MONTGOMERY COLLEGE STUDENT SERVICES CENTER

ROCKVILLE, MD

Evaluation of Existing Mechanical Systems

Technical information courtesy of James Posey Associates

Interior Rendering – Courtesy of Cho Benn Holback + Associates, Inc

Architectural Engineering 481W | Senior Thesis

Technical Report 3

Casey Zarger | Mechanical

Dr. James Freihaut | Faculty Advisor

http://clzarger.wixsite.com/thesis

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Executive Summary

This report focuses on the mechanical equipment used in the Montgomery College Student Services Center. In addition, the system operation sequences and LEED certification potential are analyzed. Information taken from the two previous technical reports are also used in the overall analysis.

The building's heating water will be supplied by a new boiler plant with five high-efficiency condensing boilers, with an additional two boilers for redundancy, based on the Fulton-Vantage 6000 boilers. The boiler plant will be located in the basement mechanical room. The heating plant will have a dedicated primary, variable secondary, and variable tertiary system. Inline primary pumps for each boiler are anticipated. Three pumps sized for 50 percent of the flow will serve the secondary campus side, while three additional pumps sized at 50 percent of the flow will serve the tertiary pumps for the building. The new campus heating water system is anticipated to match the existing campus supply and return temperatures; 180 degrees F heating water supply, and 160 degrees F heating water return.

Campus chilled water is currently generated and distributed in the basement of the Humanities building. The chilled water for the Student Services Center will be supplied by two new water cooled chillers and cooling towers. These satellite chillers will be located in the Student Services Center's basement mechanical room, while the cooling towers will be located on the roof. The chillers will be based upon the Daiken Maglev Centrifugal chiller with variable frequency drive.

Two variable air volume air handling units will serve the Student Services Center. They will be equipped with 2-inch flat MERV 8 pre-filters, 12-inch cartridge type MERV 13 final filters, heating water preheat coils, chilled water cooling coils, and direct-drive plenum-type supply and return fans.

Single-duct VAV supply air terminal units with hydronic heating coils are anticipated for providing both space temperature and ventilation control for the building. A dedicated VAV terminal unit will be provided for each classroom, adjunct suite, conference room, corner office, department chair office, and specialty spaces. A single VAV terminal unit will support three or more interior offices, or perimeter offices with a common exposure. Dedicated and redundant ductless split systems and VAV terminal units will serve elevator machine rooms, IT rooms, and security closets.

Operational statistics and history are not available for the Montgomery College Student Services Center since it is not yet completed. Construction is planned to be finished in March of 2019. Information from Technical Report 2 will be used in order to estimate the annual operating cost of the mechanical system, electrical consumption, and heating fuel consumption.

Building Overview

General

The Student Services Center is being designed and constructed by Montgomery College to replace its existing facility. The new building will house various student services, intake functions and programs serving students. It will also contain one academic department (school of education), administrative offices, the campus security office and a central plant operation serving both this building and the campus. The proposed building will consist of four stories above grade and a basement, and will contain 70,227 nsf and 128,004 gsp. The mechanical equipment will be located on the roof and in the basement. Each department is located within the building such that they remain a cohesive unit on the same floor and near other departments that work together. An emphasis was put on making the space inviting and easy to navigate for students. A large atrium on the first floor has a welcome center to aid students with questions and direct them to whatever department they'd like to visit. The building will be located at the end of the mall that runs the NS length of the campus. Glazing on the southern exterior will create an appealing gateway to the campus.

Figure 1. Building Floor Plan – Courtesy of Cho Benn Holback + Associates, Inc

The main mechanical room is located on the basement level, which contains two water cooled chillers, five boilers, eleven pumps, and a network of piping and ducts. Two custom air handlers are located in on the roof, and they both serve a single main chase that travels the height of the building. A two-cell cooling tower and VRF units are also located on the roof.

