on the organization of the historic campus core. The campus core is envisioned to expand to the west and south over the next several decades. In order to ensure that the campus becomes cohesive in character, each increment of growth should embody the qualities of the existing core. This approach requires consistency in the development of buildings and grounds and sensitivity to the scale and character of outdoor space.

To ensure that Oregon State University maintains and expands upon the historic patterns, it is critical that development provides consistency and a common approach, regardless of the scale...
of a campus improvement. This document provides guidelines which are critical to the continuation of the quality of the campus. It is intended to provide the basis for evaluation of all campus improvements and should be used as a tool to ensure that campus development be of the highest quality.

CAMPUS CIRCULATION
*Development of the Campus should reinforce the existing grid pattern of streets and walks as primary circulation.*

*The historic pattern of streets with defined edges, continuous street tree planting and walkways separate from the street should be maintained throughout campus.*

*OSU should continue to be a pedestrian dominant campus with continuous and convenient pedestrian access throughout the campus. Safe and convenient bicycle access should be provided on designated bicycle routes.*

1. **STREETS**
   A. Streets should adhere to the existing rectilinear street grid.
   B. Pavement types, street configurations and street tree placement should be consistent throughout street corridors.
   C. Streets should be continuous and not bridged or encroached upon by buildings or other facilities. Building setbacks should be uniform along campus streets.

2. **WALKWAYS**
   A. Walkways should be located on both sides of all campus streets.
      01. Walkways should interconnect campus quadrangles and provide access to all campus facilities.
      02. Walkways should provide direct routes to campus facilities. Walks should be simply detailed, rectilinear in nature, and sized to accommodate the volume of pedestrians using them.
      03. Walkways should meet Americans with Disabilities Act requirements.
      04. Walkways should be a minimum of five feet in width except in specialty areas.
      05. Tree lawn areas, those areas between the edge of the street and the sidewalk, should be a minimum of ten feet in width and planted in lawn or low shrubs to ensure visibility and personal safety.

3. **BICYCLE ROUTES AND PARKING**
   A. Bicycle use should be managed similarly to other vehicles on campus.
      01. Bicycle routes should be located primarily on campus streets and be distinct from vehicular and pedestrian routes where possible.
      02. Bicycle circulation should be designated in a routing plan and minimize conflicts between pedestrians and bicyclists.
03. Bicycle parking should be conveniently located to designated bike routes and not within the quadrangle areas.
04. Bicycle parking should be near, but not directly adjacent to, primary building entries.
05. Bicycle parking should be buffered from view with diffused screening.

4. ACCESSIBLE ROUTES INTEGRATION
   A. Accessible routes should be constructed from the same paving material and detail as other building entry pavements.
   01. Ramps should be integrated into the campus through the use of masonry walls and plant material screening where appropriate.
   02. Accessible routes which are added to existing buildings should appear to be integral to the building entry.
   03. Where possible, primary routes should provide single routes for all users, instead of segregating accessible portions.
   04. Accessible routes should be constructed from the same paving material and detail as other building entry pavements.
   05. Ramps should be integrated into the campus through the use of masonry walls and plant material screening where appropriate.
   06. Accessible routes which are added to existing buildings should appear to be integral to the building entry.
   07. Where possible, primary routes should provide single routes for all users, instead of segregating accessible portions.
   08. Signs denoting accessible routes should be clear, concise appropriately sized, and consistent with the campus sign policy.

PLANTING
The campus landscape should adhere to the tenets of the 1909 Olmsted Plan, in order to maximize the plants' visual qualities and reinforce the campus organization and function. Plant material selection, placement and maintenance should focus on their appropriateness to the adjacent land use as well as the materials’ ability to reinforce the campus character.

5. PLANT SELECTION
   A. Plant materials should remain appropriate in their location as they mature and reach ultimate size.
   B. Continuous plantings of large street trees should remain a primary method of linking the campus together. Tree types and spacing should be consistent within large defined areas. Breaks in species should occur in significant intersections only.
   C. Groundcovers, flowering trees and deciduous and evergreen shrubs should be used primarily at the base of buildings to provide seasonal color and variation, reinforce the building's architectural style and soften the building's bulk and mass.
D. When adjacent to buildings, trees should be chosen and located to allow sun penetration during the winter and shading during the summer.

E. Specialty plantings, including perennials, should occur primarily in courts and special gardens. Plants should be selected based on the University’s ability to maintain them.

6. ORGANIZATION
   A. The historic Olmsted pattern of planting should be reestablished and adapted to support current building uses and site requirements. As the campus core expands, planting should be of similar character to that of the historic core.
   B. Large deciduous trees planted in continuous and uniform rows (allees) should line campus streets.
   C. Primary open spaces such as quadrangles should be planted in open lawn framed and highlighted with large coniferous and deciduous trees.
   D. Plantings at building foundations should ideally respond directly to the adjacent architecture. Shrubs should not be taller than the building’s visual base, or obscure the views from primary windows and entries. Shrub beds adjacent to the building should generally have widths approximately 20% of the building's height.

7. SPATIAL DEFINITION
   A. Plants should be used to define building entries, create outdoor space and assist in focusing pedestrian circulation.
   B. Plants alone will not deter pedestrian desire lines or provide significant barriers to circulation. Therefore, plants should be used in conjunction with good site design, effective circulation systems and other elements such as masonry walls.

8. SCREENING
   A. Plants may be used to visually screen undesirable views, such as service areas, waste and recycling stations, and above grade utilities.
   B. Plants used for screening should be selected based on the ability to provide year-round screening, the material’s ultimate size and requirements for healthy growth without sheering or excessive pruning.
   C. Plants should provide the desired height and density taking into consideration circulation requirements, safety, the needs of the use being screened, ingress and egress requirements as well as aesthetics.
   D. In many cases, plant materials used in conjunction with constructed screening devices such as masonry walls provide the most appropriate and functional solution.

