SECTION 00 40 00

PLUMBING DESIGN GUIDELINES

PART 0 PURPOSE

A. Describe broad guidelines for design of schools.

B. Establish materials qualities and applications.

C. Describe materials and conditions which do not easily fit into specific specification sections.

D. See specific sections of Design of Construction Standards for additional requirements.

PART 1 COMMON WORK RESULTS FOR PLUMBING

A. Assume that buildings will be enlarged and modified in the future.

1. Make provisions for future interconnections, upgrading, and expansion of mechanical systems.

B. Designs for plumbing shall not locate any plumbing in exterior walls.

C. DPS looks with concern on new and untried materials and equipment. We are opposed to experimentation on our projects. However, we look forward to preliminary evaluation of innovative designs.

D. For aesthetic reasons, locate or appropriately enclose large and unsightly exterior installations to be hidden from public view.

1. Building elevation drawings must show mechanical installations, including installations projecting above parapet walls.

2. If due consideration of aesthetics is not observed, the Owner will require redesign until an acceptable aesthetic design is achieved.

3. Historic landmark structures require design coordination with the Denver Landmark Commission.

E. For security reasons, include enclosures and barriers to protect exterior and rooftop mechanical equipment from vandalism and unauthorized intrusion.

F. Equipment air intake locations

1. As high off the ground as possible to avoid vehicle exhaust and other biological contamination.

2. As far away as possible from plumbing vents, kitchen exhaust vents, fume hood exhaust, and similar ventilating and exhaust units.

G. Design sufficient facilities and clearances for orderly arrangements, concealment, and optimal maintenance of equipment, piping, and conduit. Give special consideration to ceiling spaces.

H. Provide sufficient and safe access for maintenance of mechanical systems.

1. Sufficient access implies the capability to replace major components with minor impact to the building.

2. Clearly indicate sizes and locations of ceiling and wall access panels.

I. Provide curbed floor areas for storage of on-site water-treatment chemicals, following water-treatment consultant's recommendations.

J. When renovating or retrofitting mechanical systems or spaces, review the need to remove asbestos-containing materials including, but not limited to, insulation.

K. Abandoned piping shall be removed in it's entirety from existing walls or other locations. Existing valve to be removed when new replacement valve is installed.

1. Contractor to remove all flushometers and faucets from demolished/removed plumbing fixtures and return to DPS.

L. Controls: Coordinate controls standards with the DPS Project Manager and the DPS Controls Application Engineer.

M. Design temperatures for heating and air conditioning systems

1. Winter: 78 degrees F temperature difference between inside and outside conditions (-10 degrees F outside air temperature, 68 degrees F inside air temperature).

2. Summer: ASHRAE Summer .04% but 92°F db and 61°F wb outside conditions if air intake is above a roof, and 95°/59° for systems with high make-up air intake. 76°F db, 63°F wb inside conditions.

3. Consult with the DPS Project Manager for temperature and humidity requirements for special areas such as computer rooms, etc.

N. Fan coil units and radiation will be required in specific areas to facilitate shut-down of major air handling units. Where necessary, the controls on these units shall be coordinated with the controls on the air handling units.

O. All air conditioning systems shall have air economizer cycles. Systems which have economizer cycles shall be capable of running the cooling equipment independent of the economizer cycle controls. Furthermore, the economizer control shall not revert to the minimum outside air damper position for cooling season unless mechanical cooling is available.

1. In order to take advantage of economizer cooling to the highest temperature possible, return air (RA) should be minimized. Therefore, RA dampers should be specified to be of outdoor sealing quality.

P. Air conditioning, heating, ventilating and exhaust systems shall be matched to the maximum required performance.

1. The use of variable volume supply and exhaust air systems is encouraged to compensate for diversities in loads and to reduce equipment sizes.

2. Space supply air outlets should be aspirating-type to prevent "dumping" of air into occupied spaces.

Q. Interior spaces requiring cooling the year around should be handled independently from perimeter areas requiring heating during the winter and cooling during summer.

1. Interior cooling only areas should be supplied from a variable volume cooling system utilizing an air economizer cycle.

2. Perimeter systems should use economizer cycles when cooling is required and minimum ventilation rates when heating is required.

R. Provide filters upstream of all air handling coils, including heat-recovery coils. All coils shall have access for cleaning, including re-heat coils in, for example, VAV terminals.

S. Outside air ventilation shall be per latest approved version of ASHRAE Standard 62.1 / IMC.

T. Direct evaporative cooling may be used in kitchens. Indirect evaporative cooling may be used in gymnasiums. Supply air temperature shall be controlled by the unit's DDC controller.

U. Pressure gauges are required across all AHU coils and filters.

V. Elevator shaft venting: In order to minimize drafts, heat loss and elevator door "whistling", it may be necessary to install a motorized damper where only a louver may be specified for elevator shaft venting. Review with current Elevator Code for minimum requirements.