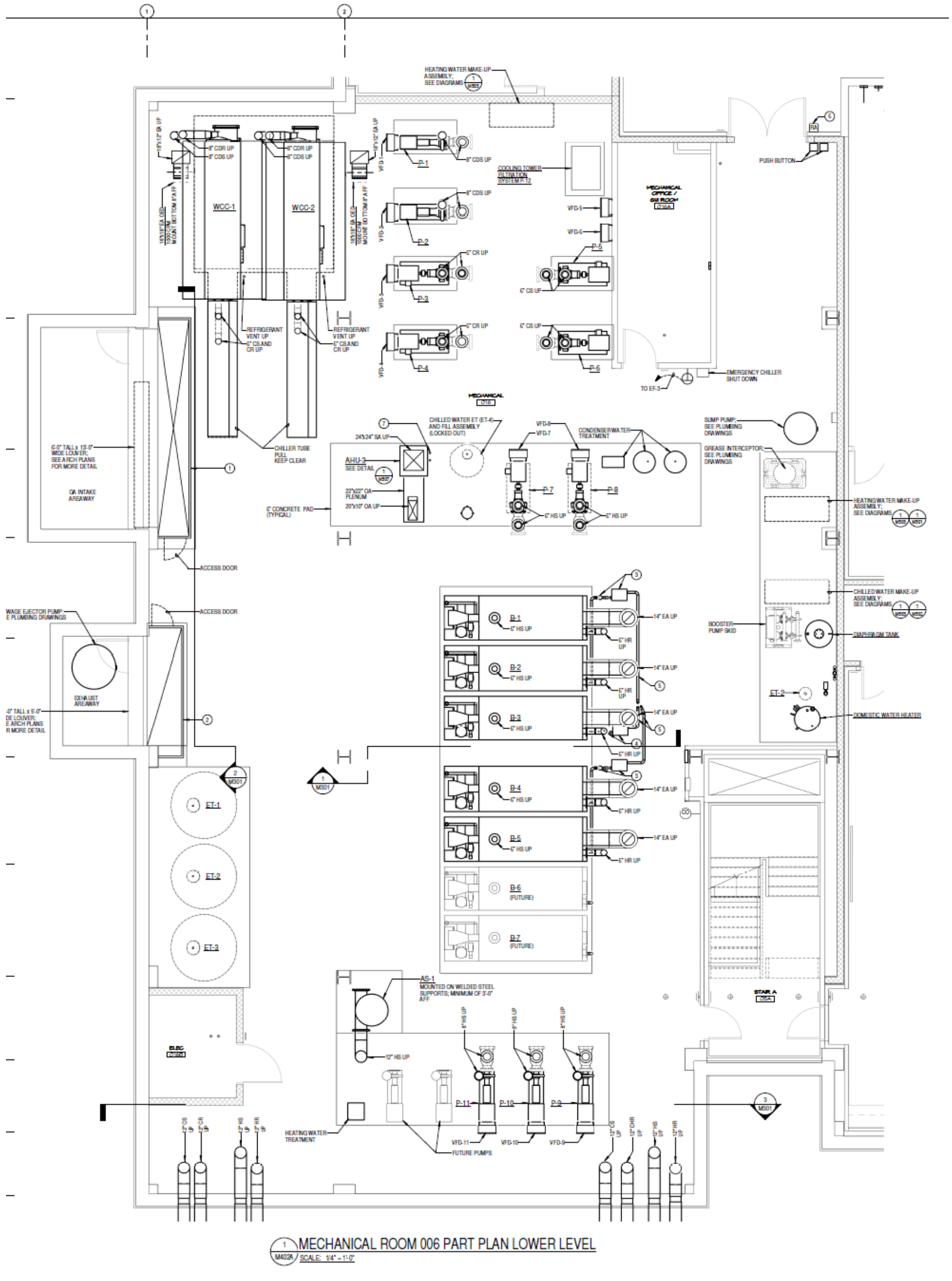

Figure 2. Mechanical Room Drawing – Courtesy of James Posey Associates

Building Construction

The same U-value was used throughout the building for each of these components during design and energy modeling.

Construction	Description	U-value (BTU/(hr*SF*°F))	SC
Roof	built-up roof, high albedo cap sheet, 2-plies of modified bitumen membrane, self-adhering base layer, cover board and R-25 rigid polyisocyanurate insulation	0.04	-
Walls	4" masonry veneer, 4" cavity, 2" rigid insulation; air/water barrier and 8" CMU back up	0.0526	-
Glazing	1" insulated glazing units held in thermally-broken glazed aluminum curtainwall frames, low-e coatings	0.29	0.39

Table 1. Building Construction

Design Considerations

Objectives

The objective of Montgomery College Student Services Center is to create a functional and aesthetically pleasing space for the students of the college. All traditional design parameters were considered. Sustainability was not a priority, but sustainable options were included in order to create a successful design.

Requirements

Outdoor Design Conditions

Montgomery College Student Services Center is located in Rockville, MD. This location is Zone 4A in ASHRAE 90.1 – 2007 and is defined as mixed-humid from Table B-4. The climate data is taken from the 2009 ASHRAE Fundamentals Handbook.

Season	Dry Bulb (°F)	Mean Coincident Wet Bulb (°F)
Summer	94	75.2
Winter	12.9	

Table 2. ASHRAE 2009 Fundamentals Handbook Rockville, MD Climate Data

Season	Dry Bulb (°F)	Mean Coincident Wet Bulb (°F)
Summer	95	78
Winter	0	

Table 3. Climate Design Data Used by Designer

As seen in Tables 1 & 2, all design conditions used by the designer were more conservative than those given in the 2009 ASHRAE Fundamentals Handbook. The summer dry bulb condition design point is 1°F higher, the MCWB condition is 2.8°F higher, and the winter design dry bulb condition is 12.9°F lower.

Indoor Design Conditions

The indoor design conditions were taken to be 75°F DB for cooling and 70°F DB for heating, with a 50% relative humidity for both cases. Thermostats are located in each room.

Ventilation Requirements

Ventilation air is provided to all spaces via the two custom air handling units on the roof, as well as a single packaged vertical air handling unit in the security suite. From the main two air handlers, air is delivered via a vertical shaft that travels the height of the building and connects to VAV terminal units. The packaged vertical unit draws in outdoor air at ground level, from the same intake as that used for OA for the boilers. The ventilation air flow rates comply with ASHRAE 62.1 – 2007 requirements.

Air Handler	Type	Cooling Airflow (CFM)	Tons	Heating Airflow (CFM)	OA (CFM)	OA Required (CFM)	MBh	Compliance
AHU-1	VAV	48,000	198	17,070	15,000	14,971	800	Yes
AHU-2	VAV	48,000	198	17,070	15,000	14,971	800	Yes
AHU-3	Packaged Vertical	1,000	7.96	1,000	1,000	1,000	43	Yes
Total	**-**	**99,000**	**404**	**44,610**	**31,000**	**30,942**	**1,959.6**	**-**

Table 4. Ventilation Summary and Compliance

Heating and Cooling Requirements

The heating and cooling loads were calculated with Trane Trace 700. This software was also used by the designer. Table 5 displays the results of each calculation. The design engineer had higher design values than those calculated for this report. In all cases, it seems that the designer applied safety factors to their calculations. There could also be errors in one or both of the calculations done by either party as well, which would account for the load calculation differences. In addition, load calculation software is not completely accurate and only serves as a design guide. Actual energy usage must be taken retroactively from existing buildings to get a better sense of the energy use of certain building types.