9. UTILITY LOCATION
   A. Above-grade utilities, i.e. power transformers, A.C. units, should be located away from primary building entries, important building facades and pedestrian routes.
B. Above-grade utilities should not occur within primary street corridors.
C. Utilities should be accessible to maintenance personnel.
D. At grade vaults should be located within paved surface areas, traffic rated, and set flush with adjacent grades and slopes.
E. Above-grade utilities should be screened from public view.
F. Utility conduits and wiring should be underground and routed to provide adequate space for tree lined streets and open space corridors.

10. SCREENING
A. All service areas and utilities should be permanently screened from view as feasible.
B. Screening materials should be similar to those used on or near adjacent buildings.
C. Vegetative screening, when used, should provide visual screening year round.
D. The choice of screening materials and their placement should be in consideration of personal safety of campus users.
E. Screening materials may include combinations of the following:
   F. Masonry
   G. Iron fencing
   H. Plant material
   I. The use of barbwire, chain link, chain link with slats is not allowed except within agricultural areas or around substations.

11. PLANTING
A. Landscape design and components shall be planned for low ongoing maintenance requirements and reduced life cycle costs.
   01. Design and plant selection shall support species and varieties that are appropriate for the climate and growing conditions particular to the region in which the OSU campus is located.
      a. Prior to the start of the project, the OSU Landscape Shop shall submit a non-approved plant list to the Project Manager.
      b. Any plant species or variety indicated on the non-approved plant list shall not be used.
   02. The landscape plan and plant species shall be approved by the OSU Landscape Manager or designee prior to the acceptance of the landscape plan.
      a. Any changes to the plan as a result of the review of the OSU Landscape Manager shall be completed prior to the issuance of the approval from the OSU Landscape Manager, or designee.
   03. The landscape design must accommodate the mature size of the plants selected.
   04. The contractor shall protect existing topsoil and subsoil from compaction during construction.
a. The contractor is responsible for alleviating any and all unavoidable soil compaction before topsoil placement or irrigation system installation.

b. Any mulch or base rock used to prevent soil compaction shall be removed from planting areas and turf areas prior to the placement of top soil.

05. Provide landscape specifications which conform with the International Society of Arboriculture development guidelines for soil preparation and planting

B. Plants

01. All shrubs and trees must be labeled with original nursery I.D. tag and shall be true to form and description.

02. Provide inspection point for landscape architect / landscape management representative/ OAR to select /approve trees:
   a. at nursery prior to digging
   b. at arrival at project site.
   c. Plant layout and installation

03. Prohibited plants include all Oregon Department of Agriculture and United States Department of Agriculture listed noxious plants as well as plants on the OSU non-approved plant list

04. Plants shall be grouped with like water requirements on same irrigation zone.

05. The minimum size for trees is 2” caliper.
   a. Exceptions may be granted by the OSU Landscape Manager or designee for unusual species.
   b. All trees smaller than 2” must be triple staked.

C. Turf

01. The minimum mowing equipment width is 72”. Turf areas must be designed to be maintained with this equipment.

02. Seed shall be Champion Perennial Rye grass.

03. Champion Perennial Rye may be substituted upon approval from the OSU Landscape Manager or designee.

04. The allowable grass seeding period for OSU campus is March 15th through October 15th, as soil conditions permit.

05. A ten- inch wide concrete mow band shall be installed at finish grade adjacent to all structures. And 20” minimum beneath all fences.

06. No plastic or metal edging shall be permitted or used.

D. Soil

01. The OSU Landscape manager or designee shall determine if any existing top soil is suitable for reuse prior to the preparation of the landscape plan.
   a. The designer shall contact the OSU Project Manager to receive approval to utilize the exiting top soil in the landscape plan.
b. All existing top soil approved for reuse shall be used to the greatest extent practicable.

c. The allowable landscape construction period for OSU campus is March 15th through October 15th, as soil conditions permit.

02. Separate top soil (maximum 18” depth) from subsoil during excavation and protect from contamination.

03. Imported soil is subject to OSU approval and shall conform to USDA soil texture class, “loam” certified within one calendar year.

a. Imported soil depth minimum
   1) 12" for turf.
   2) 24" for shrubs and turf areas containing trees.
   3) Tree planter pits shall have sufficient soil volume to support mature tree root space as calculated per ISA standards.

b. The contractor shall provide OSU a test sample for textural class determination prior to the installation any imported soil.
   1) The test shall be performed by OSU Soil Analysis Lab or other OSU approved lab.
   2) Provide a minimum of two soil samples with the accompanying soil test report from samples obtained randomly throughout the source field location or stockpile.
   3) Submit approved test results at least 4 weeks prior to soil placement.

04. Athletic play areas may include USDA soil texture class sandy loam.

05. Soil must be free of contaminants and noxious weeds.
   a. If noxious weeds are present, contractor shall eradicate following guidelines in PNW weed control handbook or Oregon Department of Agriculture recommendations and shall continue monthly control measures on all emerging weeks for a period of one year from final acceptance.

06. Incorporate organic matter homogeneously throughout the planting area.

07. Remove all rock from planting areas prior to topsoil placement.

08. Provide inspection point for:
   a. subsoil preparation
   b. irrigation installation and as-built mark-ups before covering with soil
   c. topsoil / amendment incorporation and finish grades
Section 32200 - TREE AND PLANT PROTECTION

PART 1 - GENERAL

1. REQUIREMENTS
   A. The contractors shall furnish all labor, materials, equipment, and services necessary for the protection of existing trees and vegetation as required and as specified herein.
   B. The plans shall include annotation that indicates it is the responsibility of the General Contractor to repair, replace, or reimburse OSU for any damaged plant material within a Tree Protection Zone.
   C. All landscape materials shall be protected to ensure they are not damaged.
   D. All staging areas located on planting areas shall be covered with woven geotextile fabric and have a minimum six inch mulch bed placed over area prior to any staging of equipment or materials to prevent soil compaction.
      01. All vehicular or motorized equipment access to a staging area over turf shall be covered with woven geotextile fabric with a minimum of six inches of mulch bed placed over the area to prevent the compaction of soil.
   E. The General Contractor is responsible for removing all construction or construction related debris from the project site and adjacent landscape or shrub beds.