W. Energy conservation

1. The District is dedicated to the principle of conserving energy and will scrutinize proposed construction for means of reducing not only initial cost, but also long-range operating costs. Design new buildings and remodeling of existing buildings to make the most efficient use of building materials and energy sources available. The architect and engineers are required to work in close cooperation to design energy efficient buildings.

2. For new facilities, additions, and major remodeling projects, the design team may be directed to work with Xcel Energy and participate in Xcel's Energy Design Assistance (EDA) program.

3. In design of HVAC and electrical systems, give consideration to building use by planning for conservation of energy during summer and winter vacations and for other periods of minimum occupancy. Spaces which might require vacation schedule operation or 24 hours/day operation must be serviced by systems separate from classroom systems.
4. The capability of using alternate sources of energy is of extreme importance.
5. Provide an updated energy budget. The budget shall show the estimated use of energy for the structure calculated on appropriate energy units per square foot per year basis.
    a. Consider constant volume HVAC systems with variable-air-volume outdoor make-up air in order to minimize the use of re-heat coils.
6. Occupied-unoccupied programming of systems should be initiated to shut off ventilation air, exhaust air, fan system, pumps, etc., wherever possible. Where shut-down of systems cannot be accomplished during unoccupied hours, heat recovery systems should be considered. Each application should be examined independently to determine any special sources for obtaining recovery of usable energy.

X. Vibration engineering

1. Unless specifically rejected by the DPS project team during program planning, vibration analysis is required for buildings having:
    a. A reciprocating machine, or an air handling unit exceeding 5,000 CFM
    b. In buildings which may be used for other than storage
    c. Where equipment or foot-fall vibration will affect the users
    d. The analysis shall be done by a firm capable of performing predictive dynamic modeling of building structures based on finite-element analysis, multi-modal structural dynamics, etc. It is typically necessary to use a "total system" approach wherein all of the vibratory components are included.
    e. Criteria for vibration amplitudes and structural center-bay stiffness
    f. Classroom and office areas
    g. Amplitude: 300 to 900 micro-inches (peak to peak)
    h. Stiffness: 100 to 300 KIPS/inch
2. Bear in mind that each building is a unique combination of shape, structure, use and equipment. As such, each should be analyzed to determine what will meet its specific requirements.

Y. Heating systems

1. Minimum two (2) hot water heating steel tube or copper tube boilers.
    a. Boilers may be forced draft; using modulating/condensing technology. Utilize highest efficiency possible.
    b. Boilers should be sized at: two at 65 +/-% or three at 35 to 45% of design heating load with boiler circulating pump (BCP) on each boiler.
2. The heating water pumping system shall be 100% redundant lead/lag stand-by system. If parallel pumping is used, then a stand-by pump shall be provided.
3. Heating water systems may be primary/secondary systems. The main distribution (secondary) pumps shall be redundant. Boiler circulation pumps (primary pumps) do not need to be redundant.
4. Do not design heating systems that utilize tertiary or circulation pumps located at the equipment. (Heating water systems shall be designed to utilize a glycol/water fluid to prevent freezing of the heating water).
5. Heating equipment shall be provided with control valves that fail to the 'open' position.
6. Heating systems shall be provided with automatic glycol/water mixture feed tanks. Do not connect the heating water system to directly to the domestic make-up water system.

7. Refer to specification sections Hydronic Piping and Specialties and 230993 Control Sequence of Operation for additional heating system requirements.

Z. Cooling systems

1. Chilled water type systems

a. Buildings under 75 tons of total cooling load: Air cooled chillers

b. Buildings over 75 tons of total cooling load: Water cooled chillers

2. Water cooled chiller systems between 75 and 300 tons: Minimum of one (1) chiller and one (1) one-cell cooling tower.

3. Water cooled chiller systems over 300 tons: Minimum of two (2) chillers and two (2) one-cell cooling towers.

4. Chilled water pumping systems may be primary/secondary type systems. However, the distribution system shall be 100% redundant lead/lag stand-by.

5. Provide one pump per cooling tower. Redundancy is not required for cooling tower pumps.

6. Design chilled water systems to supply 45°F chilled water and return water at 55°F.

7. Provide cooling equipment with control valves that fail to the 'closed' position.

8. Provide automatic glycol/water mixture feed tanks. Do not connect the chilled water system to directly to the domestic make-up water system.

AA. Meters

1. Unless otherwise indicated by DPS, all buildings shall be metered for all utilities including electricity, gas, water, etc.

a. Provide sub-meters on cooling tower makeup, cooling tower bleed water, boiler makeup water, chiller/closed loop chill water makeup.

