HVAC Distribution Services, Layout, and Space Requirements

An Online Continuing Education Course for Engineers

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HVAC Distribution Services, Layout, and Space Requirements

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Heating, ventilation, and air-conditioning (HVAC) systems in buildings may be described in general terms as systems that provide the right conditions inside the building for the thermal comfort of the occupants. They usually involve the addition or removal of heat or moisture between the building interior and the exterior environment.

The design of HVAC systems is mainly related to various parameters, including but not limited to the factors listed below.

Details of Architecture

a. Structure, orientation, geographical location, altitude, shape, modules size & height
b. Purpose of the building, area classification, occupancy, and usage patterns
c. Ratio of internal to external zones, glazing, plant room sitting, space for service distribution
d. Climate and shading, thermal insulation, passive climate control, relationship with adjacent buildings
e. New or existing building, renovation or extension project, retrofitting or new equipment
f. Plant and system design to match the characteristic of the building and the need to meet the needs (known and unknown) of the ultimate occupants.

Details of Space Allocation

a. Floor space and clear heights to accommodate HVAC plant, equipment, distribution, and room elements
b. Shaft spaces available for routing ducts/pipes
c. Location and size of structural columns and beams, clearance through steelwork, the position of reinforcing rods
d. Ceiling height, clearance between suspended ceilings and beams
e. Foundation and supports requirement, permissible loadings
f. Location of obstructions that may be in the route of air-conditioning services, particularly ductwork.

Details of Building Construction

a. Materials and thickness of walls, roof, ceilings, floors and partitions and their relative positions in the structure, thermal and vapor transmittance coefficients, areas and types of glazing, external building finishes and color as they affect solar radiation, shading devices at windows, overhangs, etc., as they reduce solar radiation and light transmission, building mass, particularly as it affects thermal capacity
b. Sound and vibration control requirement, relation of air-conditioning equipment to critical areas
c. Co-ordination with other services (e.g., electrical and plumbing work), use of service shafts, ducts, and equipment rooms to best mutual advantage.

Building Regulations

a. Government and local regulation on occupancy & safety classification
b. Regulations of Public utilities on electrical wiring, power usage, water supply, and drainage
c. Health and Safety regulations on indoor air quality, ventilation air quantities, noise control, electrical, fuel, insulation, and other hazardous materials
d. Local fire authority regulations and smoke removal systems
e. Insurance company regulations.

Miscellaneous Requirements

a. Correct selection of HVAC equipment and design specifications
b. Accessibility for installation of equipment, space for maintenance
c. Location of fresh air intakes and exhausts (to avoid short-circuiting and contamination)
d. Location of fire zones and fire walls (position of fire dampers)
e. Acceptable noise level: space available to house equipment and its location relative to the conditioned space
f. Indoor and outdoor equipment preferences
g. Acceptability of components obtruding into the conditioned space.

Building Aesthetics

a. Architectural characteristics of the space
b. Reflected ceiling plans: Integration of air distribution devices in the ceiling to harmonize with lighting layout, fire sprinklers, detectors, communication systems, and ceiling design
c. Size and appearance of terminal devices

In a typical Building design and construction project, the MEP consultant/engineer manages the system design of HVAC services, and the architect retains the overall control of the building product. While typically, the design of an HVAC system is by a specialist consultant, the architects also need to be familiar with various types of HVAC systems and their relative strengths.

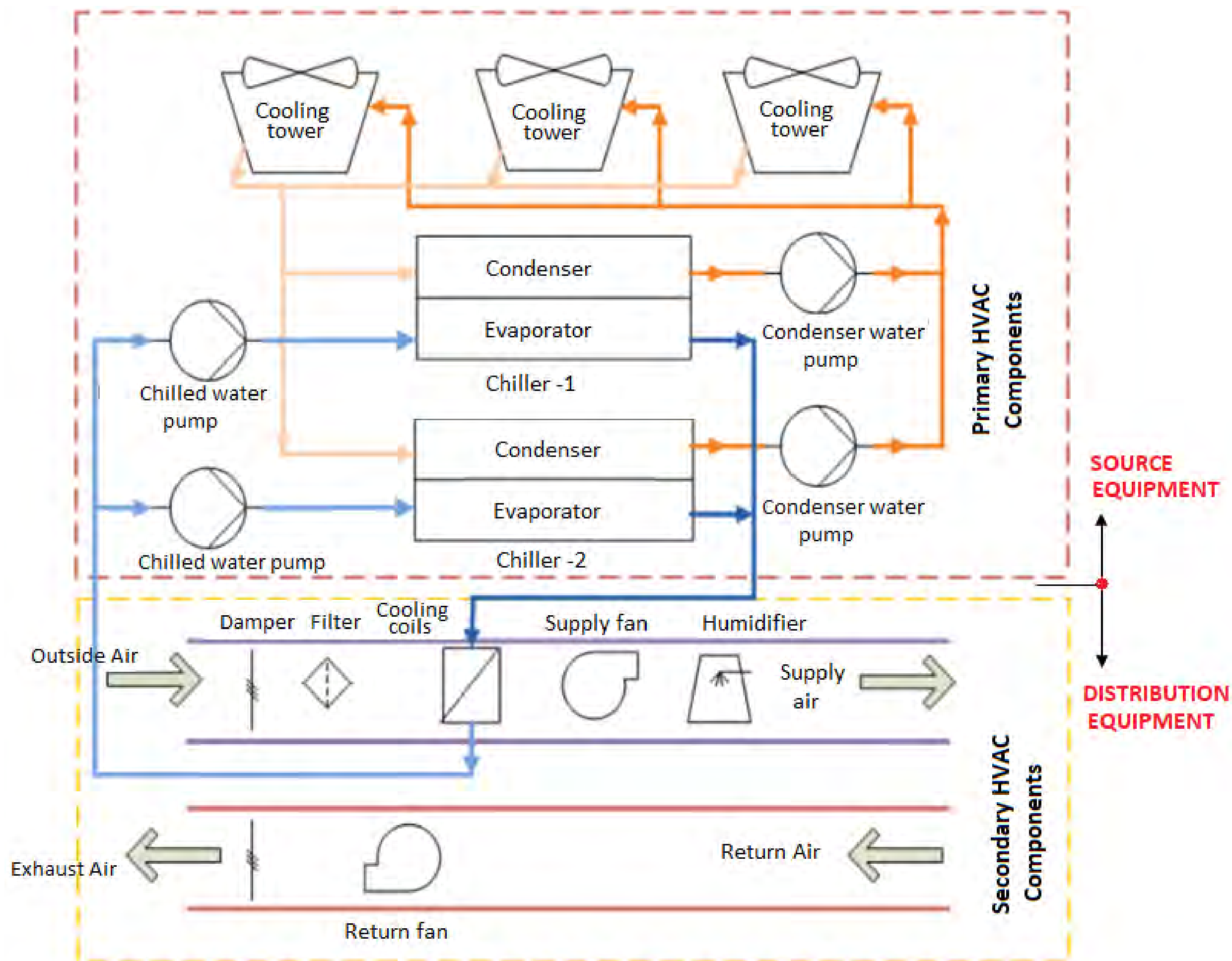
The type of system selected is determined by the HVAC designer's knowledge of systems. There are broadly two types of HVAC systems:

