BROOKS HALL (0055)

Brooks Hall was originally constructed in 1928 with a major expansion in 1972. The building experienced a major fire in 1995 that destroyed the roof of the original building and heavily damaged the top three floors. Several of the building heating, ventilating and air conditioning (HVAC) systems were renovated in 1996. The auditorium was renovated in 1998. The chiller plant was renovated in 2013. A partial renovation of finishes and limited HVAC renovation work occurred in 2017. The building has six floors from the ground floor to the fifth floor. The ground and first floors are part of the 1972 expansion. The second and third floors are a combination of both the original building and the addition. The fourth and fifth floors are part of the original building only. Many of the building's central air handling units are provided with operating schedules to allow units to be disabled during periods where the building is not being occupied. FMD has modified these schedules as needed to increase system operation during unoccupied periods as a way to provide additional ventilation to the building as part of FMD's COVID-19 response plan.

The ground floor is served by three small air handling units (AHUs) with chilled water coils only. Heating is provided by perimeter hot water radiators on the exterior walls or by electric duct heaters mounted in the supply air ductwork. All of the outside air is provided by a dedicated outdoor air system, AHU-G1. The system utilizes MERV 11 filters. The fraction of outdoor air mixed into the supply air to the building for the units serving the ground floor is approximately 10.5%.

The offices surrounding the auditorium on the first floor are served by constant volume air handling unit (CV AHUS) with a chilled water coil. The unit serves the area through four independent zones. Each zone has a duct mounted electric heating coil for space heating when necessary. This CV AHU supplies air to the zones with approximately 14% outdoor air mixed in. The unit has MERV 11 filters.

The remaining offices along the west perimeter of the auditorium are served by 18 four-pipe fan coil units (FCUs) with heating and cooling. Ventilation air is provided above the ceiling by a dedicated fan coil unit (FCU-6). This unit is equipped with an electric duct heater.

The auditorium is two stories tall and is served by a single zone air handling unit mounted in a penthouse on the roof. The unit is a single zone, constant volume air handling unit (SZ AHU) with chilled water coils and hot water heating coils. The unit was replaced in 1998 as part of a renovation of the auditorium This SZ AHU supplies air to the auditorium with approximately 62% outdoor air mixed in. The unit was designed to use MERV 8 filters.

The offices and spaces surrounding the auditorium are conditioned by a multi-zone air handling unit also located in the penthouse. The unit serves 10 zones consisting primarily of offices. Warm and cool air are blended at the AHU to meet the temperature needs of each zone. This AHU supplies air to the zones with approximately 14% outdoor air mixed in.

The North West wing of the third floor is served by a single zone, constant volume air handling unit with chilled water coil. The unit serves five classrooms. Each classroom is supplied by a separate supply duct that is equipped with a hot water heating coil. This CV AHU supplies air to the zones with approximately 26% outdoor air mixed in. This unit was part of the original building addition.

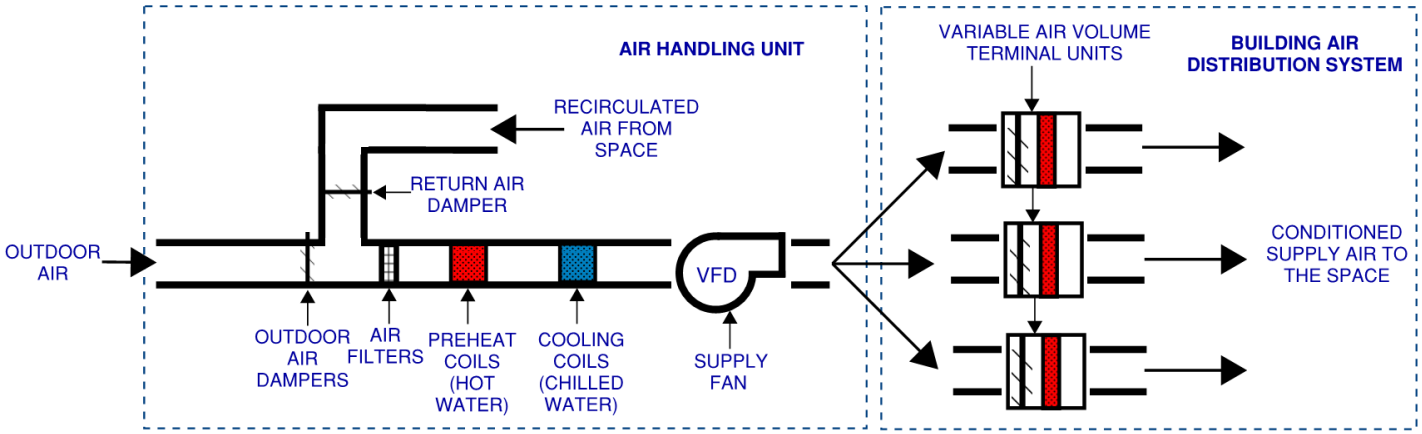
The balance of the building consisting predominately of the original building, was renovated in 1998. At that time all of the air handling units and the original ductwork were replaced. The second and third floor of the original building, plus the southwest wing, are served by two variable volume air handling units with variable volume terminal units with hot water reheat that are located on the second floor. The two units split the floors in half along a line from the east to west at the center of the courtyard. The two units serving the second and third floor each deliver air with 20% of the mixed airstream from outdoor air.