Air Handler	Type	Cooling Airflow (CFM)	Tons	Heating Airflow (CFM)	MBh
AHU-1	VAV	42942	176.8	15271.1	715.7
AHU-2	VAV	42942	176.8	15271.1	715.7
AHU-3	Packaged Vertical	1489.2	11.9	1489.2	64.6
CUH-1	Cabinet Unit Heater	-	-	515.1	25.84
CUH-2	Cabinet Unit Heater	-	-	515.1	25.84
CUH-3	Cabinet Unit Heater	-	-	515.1	25.84
CUH-4	Cabinet Unit Heater	-	-	515.1	25.84
CUH-5	Cabinet Unit Heater	-	-	515.1	25.84
CUH-6	Cabinet Unit Heater	-	-	515.1	25.84
PUH-1	Propeller Unit Heater	-	-	642.6	15.98
PUH-2	Propeller Unit Heater	-	-	642.6	15.98
PUH-3	Propeller Unit Heater	-	-	642.6	15.98
PUH-4	Propeller Unit Heater	-	-	642.6	15.98
PUH-5	Propeller Unit Heater	-	-	642.6	15.98
PUH-6	Propeller Unit Heater	-	-	714	20.06
PUH-7	Propeller Unit Heater	-	-	642.6	15.98
PUH-8	Propeller Unit Heater	-	-	714	20.06
PUH-9	Propeller Unit Heater	-	-	642.6	15.98
PUH-10	Propeller Unit Heater	-	-	642.6	15.98
Total	**-**	**87,373.2**	**365.5**	**41,690.8**	**1,819**

Table 5. Load Calculations

Air Handler	Type	Cooling Airflow (CFM)	Tons	Heating Airflow (CFM)	MBh
AHU-1	VAV	48,000	198	17,070	800
AHU-2	VAV	48,000	198	17,070	800
AHU-3	Packaged Vertical	1,000	7.96	1,000	43
CUH-1	Cabinet Unit Heater	-	-	505	25.3
CUH-2	Cabinet Unit Heater	-	-	505	25.3
CUH-3	Cabinet Unit Heater	-	-	505	25.3
CUH-4	Cabinet Unit Heater	-	-	505	25.3
CUH-5	Cabinet Unit Heater	-	-	505	25.3
CUH-6	Cabinet Unit Heater	-	-	505	25.3
PUH-1	Propeller Unit Heater	-	-	630	15.7
PUH-2	Propeller Unit Heater	-	-	630	15.7
PUH-3	Propeller Unit Heater	-	-	630	15.7
PUH-4	Propeller Unit Heater	-	-	630	15.7
PUH-5	Propeller Unit Heater	-	-	630	15.7
PUH-6	Propeller Unit Heater	-	-	700	19.6
PUH-7	Propeller Unit Heater	-	-	630	15.7
PUH-8	Propeller Unit Heater	-	-	700	19.6
PUH-9	Propeller Unit Heater	-	-	630	15.7
PUH-10	Propeller Unit Heater	-	-	630	15.7
Total	**-**	**99,000**	**404**	**44,610**	**1,959.6**

Table 6. Design Engineer's Load Calculations

Annual Energy Use

Figure 3 displays the monthly electricity consumption of the building. The building load is dominated by the utility load, which includes the high receptacle load, as well as the cooling load. A bell curve peaking in July would have been expected, but according to the model this is not the case. The monthly HVAC electrical consumption is displayed in Figure 4, with the cooling load dominating the energy consumption. Utility loads dominate the annual energy consumption, as seen in figure 3.