2. DEFINITIONS
   A. Tree Root Protection Zone (TRPZ): An area that generally extends from the base of the tree trunk beyond the dripline of the tree.
   B. Dripline: Outer perimeter of branches of any plant.
   C. Project Arborist: A certified arborist with the experience to conduct the required work outlined in this section shall be employed by the University.

3. CALCULATING THE TREE ROOT PROTECTION ZONE
   A. Measure the tree’s diameter at breast height (DBH), in inches. DBH is calculated using the circumference of the tree trunk at 4.5 feet above grade.
   B. Multiply the DBH by 1.5.
      01. Example = 7” DBH x 1.5 = 10.5’.
   C. The result expressed in feet shall be the minimum radius of the TRPZ.
   D. For trees less than 8” in DBH, the TRPZ shall not be less than the diameter of the canopy dripline.
   E. For shrubs scheduled to remain the protection shall be the dripline of the existing plant or plant grouping.
4. COORDINATION
   A. The project arborist will coordinate with other trades and contractors affecting or affected by work of this section to ensure that tree protection measures are understood prior to work commencing.
   B. An on-site review of tree protection measures will be completed among the project arborist, contractor, OSU Project manager, City of Corvallis, and OSU Landscape Manager or designee prior to any site work or grading is started.
   C. During this meeting the pre-construction evaluation of those trees identified to remain shall be completed.
   D. The contractor is responsible for maintaining all tree protection measures during all construction phases of the project.
   E. The project arborist and OSU Project Manager or shall be contacted immediately if any of the trees on site are damaged during the construction of the project. The project arborist in consultation with the OSU Project Manager and OSU Landscape Manager or designee will assess the damage to any tree and provide corrective measures, which may include pruning; tree wound repair, or even removal.
   F. Upon completion of the project the project arborist will contact the OSU Project Manager and review the post construction evaluation of the trees on the site.
   G. No tree shall be removed from the site without the completion of a tree condition report and prior notification and approval of the OSU Project Manager.

01. Tree removal within the OSU National Historic District requires a Historic Tree Checklist to ensure that any trees being removed are not considered historic. An arborist report must accompany the Historic Tree Checklist.

PART 2 - MATERIALS

1. FENCING
   A. The contractor is responsible for installing a tree protection fence around all the trees identified to remain on site prior to the start of any site work, grading, or staging of any equipment or materials.
   B. The tree protection fence shall be a galvanized chain link fence that measures a minimum of six feet high.
      01. The fence shall be secured using steel posts that are the same height as the fence.
      02. The steel posts shall be driven no less than two feet into the ground, and be a minimum of ten feet apart.

2. SIGNAGE
   A. A highly visible sign shall be posted on the chain link fence demarking the area as a tree root protection zone. The sign shall remain posted and unobstructed until the project is completed.
PART 3 - EXECUTION

2. ASSESSMENT
   A. Pre-Construction Tree Assessment: Prior any site work, grading, staging of equipment, materials or any other mobilization of the project, the project arborist shall complete a pre-construction assessment report that outlines the physical conditions of the trees identified to remain on the site. The project arborist shall review the report with the OSU Project manager and the OSU Landscape Manager or designee.
      01. The OSU Landscape Manager or designee shall provide written notification to the project arborist that the report has been reviewed and is acceptable prior to the mobilization of the project.
      02. The assessment report shall provide any specific tree protection measures required to ensure the health and vigor of the trees during the construction of the project.
      03. The assessment report shall also include a value appraisal of the trees completed according to the most recent Council of Tree and Landscape Appraiser standards (currently the 9th edition, copyright 2000).
         a. The value of the trees that are to remain will be provided to the contractor prior to the mobilization of the site to ensure the contractor is aware of the replacement cost of the trees as outline in the appraisal report.
   B. Tree Protection Areas: Prior any site work, grading, staging of equipment, materials or any other mobilization of the project the contractor shall establish the tree root protection zones and install the specified fencing.
   C. This protection area shall be maintained by the contractor during all phases of construction and only removed upon demobilization of the site.
   D. In consultation with the OSU Project manager and OSU Landscape manager or designee, the project arborist shall recommend corrective measures for any tree damaged during construction,
      01. Prior to any removal of a damaged tree the project arborist will ensure a replacement cost is determined for the damaged tree.
   E. The project arborist shall complete a post construction assessment of the trees to determine the condition of the trees. The report shall be submitted to the OSU Project Manager and OSU Landscape Manager or designee for review and approval.
      01. The OSU Landscape Manager or designee shall provide written notification that the post construction report has been reviewed and accepted prior to the close out of the project.
3. PROTECTION
   A. There shall be no alteration or disturbance of existing grade of any kind within the TRPZ.
   B. No alteration of drainage flow into the TRPZ shall be permitted without the written authorization from the project arborist.
   C. No storage of construction materials, equipment or supplies of any kind shall be permitted within the TRPZ.
   D. No disposal of any liquids of any kind shall be permitted within the TRPZ.
   E. No movement of vehicles, equipment, pedestrians, etc. shall be permitted within the TRPZ.
   F. No excavation or trenching shall be permitted within the TRPZ.
   G. No tunneling under the TRPZ without prior written authorization from the project arborist and landscape coordinator.
   H. No roots extending beyond the TRPZ shall be pruned or cut without prior authorization from the project arborist.
   I. No exceptions of the tree protection measures shall be provided without written approval from the OSU Project Manager and the OSU Landscape manager or designee.

4. PLANS
   A. All site and landscape plans shall identify the trees that are to remain, the trees to be removed, the tree root protection zone and protection fencing.