2. Meters may be connected to the IBAS for energy monitoring. Coordinate controls standards with DPS and the DPS Controls Application Engineer.

PART 2 MECHANICAL SOUND AND VIBRATION

A. For existing structures only, the A/E may specify mechanical equipment mounted on vibration isolators to prevent the transmission of vibration and mechanically-transmitted sound to the building structure.

B. New buildings shall have equipment directly anchored to floors, if approved by acoustic/vibration consultant.

C. Pump bases for split-case pumps shall include support for suction and discharge base ells.

D. Specify flexible connectors for all rotating and reciprocating equipment unless approved otherwise.

1. Exception: Not required for fan-coil units with internal isolation of fans.

E. Specify flexible connectors to the following:

1. To relieve pump flanges of strain

2. To provide comparative freedom for floating equipment

3. If installed horizontally, to relieve equipment of piping weight

F. If needed, specify travel limiters for interconnected equipment.

G. Stainless steel flexible connectors are preferable in general.

H. Specify flexible stainless steel braided hoses for heating and ventilating unit connections that may be located away from the equipment room area.

I. Specify hoses on the equipment side of shutoff valves; require horizontal installation whenever possible.

J. Consider acoustic pipe riser anchors where interruptible water flows may cause vibrations in piping, such as variable condenser water flows to remote cooling tower sumps or cycled pumping.

K. Interior duct lining is allowed only in short, open-ended air transfer ducts. All other ducts shall be externally insulated.

PART 3 IDENTIFICATION FOR PLUMBING

A. Assign unit identification numbers to operating units of equipment within a class or subclass during the design phase of new buildings, additions, or remodeling of existing structures.

1. In new structures, start the numbering system with 001, within a class or subclass.
2. Numbers shall include building identification, system, type, sub-type and number compliant with the DPS Facility Information System and DPS project numbering system.
3. When new operating equipment is to be added to an existing structure, the numbering of new units of equipment shall fit in with the existing numbering scheme.
4. Drawings shall indicate unique numbers for all terminal units (e.g., VAV boxes). Specify that Contractor shall label the units accordingly, including the space being served.

B. Coordinate mechanical identification with painting standards. Refer to standard Section 09 91 00.

PART 4 PLUMBING INSULATION

A. If more than one type of insulation material is available for satisfying technical requirements, then price-performance should be evaluated and maximized in material selection.

B. Weigh need to insulate unions, flanges, valves, control devices and similar items where maintenance access is needed. Give consideration to:

1. Energy conservation.
2. Where heat gain to space or ductwork is objectionable.
3. Where condensation must be prevented.

PART 5 DOMESTIC WATER PIPING

A. Point of connection is normally five (5) feet outside building line. Coordinate plumbing design with utility design.

B. For ease of maintenance, isolate areas by section with isolation valves and provide easy maintenance access to valves.

C. Design and route plumbing lines to minimize potential disruption due to future remodeling.

D. Vertical pipe runs shall be grouped in chases and shall not be installed in demising walls.

E. Avoid placing plumbing lines below slab-on-grade. Where sewer lines must be located below slabs, route piping to minimize the amount of below slab piping.

F. Domestic water supply (from flanged connection within building)

1. Service supply pressure can reach 130 psi. Regulate down to 80 psig. Minimum supply pressure should be 60 psig.
2. Design water distribution velocities (6-10 feet/second) for minimal noise while maintaining adequate flow. Maximum water pressure drop shall be 4ft/100ft of pipe.
3. Specify flange connections to valves and equipment for pressure reducing valve (PRV) stations at each end of the legs, to allow for component replacement.

G. Whenever remodeling, plumbing systems shall be brought up to code and DPS Design & Construction Standards.

H. A/E to remove all conflicting language in their technical specifications or any variations from the DPS Design and Construction Standards.

PART 6 STORM DRAINAGE PIPING SPECIALTIES

A. Size drains in accordance with ASPE Data Book, Volume 1, Fundamentals of Plumbing Design, Chapter 2, Storm Drainage Systems.

B. Cleanouts

1. Design cleanout locations and access for minimum disturbance of occupant functions and building systems operation during cleanout servicing.
2. Provide above urnial without/outside DF's.
3. Provide 2-way cleanouts on all building sewers within 5'-0" of building.

C. Hose Bibbs

1. Provide hose bibbs with vacuum breakers in the following locations:
   a) Each equipment room
   b) Kitchen areas equipped with floor drainage systems
   c) Near cooling towers and condensers
   d) In public and student toilet rooms (provide locking cover recessed hose bibb)
2. Maximum spacing shall accommodate 50' of hose to any point within the drainage area, measured around obstructions and equipment.
3. Provide freeze proof hose bibs in exterior areas and unheated interior areas.
4. Provide isolation valve on branch.