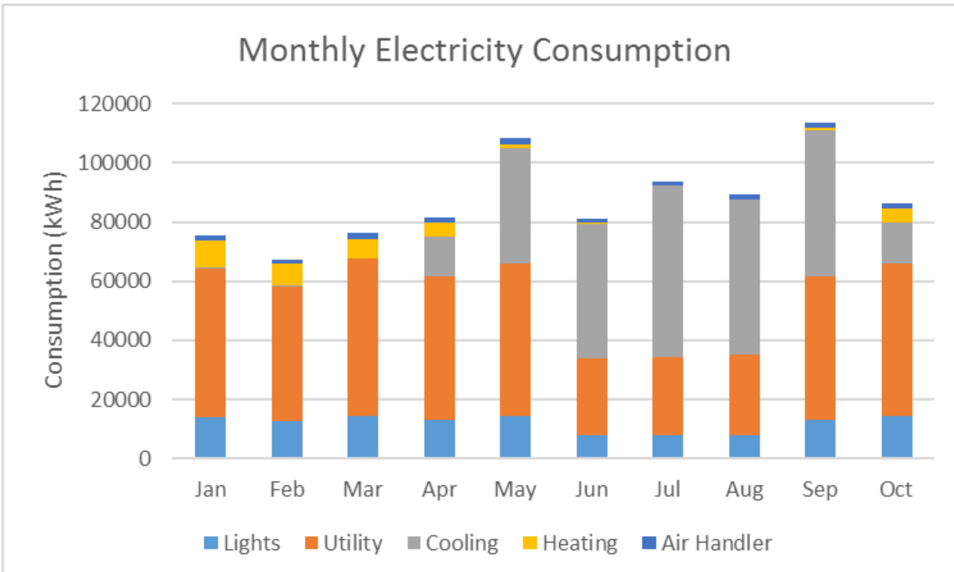

Figure 3. Monthly Electricity Consumption

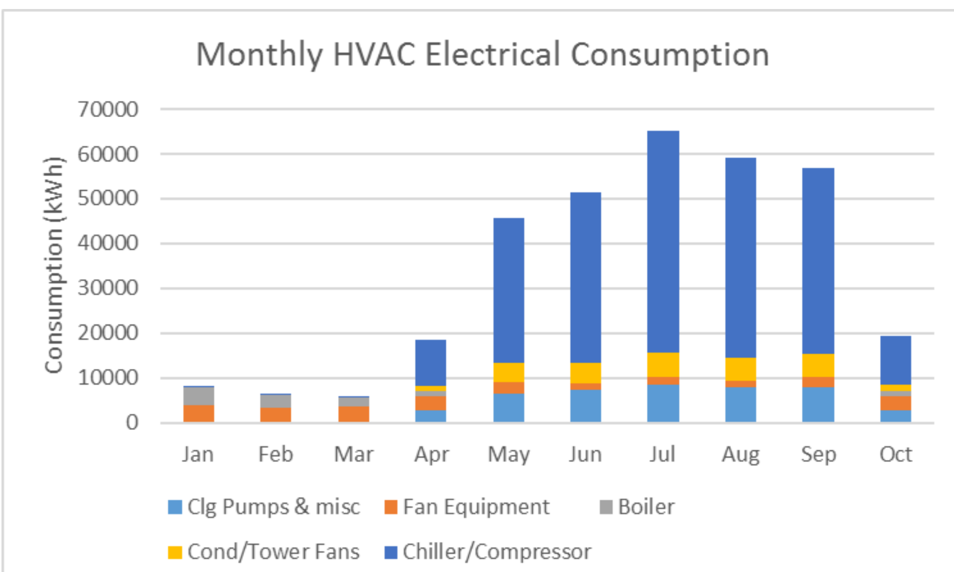

Figure 4. Monthly HVAC Electrical Consumption

Figure 5 shows the percentage of each electricity used by each system component relative to the annual electricity consumption. The total energy usage is estimated at 1,800,000 kWh and the total demand is estimated at 820 kW.

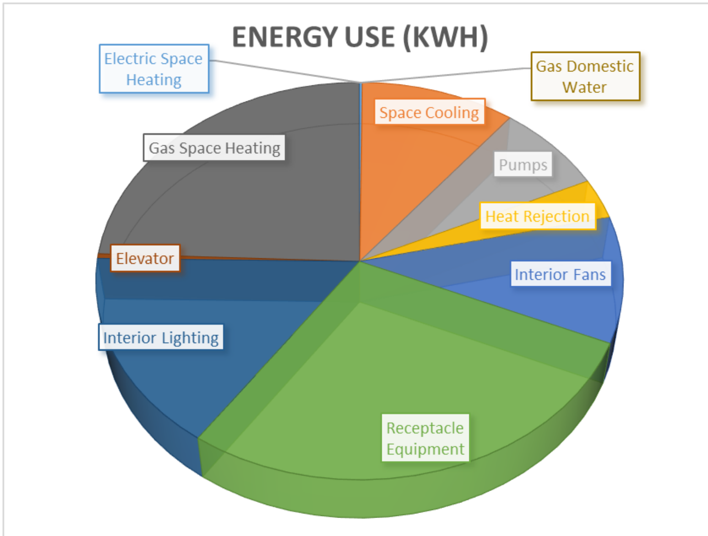

Figure 5. Energy Use Bar Graph

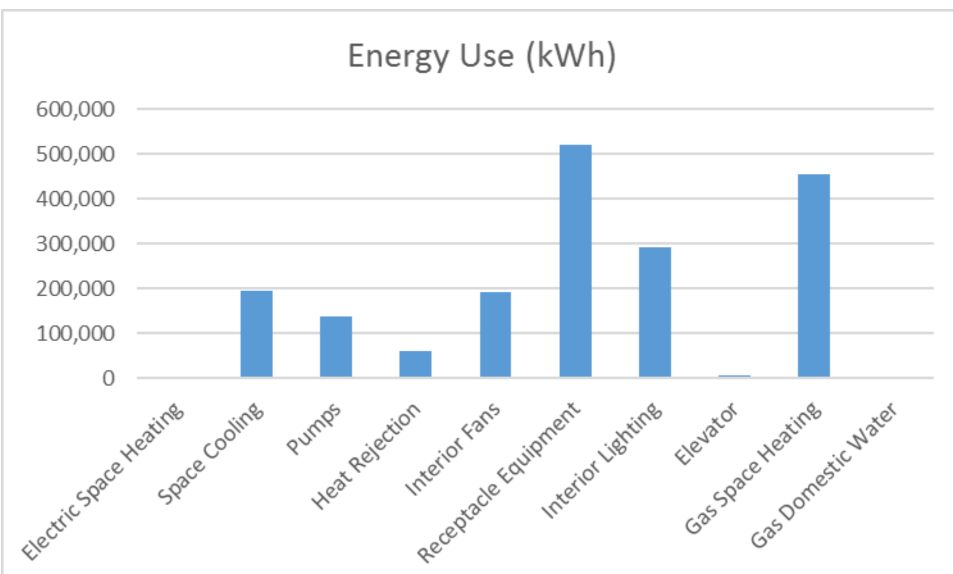

Figure 6. Energy Use Pie Chart

Annual Utility Costs

Annual utility cost for Montgomery College Student Services Center is summarized below. Data for fuel consumption costs was taken from March 2014 EIA reports for natural gas and July 2015 EIA reports for electricity.