The fourth and fifth floor of the original building are served by two variable volume air handling units with variable volume terminal units with hot water reheat that are located on the fifth floor. The two units also split the floors in half along a line from the east to west at the center of the courtyard. The two units serving the fourth and fifth floor each deliver air with 20% of the mixed airstream from outdoor air.

Chilled water is supplied throughout the building from a chiller located in the ground mechanical room or from the campus chilled water system. Heating hot water, distributed throughout the building for heating, is provided by a steam to water heat exchanger using steam from the campus steam system.

VARIABLE VOLUME AIR HANDLING UNIT

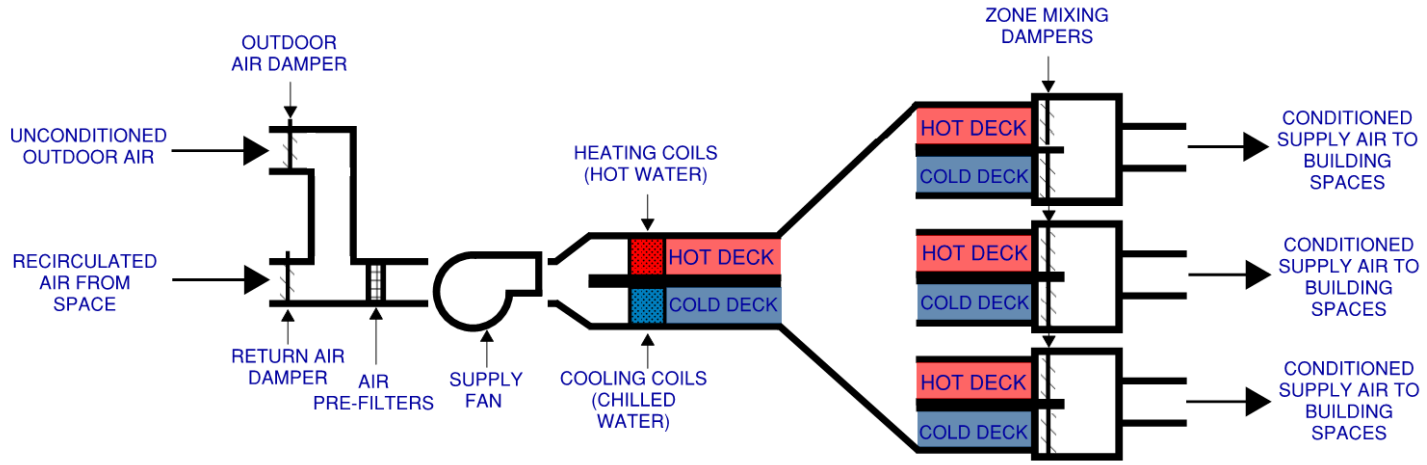
The typical variable volume air handling unit delivers a variable volume of conditioned air consisting of a mixture of recirculated building air and fresh air from outside of the building. The building return air is filtered, mixed with outdoor air and cooled with chilled water coils in the buildings air handling unit before being supplied to rooms throughout the building through above ceiling ductwork. Space heating is provided by Variable Air Volume terminal units (VAVs) with hot water reheat coils located in supply ductwork throughout the building. The VAVs are equipped with an air damper to regulate the volume of air delivered from the central AHU to the space based on the current space temperatures and a hot water reheat coil to provide space heating when needed. Air is recirculated from the spaces back to the air handling unit through ceiling mounted air return registers located in each space. Return air is pulled through a plenum space above the ceiling, in lieu of ductwork. Exhaust is provided in restrooms on each floor to remove odors and to maintain a slightly positive building pressurization.