5. TREE DAMAGE AND REPAIR
   A. Upon notification of a damaged tree the project arborist shall inspect the tree and assess the damage. The arborist shall outline in writing the corrective measures necessary to repair the damage.
   B. If a tree is to be removed as a result of construction related damage then the cost of the removal and replacement and one year establishment care of the tree shall be the responsibility of the general contractor.
   C. Tree Replacement
      01. Up to 8” DBH: Same size as damaged tree, species selected by Landscape Architect after consulting with OSU Project Manager and OSU Landscape Manager or designee.
      02. Over 8” DBH: Compensate owner as determined by value appraisal completed by project arborist according to the most recent Council of Tree and Landscape Appraiser standards.
   D. Replacement shrubs and groundcovers: Same size and quality as damaged, species selected by project Landscape Architect in consultation with the OSU Project Manager and OSU Landscape Manager.
Section 32250 – EXTERIOR SIGNAGE

PART 1 - GENERAL

1. REQUIREMENTS

Oregon State University requires an effective system of visual communication that projects a uniform institutional identity, while at the same time integrating well with the present and future campus environment. OSU shall be requested, designed and installed by Facilities Services. The following requirements identify how exterior signage will be applied to the OSU main campus.

A. Monument signs are considered the main building identification and will only include building name, abbreviation and street address.
   01. Minimum setback for primary identification signs from the curb face shall be two (2) feet.
   02. Minimum separation between primary identification signs shall be 100 feet.

B. Directional Signs provide direction to parking lots, buildings, and athletic and/or event facilities within a specific location and include the following requirements:
   01. Minimum clearance for these signs located above a pedestrian walkway shall be 10 feet. If a directional sign is attached (such as building, light post, etc.):
      a. If the attached sign projects more than 6 inches, the minimum clearance above a pedestrian walkway shall be 7 1/2 feet;
      b. If the attached sign projects more than 1 foot, the edge of the sign face closest to the building shall not project more than 6 inches;
      c. No attached sign shall project more than 8 feet from the building face.
   02. No direction signs are to be attached to any historic building. (Refer to the OSU Historic Preservation Plan Design Guidelines.)

C. Banners must be mounted on dual arms to a campus light pole.

D. Exterior signs within the historic district must comply with City of Corvallis Land Development Code Chapter 2.9 – Historic Resources. Installation of exterior signs within the historic district to be coordinated with Campus Planning.
Section 32300 – PAVING

PART 1 – GENERAL

1. REQUIREMENTS
   A. Asphaltic Paving Sections
      01. The use of permeable paving should be considered as appropriate to meet OSU sustainability initiatives.
      02. Multi-use paths require a minimum of 4-inches of Class “C” asphalt (2-2 inch lifts) over 6-inches of ¾”-0” baserock and subgrade geotextile.
      03. The design should try to match existing grade, in order to minimize elevation differences at the edges.
      04. Compaction of exposed edges should be called out on design.
      05. Non-thoroughfare paving sections (i.e., parking lots) accessible to cars require 4-inches of Class “C” asphalt (2-2 inch lifts) over 12-inches of ¾”-0” baserock.
      06. Streets, alleys, and access ways for trucks and buses, including thoroughfares through parking lots require, at minimum 4-inches of Class “C” asphalt (2-2 inch lifts) over 18-inches of ¾”-0” baserock.
   B. PCC Paving Sections
      01. All Portland cement concrete (PCC) paving and slab sections are required to have 6-inches of ¾”-0” baserock and 6-inches of 4,000 psi concrete, as a minimum.
      02. If vehicles have any possibility of access to the paving section, then reinforcing bars (ASTM A615, Grade 60) should be specified.
      03. If vehicles do not have the possibility of access to the section, then wire fabric conforming to ASTM A185 may be used.
      04. If wire fabric is allowed, proper specifications are required to ensure it is placed properly during concrete placement, and not left in contact with the ground.
      05. Portland Cement Concrete (PCC) paving sections for main thoroughfares, including heavy trucks, buses, and heavy equipment require a minimum of 8-inches of ¾”-0” baserock and 8-inches of 4,000 psi concrete.
      06. All concrete sections designed for vehicular traffic, requires reinforcing steel, and a 2-inch thicker concrete section within 12-inches of all edges.
   C. Sidewalks, wheelchair ramps, driveways
      01. All sidewalks, wheelchair ramps, and driveways shall be designed per latest City of Corvallis Standard Construction Specifications and associated detail drawings, with the following exceptions:
         a. Minimum depth of baserock shall be 4-inches, rather than 2-inches.
         b. All concrete shall have a minimum strength of 4,000 psi.
c. All sections of sidewalk to be used for vehicular parking, maintenance, and/or construction access, are required to be a minimum of 6-inches thick and reinforced per “PCC PAVING SECTIONS” in this Design Criteria.

D. Parking Lots

01. Parking lot designs shall be based on this document: “City of Corvallis Design Criteria, and City of Corvallis “Off-Street Parking and Access Standards”, latest version. The Consultant and/or Contractor are responsible for obtaining a copy of the document from the City of Corvallis.
1. REQUIREMENTS
   A. A utility locate of the areas within the proposed construction zone shall occur prior to any excavation or mobilization of project.
   B. The OSU Project Manager shall coordinate the utility locate, and all correspondences associated with the completion of the utility locate shall be provided to the project manager.
   C. All underground utilities shall be designed and constructed per City of Corvallis “Design Criteria” and “Standard Construction Specifications”, respectively.
      01. Capacities, slopes, and other design considerations for gravity flow lines require the most conservative design, unless otherwise approved in writing by the University Civil Engineer.
      02. Minimum allowable depth of cover for all utilities is 36-inches, unless other design provisions are implemented, and approved by the University Civil Engineer.
      03. Stormwater detention and water quality systems shall be based on City of Corvallis criteria, and require approval of the University Civil Engineer.
      04. Volume capacity for detention basins, should be calculated based on saturated ground water conditions.
      05. All detention systems should be designed to minimize maintenance, and provide adequate access for cleaning and maintenance activities.
   D. All projects connecting to existing gravity flow utilities shall include provisions requiring the Contractor to video all new piping outside the building, to one manhole downstream from the new connection.
      01. If the project ties into an existing manhole, or replaces a manhole, then the camera work needs to include the piping to the next manhole downstream.
      02. The video is to be submitted to the University Civil Engineer upon completion.