Source	Rate	Unit	Cost
Electricity	0.1122	$/kWh	201,960
Natural Gas	1.01	$/therm	1,650

Table 7. Fuel Consumption Costs

Existing Mechanical System

Equipment

Heating Equipment

The building's heating water will be supplied by a new boiler plant with five high-efficiency gas fired condensing boilers, with an additional two boilers for redundancy. The boilers used the Fulton-Vantage 6000 boilers as the basis of design. The boiler plant will be located in the basement mechanical room. B-1 thru B-5 are their designations, they have a 6000 MBH input each, with 5640 MBH output (87% efficient). Each boiler operates at 160°F EWT, 180°F LWT, 560 GPM, 15' WG MAX WPD, with a single point power connection, 208V-3PH, 7.5HP blower. The units have a 5:1 turndown ratio and a minimum as pressure requirement of 18" w.c. Each boiler is 88"H x 51"W x 155" L, and has an operating weight of 14,800 lbs. The new campus heating water system matches the existing campus supply and return temperatures.

The heating plant will have a dedicated primary, variable secondary, and variable tertiary system. Inline primary pumps for each boiler are anticipated. Three pumps sized for 50 percent of the flow will serve the secondary campus side, while three additional pumps sized at 50 percent of the flow will serve the tertiary pumps for the building. There are three primary heating water pumps at 725 GPM each and two secondary heating water pumps at 655 GPM each.

Cabinet unit heaters are provided in order to serve stairways, and propeller unit heaters are provided to serve the mechanical room, fir pump room, trash, material storage, loading dock "A", and the AHU service corridor. The majority of the heating capacity serves VAV units throughout the building. Four hot water radiator panels are also provided for the building and located in the floor. There are also thirteen variable refrigerant terminals and two variable refrigerant system air cooled heat pumps.

Cooling Equipment

Campus chilled water is currently generated and distributed in the basement of the Humanities building. The chilled water for the Student Services Center will be supplied by two new water cooled chillers and a dual cell cooling tower. These satellite chillers will be located in the Student Services Center's basement mechanical room, while the cooling tower will be located on the roof. The chillers will be based upon the Carrier 23RXRV 250 ton centrifugal chiller with variable frequency drive. The cooling tower will be based on Baltimore Air Coil (BAC) – series 3000

The two chillers are water cooled centrifugal compressor chillers. The evaporator operates at 550 GPM, 50°F EWT, 39°F LWT, max 20' PD, 0.00010 fouling factor, while the condenser operates at 750 GPM, 85°F EWT, 94.5°F LWT, max 20' PD, 0.0002 fouling factor. They require 152.1 Kw input, 480V-60Hz-3PH, 263 MCA, 350 MOP. They have a max of 0.387 NPLV, R134a refrigerant, and they are 181” long, 46” wide, and 89” high. During unoccupied mode, the evaporator EWT and LWT are changed to 58°F and 42°F respectively.

The dual cell cooling tower is an induced draft crossflow type cooling tower with vertical air discharge. The cells operate independently, have FRP casing panels, single end inlet, single end outlet, louver side access with external ladder, safety cage, and anti-skid surface platform to fandeck and access doors. They have sweeper piping for use with Lakos solid separator filtration package. They are designed with 10% additional capacity.

Sound power levels of the cooling towers are not to exceed the following:

Frequency (Hz)	63	125	250	500	1000	2000	4000	8000
Sound Power (dB)	99	99	99	94	90	83	79	76

Table 8. Cooling Tower Sound Power Levels

Air Handling Units

Two custom variable air volume air handling units will serve the Student Services Center. They will be equipped with 2-inch flat MERV 8 pre-filters, 12-inch cartridge type MERV 13 final filters, heating water preheat coils, chilled water cooling coils, and direct-drive plenum-type supply and return fans. They are located on the roof of the building and are headered together in order to serve a vertical shaft that runs throughout the building. Each air handling unit has a total CFM of 48,000 with 15,000 CFM of outdoor air.

There is one other packaged air handling unit that provides air for the security suite. It is located in the basement mechanical room, and it draws in outdoor air from the same air intake as the boilers. It is a vertical unit with a total of 1,000 CFM, and it brings in 100% outdoor air. It is connected to an air cooled condensing unit located outdoors, and both units are connected to emergency power.

VAV Terminal Units

Single-duct VAV supply air terminal units with hydronic heating coils are used for providing both space temperature and ventilation control for the building. A dedicated VAV terminal unit will be provided for each classroom, adjunct suite, conference room, corner office, department chair office, and specialty spaces. A single VAV terminal unit will support three or more interior offices, or perimeter offices with a common exposure. Dedicated and redundant ductless split systems and VAV terminal units will serve elevator machine rooms, IT rooms, and security closets.

There are 168 total VAV terminals, which are based on Titus model desv single-duct terminal unit. Heating coils are designed at 130°F EWT and 55°F EAT with a max pressure drop of 10’ HD. All VAV terminals are provided with sound attenuators; a total of five different types of sound attenuators are specified for this building, depending on VAV terminal size and airflow.

