

## **Basis of Design**

This section applies to the general mechanical requirements for all Division 15 work.

### **Background**

- This section is intended to assist the Mechanical Engineer and other design team members during the design process by answering questions about how the University builds, operates, and maintains mechanical systems in buildings. If there are questions about this information or proposals of alternate solutions, discuss them with the Project Manager and Campus Engineering.

### **Programming**

- Design facilities to minimize annual operating costs and future repair and replacement costs.
- Facility design standards can vary for the Tacoma campus, Bothell campus and off-site facilities. Review each project with the Project Manager and Campus Engineering to determine modifications to the Facilities Services Design Guide as appropriate. State these modifications clearly in the Technical Program.
- The Central Power Plant (CPP) is located on the east side of the central campus and provides utilities to the buildings adjacent to the utility tunnel system. This includes all buildings on the central, south, and southwest campuses and most of the buildings on the east campus and along Campus Parkway. Mechanical utilities from the CPP include steam, condensate return, central cooling water and compressed air. Due to the capacity and hydraulics limitations of these system, verify the addition of new loads onto these systems with Campus Engineering.
- Mechanical rooms need to be large enough to house the equipment and provide adequately sized access pathways for the repair, maintenance, and eventual replacement of the equipment. Equipment access pathways shall be large enough to allow for the removal of coils and other large pieces of equipment. Identify these areas on the design document drawing.
- Where a detailed analysis of the program reveals an inadequate budget to provide the appropriate system design, notify the Project Manager, in writing, of the budget deficiency, the recommended system and its cost, and the alternatives if a budget revision is not provided. Identify and evaluate alternates early in the design process.
- Include an evaluation for building system renovation projects which describes the condition of the building systems, variances from present codes, and identifies spare system capacity or system deficiencies and opportunities for improving energy efficiency. The design team's mechanical, electrical, civil, structural, and architectural disciplines should participate jointly in this evaluation.
- The mechanical infrastructure shall consist of the mechanical rooms, penthouses, shafts and plenum areas. Extra attention should be given to the plenum areas above the corridor ceiling, as they often become the critical space for mechanical and electrical distribution.

### **Design Criteria**

- Important mechanical areas of coordination with Campus Engineering:
  - 1) Connection to existing utility distribution systems, including capacity and location,
  - 2) Temporary construction water and sewer point of service,

- 3) Distribution concepts including piping and ductwork,
  - 4) Load calculations for campus utilities,
  - 5) Noise criteria levels for all spaces,
  - 6) Seismic bracing,
  - 7) Special systems design (research and diagnostic equipment, and other equipment and designs not specifically covered by the Facilities Services Design Guide),
  - 8) Control systems and indoor environmental monitoring,
- Provide Basis of Design Narrative including the design conditions for each space as follows:
    - 1) Indoor dry bulb temperature,
    - 2) Indoor relative humidity,
    - 3) Outdoor dry bulb temperature,
    - 4) Outdoor wet bulb temperature,
    - 5) Occupancy, hours, and degree of activity,
    - 6) Lighting and miscellaneous power,
    - 7) Ventilation – recirculation and outside air,
    - 8) Internal loads,
    - 9) Special loads,
    - 10) Insulating R-values for roof, wall, glass, etc.,
    - 11) Percentage of glass – fenestration,
    - 12) Type of glass, including coatings and solar coefficients,
    - 13) Building pressurization and infiltration,
    - 14) Building mass,
    - 15) Code requirements and impact on criteria,
    - 16) Air quality design criteria, i.e. ASHRAE 62-2007,
    - 17) Noise criteria,
    - 18) Fire and life safety,
    - 19) Energy efficiency and cost,
    - 20) Sustainability,
    - 21) Maintainability.
  - Design systems and components with maximum reliability, maximum flexibility, and minimum operation and maintenance cost. Give full consideration for future system alterations with a minimum of system shutdowns. Accomplish preventive maintenance without a major building shutdown. Maintenance accessibility is very important. Meet current regulations for worker safety, including fall protection.
  - Since laboratory buildings will need constant renovation to keep up with changing technology, the building will be divided up into lab modules.