2. FRANCHISE UTILITIES
   A. All franchise utility underground work requires coordination, review, and approval of the University Civil Engineer.
      01. All work shall conform, at a minimum to all jurisdictional codes and regulations. Minimum depth of cover for all utilities is 36-inches, unless otherwise approved by the University Civil Engineer.
   B. Chapter 2 of the Campus Master Plan recommends utility distribution lines be underground, and OSU’s preference is to locate all new utilities underground. If existing above ground utilities are within the project limits, then provisions
should be implemented by the designer to have the utilities relocated underground unless otherwise approved by the Director.

01. If the utility is owned by a franchise, with a recorded easement, then the cost of relocation would be the responsibility of the project. If an easement does not exist, then the cost would be the utility’s responsibility, and a new easement would need to be coordinated through the University Civil Engineer.
Section 33050 – METERS

PART 1 - GENERAL

1. REQUIREMENTS
   A. Building Electric Meters: Demand meters, programmable and readable with Landis & Gyr 1132 prog & 1132 com, for windows with Gyrbox diagnostic program to meet existing equipment and employee software knowledge.

PART 2 - METERING

2. REQUIREMENTS
   A. All buildings shall be fully metered for electricity, steam, condensate, potable and irrigation water, sewer deductions natural gas, chilled and heating water, and other utilities where applicable.
   B. The installation of any utility equipment (e.g., electrical, natural gas, etc) shall be completed in accordance with the utility requirements of the supplier of the utility (i.e., Pacific Power, NW Natural Gas, etc). Utility meters shall be integrated with the Building Management systems to allow for monitoring, trending and preservation of records for all utilities.
   C. Prior to changes to any utility meter on OSU property the OSU Change of Meter Status SOP shall be reviewed and procedures followed therein.

3. SPECIFICATIONS
   A. Electrical meters: Demand meters, programmable and readable with Landis & Gyr 1132 prog & 1132 com, for Windows, with Gyrbox diagnostic program to meet existing equipment and employee software knowledge.
   B. Steam meters: Foxboro Vortex 84F (flanged) flow meters equipped with either digital remote transmitter or KEP Intellect-69 remote totalizer. Communication of digital 4-20mA and/or scaled pulse outputs.
   C. Condensate meters: Sierra Instruments model 205 ultrasonic flow meter with high temperature transducers with either a digital remote transmitter or KEP Intellect-69 remote totalizer. Communication of digital 4-20mA and/or scaled pulse outputs.
   D. Water meters: Sensus meters, to meet City of Corvallis requirements. 1” and below are to be SRII; 1.5” and above are to be either SR or OMNI-type meters.
      a. Meters to be placed on all incoming domestic and fire mains.
   E. Sewer deduct meters: Sensus meters, to meet City of Corvallis requirements. 1” and below are to be SRII; 1.5” and above are to be either SR or OMNI-type meters.
      a. Meters to be placed on lines dedicated to equipment that does not send water to drain. These include cooling towers and irrigation systems.
F. Natural gas meters: Natural gas meters will be provided by the utility, currently Northwest Natural.
To: Construction Standards Committee members, Campus Planning and Design staff, Campus Operations managers, Rainier Farmer, Chair Alternative Transit Advisory Committee

From: Vincent Martorello, Director Facilities Services

Date: 9/28/2009

Re: Covered Bike Racks with New Construction

Technical Update 01-2009

Division 12
Section 12550 – Approved Site Furnishings List
Part 1

Subsection (E) will be added to Part 1, and read as follows:

(E) When covered bike racks are installed as part of a new construction project or major renovation, the project team can modify the approved specification so the architectural appearance of the covered bike rack is more compatible with the proposed renovation or new construction. The Project Manager will review the change with the Project Review Team for final approval.
To: Construction Standards Committee Members, Campus Planning and Design Staff, Campus Operations Managers, Margret Mellinger, Chair COSID Committee, Angelo Gomez, OAA, Tracy Bentley-Townlin, DAS.

From: Vincent Martorello, Director Facilities Services

Date: 12/10/2009 - updated

Re: Percent for Cross Slopes on Ramps and Sidewalks

Technical Update 02-2009

Division 32
Section 32300-Paving
Part 1

Subsection (C) will be amended and read as follows:

d. The maximum percent of cross slope used for sidewalks is less than 2%, preferred is a cross slope 1.5-1.75 to ensure less than 2% is achieved.

e. When a cross slope for a ramp is used, it shall comply with (d).

f. Avoid using cross slopes on landings, unless required for drainage, then use a slope of less than 1%.

g. Refer to Section 01200, Part 2, Subsection 6, OSU Americans with Disabilities Best Practices for additional standards.

Effective December 01, 2009
To: Construction Standards Committee Members, Campus Planning and Design Staff, Campus Operations Managers, Margret Mellinger, Chair COSID Committee, Angelo Gomez, OAA, Tracy Bentley-Townlin, DAS.

From: Vincent Martorello, Director Facilities Services

Date: 12/10/2009 - updated

Re: Elevator Control Buttons

Technical Update 03-2009

Division 14
Section 14050
Part 1

Part 1 will be amended and read as follows:

1. Requirements
   A. Preferred Bidders and equipment is to be used unless a change is approved by the project manager.
   B. If there are upgrades available with the controllers they need to be furnished. If they take a special tool, that tool needs to be furnished.
   C. All elevator buttons shall be centered at 33” above the final finish floor elevation where possible.
   D. All elevator buttons will be the Beaver element buttons. Contact Project Manager for more information.
   E. Call buttons in lobbies and halls shall be mounted at 33” on center above the final finish floor elevation.
   F. Call buttons within the elevators shall be mounted at 33” on center where possible above the final finish floor elevation.

2. Preferred Vendors
   A. Thyssen
   B. Otis
   C. NW Elevator
   D. Elevator Solutions
3. Preferred Equipment: Preferred controllers are to be used unless the Project Review Team approves a change to another controller.