Hot Water Pumps

Hot water is pumped to the heating coils in the air handlers, VAV terminal units, cabinet unit heaters, and propeller unit heaters. There are three primary heating water pumps, each rated at 725 GPM, 130 FT HD, 40 HP, and sized at 33% of full flow to campus loop. They are B&G

Series E110 4GC pumps. There are also two secondary heating water pumps, each rated at 655 GPM, 65 FT HD, 15 HP, and sized for full flow to the building. They are located in the basement mechanical room and are B&G Series E110 4BD pumps.

Chilled Water Pumps

Chilled water is pumped from the cooling tower to the chiller and around the building to the air handlers and VAV terminal units. Two primary chilled water pumps are located in the basement mechanical room, and they are rated at 550 GPM, 55 FT HD, 15 HP, and are each sized for full flow through one chiller. They are based on B&G Series E-1510 3BD. Two secondary chilled water pumps are located in the basement mechanical room, and they are rated at 600 GPM, 100 FT HD, 20 HP, and are each sized for full flow to the building. They are based on B&G Series E-1510 3AD. There is also a cooling tower filtration pump sized at 410 GPM, 60 FT HD, and 10 HP, based on Lakos eCTX-0410-SRV.

Condenser Water

Two condenser water pumps are sized for full flow to one tower plus 10% additional capacity. They are rated at 825 GPM, with 85 FT HD, 25 HP, and are based on B&G Series E-1510 EB.

Equipment Initial Cost

The initial cost of mechanical equipment is estimated to be $11,406,364, with a per square foot cost of 89.11 / GSF

System Operation and Schematics

Chilled Water

The cooling tower (CT-1), located on the roof, sends condenser water to the two 250-ton centrifugal chillers in the basement mechanical room. Two parallel condenser water pumps provided the pumping energy to move the condenser water. The chillers send their chilled water to serve the building and existing campus main system. From the building loads, the chilled water passes through the chilled water air separator (AS-2) and returns to the chillers via the two primary chilled water pumps (P-3 and P-4). These loops between the chillers and the loads and between the chillers and the cooling towers run continuously when a cooling load is present.

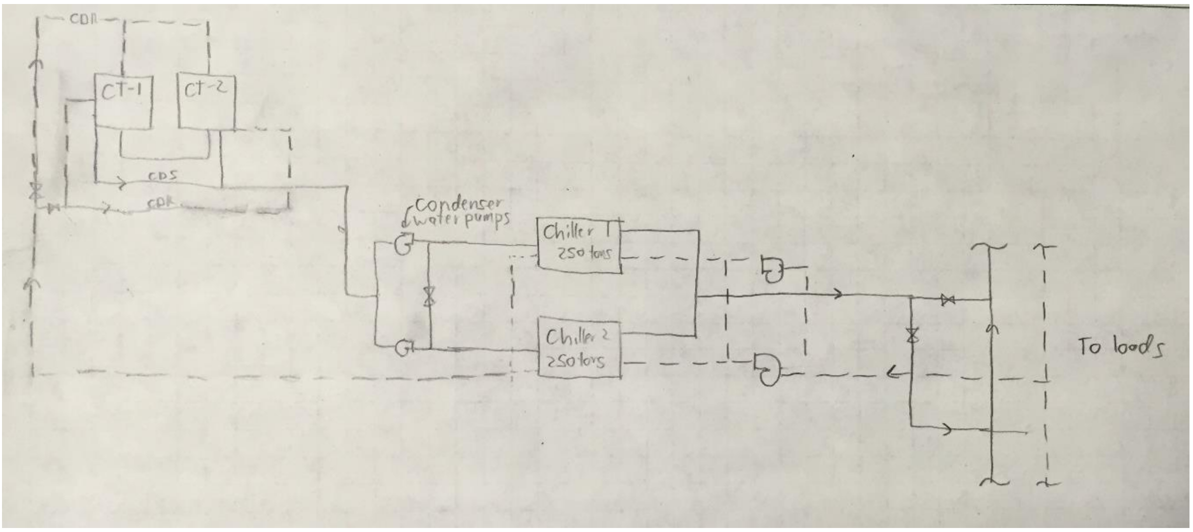

Figure 7. Chilled and Condenser Water Schematic

Heating Water

Hot water is generated by the seven parallel boilers and distributed to the building via three parallel heating water pumps. From the building loads, the hot water is returned to the boilers and is reheated and sent back to the building loads. Lead and lag pumps operate in sequence to maintain the differential pressure setpoint of the sensor in the main mechanical room.