VARIABLE VOLUME AIR HANDLING UNIT SCHEMATIC

MULTI-ZONE AIR HANDLING UNITS (AC-1)

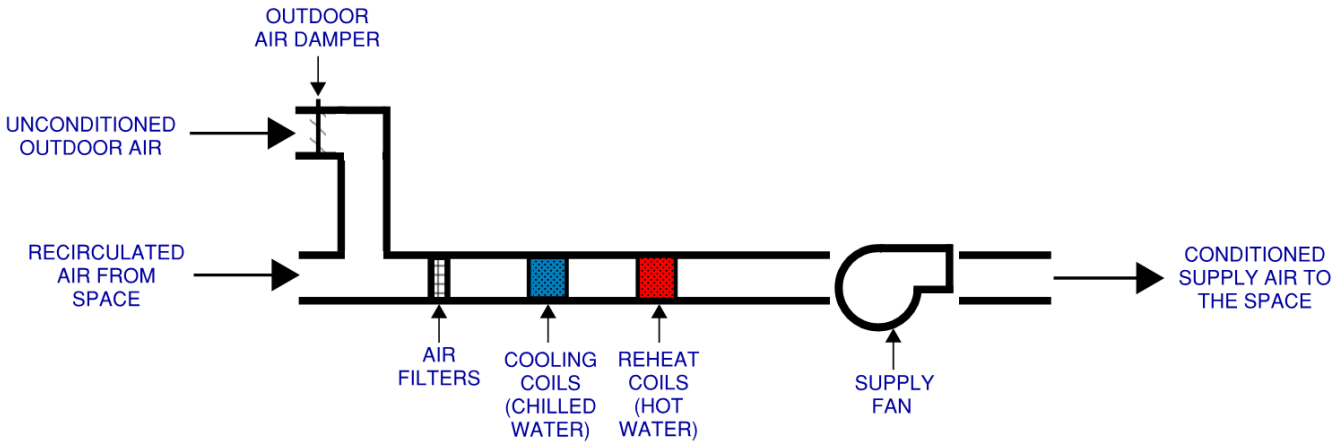
The multi-zone air handling unit (AHU) provides ventilation, air filtration and movement, and heating and cooling functions to a single floor. The AHU has a hot water heating coil and chilled water cooling coil that respectively generate parallel warm and cool air streams. The air flow is distributed to a number of ducts that exit the AHU to serve individual zones, which may be single rooms or groups of rooms depending on their size. Each zone's duct has a mixing damper that allows only warm air, only cool air, or a mixture of the two, depending on the signal being sent from the zone thermostat. Ventilation is provided at each AHU by drawing a mixture of fresh air from outdoors and recirculated air from the area being served by the AHU.



MULTI-ZONE AIR HANDLING SYSTEM SCHEMATIC

SINGLE ZONE AIR HANDLING UNITS

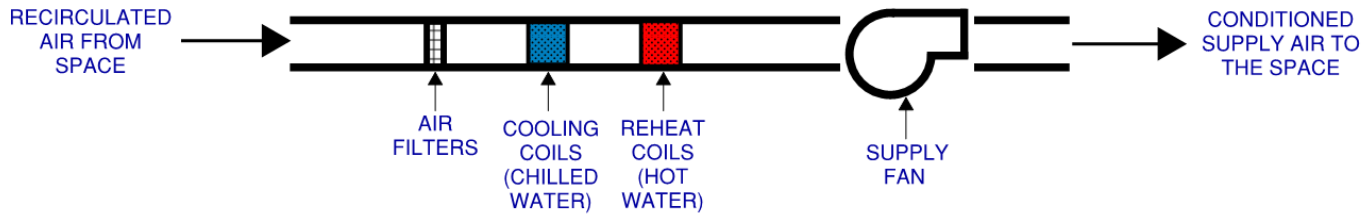
Auditorium room 145 is served by a single zone, variable volume air handling unit (AHU-204). The variable supply air volume is composed of a mixture of recirculated air from the space and outside air included for ventilation that is filtered, heated, cooled or dehumidified before being supplied to the space. The unit maintains the space temperature by modulating the flow of chilled water and hot water to coils in the unit. The units also have the capability of operating in a dehumidification mode when relative humidity levels are elevated, by simultaneously cooling the mixed air and then reheating it to a moderate temperature before supplying the air to the auditorium. The auditorium AHU has demand controlled ventilation (DCV) programing that adjusts the ventilation rate based on measured occupancy (space CO_2 is measured as an indicator of real time occupancy). The DCV programing has been disabled during the pandemic as part of FMD's COVID-19 response plan. In addition the SZ AHU serving the auditorium is equipped with an air side economizer function that increases the ventilation rate when ambient weather conditions are appropriate.



SINGLE ZONE AIR HANDLING UNIT SCHEMATIC

FAN COIL UNITS

A fan coil unit is fairly simple: it's a fan with a coil or coils (like a car radiator) that can add heating and cooling to the air stream flowing through it. The FCUs have air filters to remove particulate matter from the air, a hot water coil and chilled water coil for heating and cooling the air, and a supply fan for forced air circulation through the unit and into the space.



4-PIPE FAN COIL UNIT SCHEMATIC