A. Controllers
   01. Motion Control Engineering, Inc, 2008 version
   02. Tac 22
   03. Otis 211

B. Hydraulic Pump Unit, Jack Assembly, Guide Rails, Line Switches
   01. Canton Elevator Company
   02. EE CO-Elevator Equipment Company, Inc.
   03. Minnesota Elevator, Inc.

C. Hydraulic Valve
   01. Maxton Manufacturing Company

D. Automatic Lowering Device
   01. R & R Electronics

E. Cab, Hoistway, Doors, and Hoistway Entrances
   01. Canton Elevator Company
   02. EE CO-Elevator Equipment Company, Inc.
   03. Minnesota Elevator, Inc.

F. Car Door Operator:
   01. G.A.L. Manufacturing Corporation-MVFR-Closed loop regulated speed performance-1/2 HP drive motor

G. Door Tracks, Hangers, Interlocks, Gate Switch:
   01. G.A.L. Manufacturing Corporation

H. Car Roller Guides:

I. Car Door Protective Device:
   01. Janus “Panaforty-3D”

J. Fixtures-Vandal Resistant
02. Car Fixtures, including In-Car Directional Lanterns: Innovation Industries Incorporated “The Bruiser-Vandal Resistant” with OSU logo.

K. Hoistway Access Door Safety Plugs: Safety plugs will be required in residential hall elevators and no safety plugs in commercial/industrial building elevators.

L. Car/Hall Position Indicators/Signals:
   01. C.E. Electronics, Inc. Place with buttons.

M. Intercoms & ADA In-Car Emergency Communication:
   01. Wurtec

N. Alarm Bell:
   01. Nylube Model ELB-6.

O. In-Car Emergency Light:
   01. Nylube Products Model EL-SS, LED’s.

4. Machine Room Equipment
   A. Hydraulic Pump Unit:
      01. Assembled unit consisting “wet type” of positive-displacement pump, induction motor, master-type control valves combining safety features, holding, direction, bypass, stopping and manual-lowering functions, shut off valve, oil reservoir with protected-vent opening, oil gauge and outlet strainer, drip pan and connections all mounted on isolating pads.

   B. Piping and Oil:
      01. Provide “ISO 32 Environmentally safe oil for the system.

   C. Shutoff valve:
      01. Provide shutoff valve in oil line at pit area and machine room.

   D. Entrance Equipment:
      01. Door hangers: We want two sheaves per door rotating on precision ball bearings, including upthrust equipment. Provide door rollers so that no metal to metal contact exists. Hangers shall be bolted to top of hoistway doors.
E. Elevator Car Station:
   01. Provide a “door open hold” button switch.

5. Car Enclosures
   A. Car Sill:
      01. Provide nickel silver car sill. Through bolt with flathead stainless steel
           fastenings.
   
   B. Car Handrails:
      01. No fastening device, set screw-etc shall be allowed inside the cab. Hand
           rail, standoff section and mounting stud shall all be as one unit.
   
   C. Interior Car Finishes:
      01. Wall covering: Provide 5-SM Vandal resistant stainless steel, on all walls
           above stainless steel base.
   
   D. Landing control stations:
      01. Provide firefighters service phase 1 key switch with engraved
           instructions at main recall floor hall station.

6. Car Size
   A. Where possible the elevator cab shall accommodate a plinth or large electric
      wheelchair.

Effective December 02, 2009
To: Construction Standards Committee Members, Campus Planning and Design Staff, Campus Operations Managers, Margret Mellinger, Chair COSID Committee, Angelo Gomez, OAA, Tracy Bentley-Townlin, DAS

From: Vincent Martorello, Director Facilities Services

Date: 1/12/2009

Re: Run slope for ADA ramps

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**Technical Update 04**

**Division 32**

**Section 32300**

**Part 1**

Subsection C will be amended as follows:

**e.** The preferred run slopes for exterior ADA ramps serving buildings is less than 1:20. If the preferred slope cannot be achieved because of site or technical restrictions, than a slope of 1:20 to 1:16 should be used. These percent slopes are considered an OSU best practice for providing access to the buildings and programs on campus.

**f.** Architects and engineers shall use this OSU practice as initial design standard when designing ADA ramps for building entries.

**g.** When the use of the best practice standard is not technically feasible, then the most practical percent slope shall be used.

**h.** Any diversion from this best practice will need to be communicated and coordinated with the Office of Affirmative Action prior to a decision not to use the best practice standard.

**i.** Refer to Section 01200, Part 2, Subsection 6, OSU Americans with Disabilities Best Practices for additional standards.

**Effective Date:** January 12, 2010
To: Construction Standards Committee Members, Campus Planning and Design Staff, Campus Operations Managers.

From: Vincent Martorello, Director Facilities Services

Date: 1/12/2009

Re: Deletion of “landscape policy” language

Technical Update 05

Division 32
Section 32100
Part 1

The following language will be deleted from the Construction Standard

*Designer must be familiar with the Oregon State University Policy & Guidelines for Campus Landscape Development.*

This document has been superseded by the Campus Master Plan and the Construction Standards Document and is no longer applicable.

Effective Date 1/12/2009
To: Construction Standards Committee Members, Campus Planning and Design Staff, Campus Operations Managers, Committee, Angelo Gomez, Tracy Bentley-Townlin, Roni Sue.

From: Vincent Martorello, Director Facilities Services

Date: 1/12/2009

Re: Addition of Section 01200 Americans with Disability Act Best Practices

Technical Update 06

Division 01
Section 01200

The following language will be added to the OSU Construction Standards.

PART 1 – PURPOSE

The purpose of these Construction Standards is to supplement the Americans with Disabilities Act and Architectural Barriers Act Accessibility Guidelines, 2004 (ADAAG 2004) and Chapter 11, of the Oregon State Building Code with standards that have been identified to help OSU establish best practices when it comes to providing access to its buildings and programs.

The standards herein are the preferred practices and should be accommodated whenever technically feasible. The architect and engineer using these standards shall approach the design making every attempt to use these standards. If a standard is not used, then the architect or engineer will need to demonstrate to the project team and Office of Affirmative Action upon request, why a standard herein could not be used.