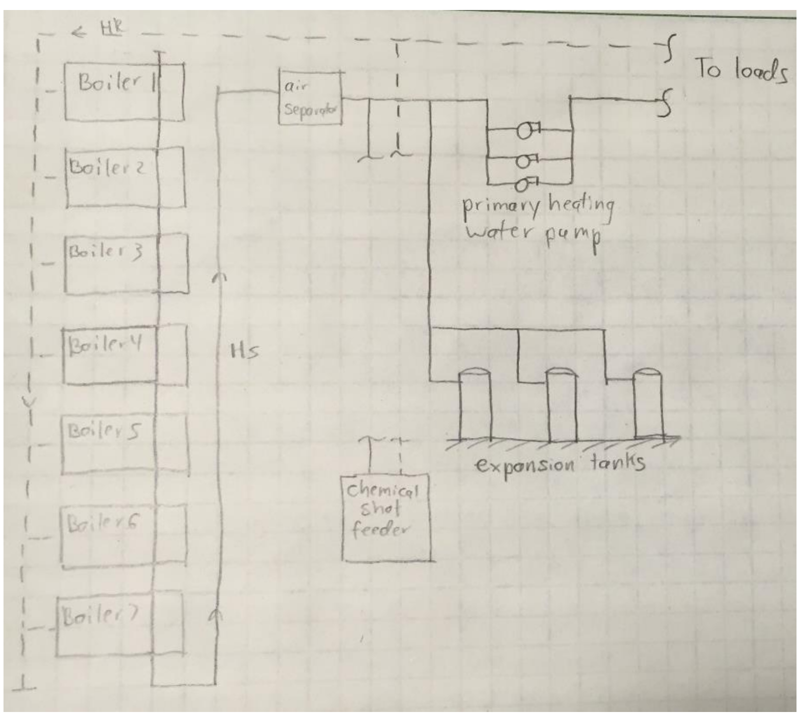

Figure 8. Heating Water Schematic

Airside

Montgomery College Student Services Center has conditioned air supplied by three air handling units. AHU-1 and AHU-2 are variable air volume units with VFDs located on the roof, and AHU-3 is located in the basement mechanical room and serves the security suite. All air handlers are operated automatically by a direct digital control system (DDC). The system is designed to operate based on the building occupancy schedule and is adjustable by the owner for each calendar day. Each air handling unit is controllable independently, and the two main units on the roof have fan arrays. Discharge air temperature is based on the quantity of cooling requests from each terminal unit room temperature sensors. Maximum unit discharge temperature setpoint shall not exceed 60°F, and minimum unit discharge shall not drop below 50°F. See below schematic for details.

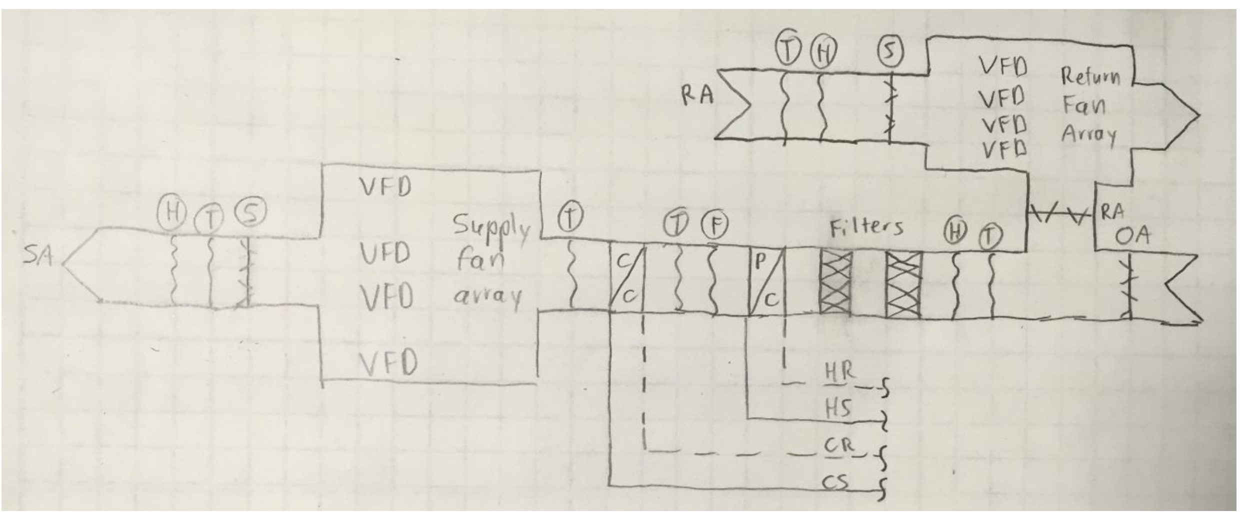

Figure 9. Airside Schematic

Mechanical Space in Building

Room	Area (SF)
Fire Pump	296
Mechanical Office/ GUI Room	166
Main Mechanical Room	5340
Shaft Space	560
Total	**6362**
Mechanical percentage of total area	**4.97%**

Table 9. Mechanical Space

LEED Checklist

The Montgomery College Student Services Center was aiming to be a LEED Silver project. The documentation for this is shown below.