D. Water Shock Arresters

1. Give careful attention to the prevention of water hammer in the design of water distribution systems.

E. Water Pressure Regulation

1. Average main pressure shall be determined by the A/E. The A/E shall acquire current water flow and pressure data from Denver Water and provide the necessary analysis to ensure that adequate pressure is supplied to the building for proper operation of plumbing fixtures. Refer to standards in Division 2 for additional requirements.

F. Emergency Showers

1. Installation shall meet ANSI Z358.1.
2. Provide curb on floor to contain the ponding of water from the emergency shower.
   a) Comply with ICC/ANSI 117.1-2003
3. Provide ADA shower base or floor drain positioned in 36" sloped floor area.

G. Water Meters

1. Specify contact-closure output.
2. Small domestic water meters
3. These meters are used for makeup and drain lines for irrigation only.
   a) Hersey Measurement Co.
   b) Niagara Meter Line
   c) MTX Series, Model 433,

4. Water meter controls: Coordinate controls standards with the DPS Project Manager and the DPS Controls Application Engineer.

PART 7 DOMESTIC WATER PUMPS

A. Design parameters for equipment selection shall conform to ASHRAE, ASPE, ASME, and applicable uniform codes.

B. Domestic hot water circulating pumps

1. Specify aquastat control in return line near each pump if building is expected to have extended operating hours; otherwise, specify a timer.

2. Provide one pump.

PART 8 SUMP PUMPS

A. Design parameters for equipment selection shall conform to ASHRAE, ASPE, ASME, and applicable uniform codes.

PART 9 SANITARY WASTE AND VENT PIPING

A. Point of connection is normally five (5) feet outside building line. Coordinate plumbing design with utility design.

B. For ease of maintenance, isolate areas by section with isolation valves and provide easy maintenance access to valves.

C. Design and route plumbing lines to minimize potential disruption due to future remodeling.

D. Vertical pipe runs shall be grouped in chases and shall not be installed in demising walls.

E. Avoid placing plumbing lines below slab-on-grade. Where sewer lines must be located below slabs, route piping to minimize the amount of below slab piping.

F. Whenever remodeling, plumbing systems shall be brought up to code and DPS Design & Construction Standards.

G. A/E to remove all conflicting language in their technical specifications or any variations from the DPS Design and Construction Standards.

PART 10 FUEL-FIRED DOMESTIC WATER HEATERS

A. Design parameters for equipment selection shall conform to ASHRAE, ASPE, ASME, and applicable uniform codes.

B. Design parameters for equipment selection shall conform to ASHRAE, ASPE, ASME, and applicable uniform codes.

C. Provide 1050 F water to restrooms and classrooms and 1400 F water to kitchen equipment.

PART 11 PLUMBING FIXTURES

A. Accessibility

1. In addition to other requirements, plumbing fixtures shall meet accessibility requirements of the Americans with Disabilities Act (ADA) and standard Section 00 00 05.

2. Provide pipe insulation on waste and hot water pipes below each accessible lavatory. Refer to standard Section 22 07 00 for pipe insulation requirements.

B. Coordinate rim heights with applicable codes, regulations, and guidelines.

C. Coordinate countertop sink heights, dimensions, and configurations.

D. Water temperature

1. Provide hot and cold tempered water service to sinks, lavatories, mop basins, emergency eye and body wash fixtures, showers, and other similar plumbing fixtures.

2. Coordinate water temperature requirements with applicable codes and guidelines.

E. Coordinate locations of garbage disposal units with DPS.

F. Coordinate electric water coolers, garbage disposers, and hand wash basins with electrical requirements.

G. Hand wash basins

1. Locate infrared scan transformer and control wiring in basin base enclosure.
2. Include disconnect switch in basin base enclosure.
3. Provide ground fault protection.

H. Emergency shower and eyewash units

1. Provide emergency shower and eyewash units at the following locations:
   a) Boiler and chiller rooms
   b) Science, art, technology, and vocational classrooms and laboratories
2. Provide a floor drain or accessible shower basin beneath each emergency shower and eyewash unit
   a) Eye wash to connect to building plumbing, not to floor

I. Electric water coolers and drinking fountains

1. In general, provide electric water coolers in lieu of drinking fountains in DPS facilities.
   a) Exception: Drinking fountains or water coolers may be provided in low traffic, special use spaces such as music classrooms and ECE and Kindergarten classrooms.
2. Dual water coolers
   a) Electric water coolers shall be dual, high-low fixtures where required by ADA accessibility guidelines, including children's standards.
   b) Coordinate design of spout heights, clearances, and accessible route requirements.
3. Water fountains ("bubblers") mounted on sinks are prohibited in DPS facilities.

J. Spitters: Coordinate locations.

END OF SECTION 00 40 00