PART 2 – REQUIREMENTS

1. Scoping for renovation projects or remodel

   A. Conduct a thorough assessment of existing conditions to determine accessibility problems and deficiencies. Focus on priority areas in the following order:
01. Priority 1: accessibility of routes, including connectivity between nearest accessible parking and/or drop off areas and building entrances, doors, and vertical access (stairs, ramps, elevators, escalators).

02. Priority 2: accessibility of goods and services, including alternative for providing access to goods and services where altering the structure is not possible (for example, when there is no elevator and second floor spaces are not accessible).

03. Priority 3: accessibility of restrooms, including provision for unisex accessible restrooms.

04. Priority 4: additional accessibility throughout the building and site, such as interior features, furnishings, equipment, floor surfaces, and lighting, and building information systems including signage.

2. Scoping uses or spaces not commonly built.

A. When designing or building uses or spaces not commonly built at OSU, such as eating establishments, kitchens, bathing facilities, etc; the project manager, engineer, and/or architect shall review the potential space and use with the Office of Affirmative Action to review potential best practices and standards that need to be incorporated into the design.

3. Controls and Objects: Placement and Location

A. Controls and objects shall be unobstructed.

B. Where forward or side reach is necessary the controls shall be no higher than 43 inches above the floor.

C. Where forward reach is unobstructed, locate objects no lower than 15 inches above the floor (ADAAG 1998 4.2 & 2004 308).

D. Controls and objects shall be placed at least 18 inches away from inside corners of walls to allow for wheelchair access.

E. All controls and objects need to be placed at a consistent height within a space or room.

F. Locate outlets and other objects that are normally closer to the floor at a consistent height of 18 inches above the floor measured to the centerline of the outlet or object.

G. Elevators

01. Provide hall call buttons that fully illuminate and are bright and are easy to recognize when activated.
02. Use flat-surfaced, raised buttons because they are easier to activate than convex buttons.

4. Parking

A. Provide surfaces for parking spaces, passenger loading zones, and adjacent aisles that are firm, stable, and slip-resistant (ADAAG 1998 4.5 & 2004 302).
B. Accessible parking spaces shall be placed on the shortest distance possible between the parking space and the adjacent building or destination.
C. Accessible routes should not cross vehicular traffic. In those cases where it is not technically feasible or reasonable to separate access route from vehicular traffic, then the accessible routes shall be clearly marked as accessible pedestrian crossings.

5. Accessible Route/Path of Travel

A. Design accessible exterior and interior routes without ramps whenever possible. In exterior routes, choose alternatives to ramps (such as sidewalks and proper grading) to achieve gentler slopes. In interior routes, elevators are preferred wherever level changes greater than three vertical feet are necessary.
B. Curb Ramps
   01. Locate curb ramps where they cannot be obstructed by parked vehicles.
   02. A curb ramp shall be installed at all sidewalk and street intersections.
   03. Do not paint curb ramp surfaces.
   04. Install curb ramp surface materials that contrast and stand out visually from surrounding surfaces (e.g., by tinting the concrete) and/or by installing detectable warnings that visually contrast with adjoining surfaces. Detectable warnings are required on all curb ramps at transitions from walking surface to driving surface (ADAAG – 2004, 406)
   05. Ensure that all transitions from curb ramps to adjacent walks, gutters, or streets are flush and free of abrupt changes (ADAAG 1998 4.7), while allowing for drainage.
   06. Provide curb ramps where accessible routes cross curbs (ADAAG 1998 4.7).
C. Adequate lighting shall be installed along access routes and paths of travel.
D. Install accessible drinking fountains on any accessible route within a building.
E. Provide at least one accessible means of egress from each accessible space in a building to the outside of the building (ADAAG 2004, 105 Advisory).

F. In an alteration, provide accessible egress that meets the guidelines for new construction whenever possible.

G. Minimum clearance for access routes is 48 inches.

H. Do not design or construct small level changes that result in single stair condition in any exterior or interior routes or at doorways.

I. Provide edge protection or barriers along routes where the surfaces adjacent to the routes are 0.5 inches or more below the level of the routes.
   01. Eliminate or avoid grates or other openings in traveling surfaces wherever possible.

J. If the use of a grate is necessary, then place grates with elongated openings so that the long dimension is perpendicular to the dominant direction of travel, and that the width of spaces in a grate is not more than 0.5 in the dominant direction of travel.

K. If the route is less than 60 inches wide provide turning spaces at reasonable intervals that meet one of the following conditions:
   01. Clear space of 60 inches minimum in diameter. A space of 60 inches by78 inches is preferred.

6. **Ramps - for building entrances and internal to buildings**

A. The preferred design solution for access is identified in C1 of this document. However, when a ramp is necessary, then the preferred run slope for exterior ADA ramps serving buildings is less than 1:20. If the preferred slope cannot be achieved because of site or technical restrictions, than a slope of 1:20 to 1:16 should be used.

B. Preferred run slopes for ramps in buildings and classrooms is 1:20 – 1:16.

C. For additional information refer to Section 32300, Part 1, subsection C.

D. In those cases when a slope will be greater than 1:16, the Office of Affirmative Action will be contacted and review the design prior to a final percent slope has been determined.

E. Avoid designing and constructing curved ramps.

F. Ramp surfaces within classrooms and hallways shall not be surfaced with carpet.

G. All surface material for approach, landing, ramps and bottom landings shall consist of the same material.

H. Where possible, provide 60 inches by 72 inches for landings or approach surfaces at the top and the bottom of the ramps.
I. Cross slope of ramp runs shall not be steeper than 1:48 or 2% (ADAAG 2004 405.3)
J. Preferred cross slope is within a range of 1.5% to 1.75% to ensure when forms are set and the ramp is constructed the final slope percent will be less than 2%.
K. Avoid cross slopes on landings, unless required for drainage, then use a slope of less than 1%.

