4.0 – Existing Conditions – Mechanical Systems

The Barshinger Life Science & Philosophy Building has three air handling units, two located on the roof and one in the basement. The two roof-mounted VAV units serve the north (AHU-1) end of the building, and the south (AHU-2) end. The main lecture hall, statistics instruction lab, and atrium are served by both units. These main two AHUs also serve some general spaces in the basement. The majority of the basement of the building holds the vivarium, served by AHU-3. This 100% Outdoor Air unit serves only the vivarium to keep any airborne pathogens separate from the rest of the building. All zone terminals have pressure-independent VAV boxes, each with a hydronic reheat coil controlled by zone thermostats. Three exhaust air handling units (EAHU) located on the roof take air from the building, both general and lab exhaust, through still more PI-VAV boxes. EAHU-3 takes air from the vivarium only, and EAHU-1 takes from spaces served by AHU-1, etc.

4.1 – System Location and Space Allocation

The building has a very tight layout of all mechanical system components. Most of the big equipment is housed on the roof or in the central utilities plant, with the minimum equipment located in the building's basement.

Space Type	Area (SF)	% of Total
Gross Building (interior)	96,500	100.0%
Mech./Elec./Telecom Rooms	5,058	5.2%
Shaft Spaces (all)	1,065	1.1%
Total Lost Space	6,123	6.3%

Most of the lost space is from the mechanical and electrical rooms, not all the shaft penetrations. The vast majority of this area (3650 / 5058 – 72%) comes from just three main mechanical/electrical rooms located in the basement. Placing all this equipment outside the actively-used areas prevents any inconveniences to occupants during times of system maintenance.

4.2 - Controls

All of the systems within the new Life Science & Philosophy Building are controlled by a DDC controls system, and will be tied into the new centralized controls system that will be used throughout the planned expansion of campus facilities, once the other updated facilities are built. All fans are VFD controlled, and maintain a static pressure differential setpoint in the ductwork. The supply and exhaust air is volume-controlled by pressure-independent VAV boxes, but the return ductwork has only static setpoints.

Most pumps in the building are controlled by Variable Frequency Drives. They all have differential pressure sensors placed throughout the building, and are set to maintain varying and adjustable pressure differences between the supply and return lines. This eliminates the need for balancing valves, but they are provided at *every* load coil none the less. All load coils (hydronic) are controlled by 2-way valves; no 3-way bypass valves are provided. To keep the hot water in the hydronic loop hot all the time, the fin-tube radiation in the north-end study alcoves is left on year-round. This provides some flow at the ends of branches at all times, and continuously heats that space, even if it is 95°F outside.

4.3 – Central Plant

The building's heating and cooling power is provided through central campus steam and chilled water from the campus north loop. This centralized system provides a more cost-effective and slightly more efficient energy delivery for all of campus. There is a pressure reduction station to keep building steam pressures down to 10-12 psig, and the building has two chilled water pumps to pull water from the north loop, supplied by the central chiller plant. Steam drives all the main AHU heating coils, domestic water heaters, the main hydronic heating loop heat exchanger, and provides steam for all the building's humidifiers. Chilled water is provided through a Primary/Secondary central chilled water plant. More expansion is planned in the future for the north loop, but for now this building is the only one utilizing that chilled water. The new 550 ton chiller is slightly oversized to account for growth and load sharing and for use during low total loading of the central plant. This can save the campus from operating any of the other three older, less efficient chillers to satisfy the load on a swing-season day.

When the designers combined the separated chilled water systems (each had been a P/S system before, each serving dedicated loads) into one, they kept all the secondary CHWS lines connected, and shared a common line with the primary return, secondary return (as usual), but also connected that line to the primary supply, but not through a decoupler line. This reduces central plant flexibility, especially in areas far from the CUP where pressure differentials are not high enough without full secondary pumping power engaged. Also, because primary chilled water can't be sent to both sets of secondary pumps without being warmed by return water from the North Loop (the LS&P building), if there isn't enough pressure to induce flow at the far chilled water coils, not only must the other set of secondary pumps be turned on, but also one of the older chillers in the other section of the main plant. While all 4 chillers are located in the same building, not 70 feet apart, they are plumbed into opposite ends of the hydraulic system, so they act like two separated plants. Outlying buildings still maintain their own cooling power independent of the central system. The new LS&P project was originally supposed to house the new central chilled water plant in the basement, but that idea was scrapped because of extensive excavation expenses. The roof of the LS&P Building still has cooling towers planned for installation for all the chillers, but the chillers themselves will need to be located somewhere else.