- Provide isolation valves and devices for each utility serving each lab. Down feed all mechanical systems except the waste lines to minimize the number of floor penetrations.
- Coordinate mechanical equipment located on the roof with the Architect. Minimize the number of roof penetrations.
- Provide access with platform for shafts that contain systems that require periodic maintenance, repair, or replacement, e.g. piping, fume ducts, etc. Accessibility will also be required if space is provided for future mechanical equipment. Provide access through access doors or removable walls and space within the shafts. Sheet rock walls are considered removable. Accessible shafts are preferred over removable walls. Coordinate access method with Architect.
- Route utilities supplied by the Central Power Plant through a tunnel system. See details Utility Tunnel Section, Utility Trench Section, Utility Tunnel Manhole Plan, Mechanical Pipe Support Details 1 and Mechanical Pipe Support Details 2 in the Civil – Utility Tunnels and Trenches.
- Provide adequate access to all equipment requiring periodic maintenance. Show building access doors on both the mechanical and architectural drawings so they are properly located for maintenance and appearance. Provide equipment access doors with a minimum size of 24 “x 24” unless discussed with Campus Engineering. Lifts or removable ladders shall not be relied upon for access unless approved by Campus Engineering.
- Mount equipment, e.g. fans and pumps, on a 4-inch thick concrete pad secured to structural slab. Size concrete pads larger than equipment. Pad shall extend at least ten times the diameter of the mounting bolts past the equipment. Coordinate with Structural Engineer for final design.
- Provide Methylmethacrylate coating over entire mechanical room floor, including over housekeeping pads under air handling units, etc. See Architectural 9B – Finishes Section.
- Provide pipe sleeves for all piping penetrations through concrete and masonry. Provide galvanized schedule 40 pipe sleeves. Coordinate with architectural and structural for location and installation.
- Include a statement in the specifications that all components of the mechanical systems (e.g. fans, duct, insulation, sound attenuators, terminal boxes, pumps, etc.) must be kept clean and dry as manufactured, delivered, stored and installed before operating the mechanical systems. At the University of Washington Medical Center, it may be necessary to provide isopropyl alcohol wipe-down at all air handling equipment prior to installation.

#### **Inter-discipline Coordination**

- Coordinate the mechanical work with other disciplines to define the work and responsibilities of the Mechanical Contractor. Because of the space taken up by the mechanical equipment, the Mechanical Engineer will need to work very closely with the Architect, Structural, and Electrical Engineers to determine the building infrastructure. In many cases, the mechanical and electrical system space requirements will necessitate changes to the floor plans, building sections, and exterior elevations, if not properly included at the onset.
- Coordinate the location of mechanical equipment (air terminal units, pipes, conduit, and ductwork) above suspended ceilings with other disciplines. The lack of proper coordination can cause both construction and maintenance problems. Advise the Project Manager and Campus Engineering of possible conflicts and provide the details necessary to resolve those problems during the design process.

- Coordinate between the Mechanical Engineer and Electrical Engineer for equipment motors, motor starters, disconnect switches, thermal overload switches and mechanical controls for all mechanical equipment including AHUs, exhaust fans, and pumps.
- Classroom Services establishes additional University standards that may affect the design of specific mechanical systems. Refer to Classroom Services requirements.
- UW Technology establishes additional University standards. Entrance rooms and communications rooms have specific continuous air conditioning loads that must be accommodated by the mechanical system. Refer to UW Technology Design Guide requirements.
- Environmental Health and Safety establishes University Life, Health, and Safety standards that may affect the design of specific mechanical systems. Refer to EH&S Laboratory Safety Design Guide.

### **Plans and Specifications**

- Extensive drawings of existing building mechanical and utility systems are available from the records vault.