7. Stairs

A. Ensure that the leading edge of treads contrasts in color with the rest of the treads to increase visibility and safety where appropriate (ADAAG 2004, 5004 Advisory).
B. Install handrails so they are 34 inches minimum to 38 inches maximum above stair tread. A height of 38” is preferred to minimize severity of stair related falls.
C. Ensure that the lighting level on all stairs is at least equal to (or greater than) the lighting level of adjacent areas.
D. In alterations to existing conditions improve stairways by
   01. Ensuring that the leading edge of all treads contrasts in color with the rest of the treads to increase visibility and safety (where conditions merit).
B. Do not design or construct stairs with overhanging nosing.
C. Eliminate overhanging nosing in existing buildings where possible.
D. When the leading edges of stair treads have either; 1) slip resistant strips, or, 2) marked or painted edges for visual prominence, ensure that all treads in the flight of stairs have strips or marked edges that:
   01. are securely and permanently attached.
   02. are between 1.0 inches and 2.0 inches wide.

8. Handrails

A. Install handrails so the top of the gripping surface is at a consistent height of 34 inches minimum to 38 inches maximum above the ramp surface. A height of 38” is preferred to minimize severity of stair related falls.
B. Provide a second, lower set of handrails if children are primary or frequent users of the ramp.
   01. A top surface height of 26 inches is preferred.
C. Locate handrails in recesses only if the recesses are 3 inches deep maximum and extend at least 18 inches above the top of the handrail.
D. Provide handrails on both sides of all stairways, including those with only one or two risers.
E. Ensure that all handrails are visually prominent with color contrast to adjacent walls and surfaces.
F. Extend handrails beyond the top and bottom of stair flights and ensure that they are parallel to the landing surfaces.
   01. Where possible, continue handrails at the bottom of stair flights with 12 inches horizontal extensions (providing that extensions do not protrude into accessible routes).
G. Provide continuous handrails around the perimeter of landings.

9. Restrooms

A. Provide at least one ADA restroom per floor of a new building, one of which to be an accessible unisex restroom.
B. In restrooms that include two or more toilets, provide at least one walk-in stall and one wheelchair accessible stall.
C. In large public restrooms, provide multiple accessible stalls of both types (wheelchair accessible and walk-in accessible.)
D. To allow for both hinged side and latch side approaches to a wheelchair accessible stall, provide 48 inches minimum clearance between the door side and stall and any wall or obstruction (ADAAG 1998 4.7 & 2004 404).
E. Install automatic faucets and flush controls where possible.
F. Locate flush controls on the rear wall.
G. When automatic controls are not technically feasible, install fixtures that are designed for universal use and do not installed special fixtures that only accommodate some people.
H. A height of 43 inches to the operable controls is preferred for all fixtures and dispensers, unless otherwise specified.
I. Mount fixtures (including hand dryers, paper towel holders, and soap dispensers) within appropriate reach range identified herein.
J. Preferred height of all toilet room or toilet stall grab bars is 34 inches.
K. Mount toilet paper dispensers below grab bars at 29” and out from the edge of the toilet by a distance of 7 inches to 9 inches.
E. Install baby-changing tables so that the front edge of the usable surface is 34 inches above floor (preferred).
F. Where children are the primary users of the toilet room, locate the dispensers and other objects so that the outlet is between 14 inches minimum and 19 inches maximum above the floor.

G. Install an accessible drinking fountain on a floor where an accessible bathroom is located.

10. Building Ingress and Egress
   A. Where technically feasible all public access points to a new building or major remodel/renovation will be accessible.
   B. At least 50 percent of all public access points to the building will be accessible. In those cases where 50 percent cannot be achieved due to technical feasibility, the Office of Affirmative Action will be contacted and review the design prior to a final decision has been determined.

11. Doors and Door Openers
   A. Install doors in series so that they swing either in the same direction or away from the space between the doors (ADAG 1998 4.13).
   B. Between two hinged or pivoted doors in a series, provide a minimum space of 48 inches, plus the width of any door into the space (ADAAG 1998 4.13 & 2004 404).
   C. In cases where doors in a series both swing towards the space between the doors, ensure 48 inches minimum clear space is maintained between door swings.
   D. Install doors that provide a minimum of 33 inches, however, 36 inches of clear opening is recommended when technically feasible.
   E. Install magnetic hold open devices or high quality automatic door openers on internal doors and fire doors in corridors, and other areas accessible entrances and along accessible routes within buildings.
   F. When installing a vision lite or side lite, locate the top edge of at least one glazed panel no less than 68 inches above the floor.
   G. The preferred height for handles, pulls, latches, locks, and other operable parts on accessible doors is 39 inches above floor (ADAAG 2004 404).

12. Signage
   A. Place signs in the appropriate locations so that people do not have to backtrack along a route after arriving at an inaccessible entrances. Place signs
at the beginning of the route to direct people to the nearest accessible entrance (ADDAG 1998 4.1).

B. Provide signs that include maps at inaccessible entrances that direct people to accessible entrances.
C. Install tactile signs at stairways and elevators that are not accessible to direct people to the nearest accessible exits.
D. Clearly mark where accessible entrances are located at an approach of a building or within the building.
E. Even though accessible building directories, menus and temporary signs are not required to meet accessibility requirements, make the information readily available to all people wherever possible. Place this information at key locations, and at a height that a person in a wheelchair can read (ADAAG, 2004 Table 703.5.5 specifies character size and location from finished height above floor.
F. Incorporate text with the International Symbol for Accessibility, use the word “accessible” rather than “handicapped” or “disabled”.
G. Install accessible signs (including those for parking, restrooms, and telephones) throughout the building and site where appropriate.

13. Clear Floor Space

A. Ensure that the space provided for legroom is unobstructed.
B. Ensure that legroom under a surface or object is 27 inches minimum.
C. Legroom (e.g., bathroom fixture, water fountain, counter, and other objects) under any surface or object should extend as far as practical.
D. Provide adequate clear floor space at accessible windows so that a person can approach and open the accessible windows.
E. Extend the distance under a fixture or surface beyond ADAAG guidelines to the maximum extent possible.

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