4.4 – Air Systems

The building has an all-air system. Three air handlers serve a network of ducts, conditioning and ventilating the building. Two of these AHUs are located on the roof, each 50,000 cfm units, primarily serving the North and South wings of the building, 1^{st}-3^{rd} floors. The third AHU is located in the basement mechanical room, and primarily serves the vivarium areas. In the event of a partial system failure, all ductwork is connected to allow even building pressurization and airflow. Three exhaust air handlers take a majority of the building's air for discharge, mainly from lab exhaust hoods, and other non-ideal air locations. Because of the great amount of fresh air supplied to the building, a simple set of glycol runaround coils is provided between AHU-1 and EAU-1, typical for all three sets. This provides some means of energy recovery. The building is served by boilers and chillers located in the Central Utilities Plant (CUP) to the south of the building. Services are provided via underground tunnels for the campus distribution system. A 550 ton electric centrifugal chiller in the CUP serves the Life Science Building (LSB). The cooling tower is on the roof of the LSB. Many additional towers are planned for the LSB roof, and large tower water supply and return lines have been run through the basement to accommodate this. Also, a central campus chilled-water system is planned for eventual use, and this building is the first to include plans to hook up to that loop; it is the hub of that loop, actually. During the summer, when Medium Pressure steam from the CUP is shut off, a Low Pressure summer boiler on the roof provides all heating needs for the building. Domestic water and fire protection water (with pumps) service enters in the basement, and passes up through the building's core.

All zones (except electrical/telecom rooms, and the main electrical room) have hydronic reheat coils, fed from a central heat exchanger using the campus' steam distribution system. This loop also provides heat to the fin-tube radiators, but they are controlled by two-position valves using outdoor temperature reset. Each zone has its own thermostat, which throttles the airflow through each VAV box down to the minimum cooling required, then opening the reheat valves. If that does not provide enough heat (such as during morning warmup), the box is allowed to open proportionally to increase heat delivery. Most spaces have both general and contaminant exhaust, since most of the building is labs. Some offices, corridors, and common gathering areas have return air that will be directed back to the main air handling units. This air is drawn back to the main AHUs (1 and 2 only have return fans) and can then be sent back into the building, or out through a relief damper.

The building's airflow is driven primarily by exhaust systems. The inputs to the whole building are provided by the operation of hoods and sashes. As the pressure in the exhaust ductwork increases, the exhaust air handlers ramp up because of the differential pressure sensors' (shown on the controls diagrams, not found plans) signals provided to the VFD controllers. This causes the building overall to become less positively pressurized, and the amount of outdoor (and supply, if necessary) is increased to maintain the building at a positive pressure differential to the outside. Building differential pressure sensors are indicated on the controls diagrams, but never located on the mechanical floor plans. If there is a call for supply air while no air is being exhausted, a great deal of return air is drawn from the building and directed through the air handler, conditioned, then delivered back to the spaces. Return air is drawn back to the air handler, but can either be re-sent to the building, or sent outside through the relief dampers. The air handlers can function in an economizer mode, but only one set of outdoor air dampers is provided, so controlling ventilation can be an issue. During economizer operation, all air returned from the building is directed out as relief air. If more outdoor air is needed for conditioning than is needed for building pressurization, the exhaust systems draw more air from the general exhaust grilles to keep positive pressurization limited. This control feedback override isn't provided for ventilation reasons; the designers assume that there will always be some exhausting going on while the building is occupied, enough to meet minimum ventilation requirements for the gross building.