- Local DX systems
- Centralized systems

Local DX systems are designed to condition a single space (or portion of a space) from a location within or directly adjacent to the occupied space. These incorporate both the production and delivery in a single piece of equipment and therefore are very compact systems. These systems are essentially decentralized or point-of-use systems. These may or may not require a dedicated mechanical room. The equipment may be located on the roof, balconies, and/or the ground adjacent to the building. The system may be designed with or without ductwork. These have drawbacks of higher noise, lower reliability, inferior air quality, uneven temperature/humidity profiles, and compromised aesthetics. Split type DX systems suffer from distance limitations between indoor/outdoor units.

Centralized systems are dominant systems in large commercial buildings and are intended to condition multiple spaces in a building. These systems can be categorized into primary and secondary HVAC system equipment.

The primary equipment is sometimes referred to as source equipment and the secondary as the distribution system. Both types of components involve distribution and heat and mass transfer components. The schematic figure below shows the distinction between primary and secondary air conditioning components.



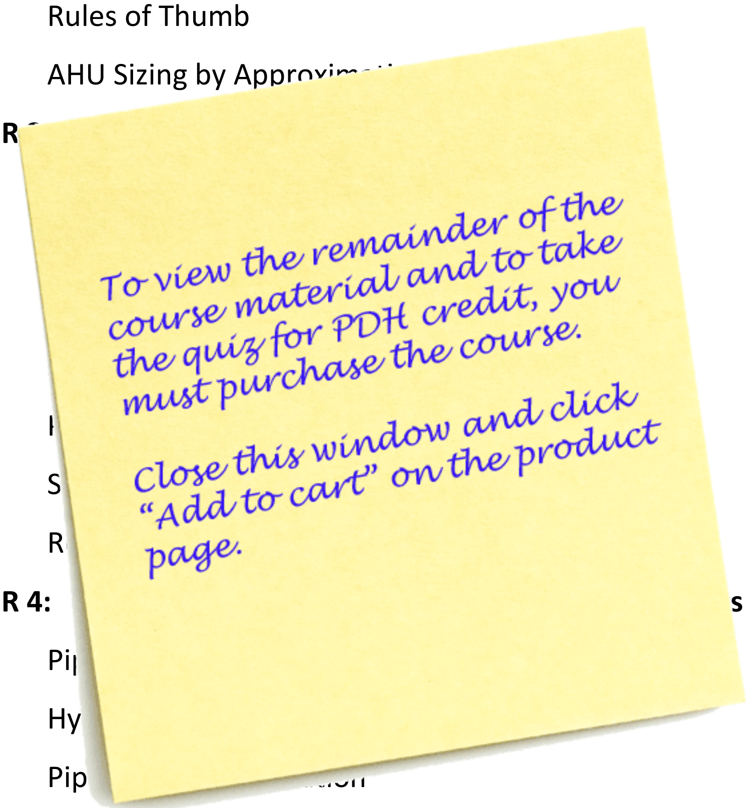
Centralized HVAC Primary and Secondary Equipment and Components

In this course, we will discuss the Secondary Distribution Equipment and Services. We have learned the primary heating and cooling equipment (chillers, boilers, furnaces, cooling towers, air-cooled condensers, and electrical services) in Part 1 of the course titled "HVAC Equipment Selection, Layout and Space Planning."

Here, in this course, we will focus on air handling units (AHUs), piping, ductwork, pumps, shafts, fire dampers, terminal units, and associated accessories. Although the general rules related to spatial planning of source components and distribution components are similar, the main difference is that the distribution services happen within the occupied areas of the building. The source components are typically located away from occupied areas in a central plant room in the basement, roof, or remote independent annex to the main building.

Rule of thumb information is included for easy learning and quick validation of end results.

Contents



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