### **Operational Constraints**

- Sustainability, operability and maintainability are key elements in the evaluation of the Technical Program and Schematic Design. General use buildings are operated to match occupancy and are normally shut down during nights (10pm to 6am), weekends and holidays. Libraries usually have extended schedules. Laboratory buildings normally run continuously to maintain a safe working environment 24 hours per day. Evaluate on a building-by-building basis; to allow a more efficient operation.
- In remodel or renovation projects, shutdowns of existing utilities and services may be necessary. These shutdowns may have to occur after normal working hours to prevent interruption of critical operations. Coordinate all shutdowns with the University. Temporary utilities may be necessary to maintain service to critical loads in laboratories and hospital health care areas and to refrigeration equipment. Factor the impact of long lead equipment into the project cost estimate and schedule.

### **Construction Requirements**

- The location of equipment, products, or processes that create hazardous or offensive noise or fumes may be restricted. Take measures to protect the building occupants and prevent atmospheric release of chemicals, fumes or other undesirable materials. Identify and discuss any of these items with the U.W. project manager.
- Include a statement in the specifications that all components of the ventilation system (e.g. fan, duct, insulation, sound attenuators, terminal boxes, etc.) must be kept clean and dry as manufactured, delivered, stored and installed before operating the HVAC system. At the University of Washington Medical Center it may be necessary to provide isopropyl alcohol wipe-down at all air handling equipment prior to installation.

### **Renovation and Demolition**

- The abandonment of existing equipment and material in place is not acceptable. Conserve space as much as possible. Abandoned systems become a serious liability since it can not easily be determined what is active and what is not. The correction of existing mechanical problems and removal of abandoned mechanical equipment, while maintaining the operation of the building, all need to be addressed in the contract documents. Disposal of materials

can be a problem with limited on-site areas for temporary storage. Define reuse of equipment where appropriate.

## **Design Evaluation**

**The following information is required to evaluate the design:**

- Programming Phase: Identify mechanical system requirements and any exceptions to the Facilities Services Design Guide. Submit Basis of Design Narrative.
- Schematic Design Phase: Refer to requirements specified in the individual Mechanical sections.
- Design Development Phase: Refer to requirements specified in the individual Mechanical sections.
- Construction Document Phase: Refer to requirements specified in the individual Mechanical sections.

## **Construction Submittals**

- Refer to requirements specified in the individual Mechanical sections.

## **Related Sections**

- Facilities Services Design Guide – Mechanical - General Requirements
- Facilities Services Design Guide – Mechanical - Plumbing
  - Potable and Nonpotable Water
  - Waste and Drains
  - Acid and Laboratory Wastes
  - Compressed Air, Vacuum, Natural Gas & Nitrogen
  - RO/DI
  - Plumbing Pressure Testing
- Facilities Services Design Guide – Mechanical - Heating, Ventilating and Air Conditioning
  - Process and Environmental Chilled Water
  - Central Cooling Water
  - Steam and Condensate
  - Hydronic Heating
  - Refrigeration
  - Air Handlers and Ventilation Fans
  - Filters
  - Coils
  - Ductwork and Duct Accessories

- HVAC and HVAC Piping Pressure Testing
- Facilities Services Design Guide – Mechanical - Piping, Valves & Accessories
- Facilities Services Design Guide – Mechanical - Hangers and Supports
- Facilities Services Design Guide – Mechanical - Pumps
- Facilities Services Design Guide – Mechanical - Motors and VFDs
- Facilities Services Design Guide – Mechanical - Metering and Gauges
- Facilities Services Design Guide – Mechanical - Nonstructural Component Seismic Design
- Facilities Services Design Guide – Mechanical - Identification
- Facilities Services Design Guide – Mechanical - Insulation
- Facilities Services Design Guide – Mechanical - Water Treatment and Flushing
- Facilities Services Design Guide – Mechanical - Noise and Vibration Control
- Facilities Services Design Guide – Mechanical - Cold/Environmental Rooms
- Facilities Services Design Guide – Mechanical - Computer Server Rooms
- Facilities Services Design Guide – Mechanical - Environmental Control Systems
- Environmental Health & Safety Design Guide - Sprinkler Protection & Standpipes
- Facilities Services Design Guide – Mechanical - Testing, Adjusting and Balancing
- Facilities Services Design Guide – Mechanical - Commissioning

END OF DESIGN GUIDE SECTION