Proj #21465 m, k4 *PRELIMINARY* LEED 2009 EVALUATION - VERSION 3.0

Category		LEED™ Credit Description	Possible Credits	Y	?	N	Implementation / Approach	Notes	Design and Documentation Lead
Sustainable Sites	SSp 1	Construction Activity Pollution Prevention		R					AMT/GC
	SS 1	Site Selection	1	1			on the site of a developed sidewalk		CBHA
	SS 2	Development Density and Community Connectivity	5		5		need to be within 1/2mi of 10units/acre net development. We should be good on the 10 basic services, but I don't think we have enough high rises within 1/2mi		CBHA
	SS 3	Brownfield Development	1			1			
	SS 4.1	Alternative Transportation- Public Access	6	1	5		need to be within 1/4 mile of a stop that services 2 or more public/campus/private bus lines	Verify bus services with MCR	CBHA
	SS 4.2	Alternative Transportation- Bike Storage & Changing Rooms	1	1			if facility is within 200 yards of a gym facility with shouwers accessable to building occupants we can get this		CBHA
	SS 4.3	Alternative Transportation- Low-Emitting & Fuel-efficient vehicles	3	1	1	1	is there parking associated with this project? On MC p3 we are hoping to show the addition of ULEV spots in a garage nearby.	Review with MCR	CBHA
	SS 4.4	Alternative Transportation- Parking Capacity	2	2			if no parking is being added to project, we can get this		AMT
	SS 5.1	Site Development- Protect or Restore Habitat	1		1		if there are rain gardens, vegetated roofs we can count them here		AMT/MVLA
	SS 5.2	Site Development- Maximize Open Space	1			1	need to protect and restore 50% of site, excluding building footprint		AMT/MVLA
	SS 6.1	Stormwater Design- Quanitity Control	1		1		use existing pond		AMT
	SS 6.2	Stormwater Design- Quality Control	1		1		may not meet 100% of Rockville's requirements.		AMT
	SS 7.1	Heat Island Effect- Non-Roof	1	1			specify high albedo hardscape, minimize hardscape exposure via trees	need 50%	AMT/MVLA
	SS 7.2	Heat Island Effect- Roof	1	1			specify high albedo roof material		BCJ
	SS 8	Light Pollution Reduction	1			1	this is very hard to achieve in campus arrangements, with security concerns		
Water	WEp 1	Water Use Reduction - 20%		R					JPA
	WE 1	Water Efficient Landscaping- No potable use or no irrigation	4	4			use native hardy plants, no irrigation systems		MVLA
	WE 2	Innovative Wastewater Technologies	2	1	1		Traditionally we can achieve 1 point by using water-conserving water closets and urinals, or by using non-potable water closets or urinals. In order to get the full 2 points we would need to treat 50% of wastewater to tertiary standards, the treated water must be used or infiltrated on site.		JPA
	WE 3	Water Use Reduction- (2-4 points)	4	2	2		We must reduce building potable water use from the baseline by 30% - this achieves 2 points, 35% - this achieves 3 points, 40% - this achieves 4 points		JPA
Energy and Atmosphere	EAp 1	Fundamental Commissioning		R					CSX/JPA
	EAp 2	Minimum Energy Performance		R					JPA
	EAp 3	Fundamental Refrigerant Management		R					JPA
	EA 1	Optimize Energy Performance (12%-48%)	19	7	12		At this point I would take a conservative estimate and assume we can achieve 7 points for this (results from a 24% energy reduction from the baseline building). This is slightly different than P3 because we are building a new building for the SSC and P3 was an existing building. (you get more points per energy savings if the building is existing)		JPA
	EA 2	On-Site Renewable Energy (2.5%-12.5%)	7			7	Ways to achieve renewable energy include but are not limited to the following: Photovoltaic systems, solar thermal, biodesel, geothermal deep well. You can achieve 1-7 points based on the renewable energy generated from a range from 1-13%, see below for an example. 1% renewable energy = 1 point 13% renewable energy = 7 points		
	EA 3	Enhanced Commissioning	2	2			Need to get guy onboard earlier. MC used David Rush for pav3		JPA/BCJ/CSX
	EA 4	Enhanced Refrigerant Management	2	2			This credit has 2 options Option 1: do not use refrigerants (we will have chiller so this is not an option) Option 2: Select equipment that is utilizing efficient refrigerants - we will use option 2 and should be able to get a full 2 points for this credit.		JPA
	EA 5	Measurement & Verification	3		3		Typically option 3 (provide whole building energy use data) is what we see. We should be in touch with the College to discuss what they would like to achieve for this credit as it directly relates to how much we want to spend.		MCR/CSX
	EA 6	Green Power	2	2			Verify if MC is using 100% Green Power		MCR/CSX

Figure 10. LEED Checklist – Part 1

Conserving Materials & Resources	MRp 1	Storage and Collection of Recyclables		R					CBHA
	MR 1.1	Building Reuse- Maintain Existing Walls, Floors and Roof	3			3	this is new construction, yes?		
	MR 1.2	Building Reuse- Maintain Interior Nonstructural Elements	1			1	same issue as above		
	MR 2	Construction Waste Management	2	2			if given warning ahead of time, should be able to achieve 100%, especially since it's new construction		GC
	MR 3	Materials Reuse	2			2	new construction		
	MR 4	Recycled Content- 10%- 20%	2	2			For the most part, you should simply be able to spec this		CBHA/BCJ
	MR 5	Regional Materials- 10%-20%	2	2			For the most part, you should simply be able to spec this		CBHA/BCJ
	MR 6	Rapidly Renewable Materials	1	1			For the most part, you should simply be able to spec this		CBHA/BCJ
	MR 7	Certified Wood	1		1		on p3 there was a conflict with this and the recycled contenct credit with regards to casework, etc.		CBHA
Enhance Indoor Environmental Quality	IEQp 1	Minimum IAQ Performance		R					JPA
	IEQp 2	Environmental Tobacco Smoke Control		R					MCR
	IEQ 1	Outdoor Air Delivery Monitoring	1	1			We will achieve this - we will install outdoor air monitoring stations (already need these for economizer)		JPA
	IEQ 2	Increased Ventilation	1		1		Increased ventilation is a challenge, it is best to take the conservative approach and assume we can not achieve this. We will be able to determine if it is possible as the design progresses.		JPA
	IEQ 3.1	Construction IAQ- During Construction	1	1					GC
	IEQ 3.2	Construction IAQ- Before Occupancy	1	1			schedule permitting, we had to omit this with p3 based on schedule concerns		GC
	IEQ 4.1	Low-Emitting Materials- Adhesives/Sealants	1	1			specify it		CBHA / BCJ
	IEQ 4.2	Low-Emitting Materials- Paints and Coatings	1	1			specify it		CBHA / BCJ
	IEQ 4.3	Low-Emitting Materials- Flooring Systems	1	1			specify it		CBHA / BCJ
	IEQ 4.4	Low-Emitting Materials- Composite Wood / Agrifiber Products	1	1			specify it		CBHA / BCJ
	IEQ 5	Indoor Chemical Pollution Source Control	1	1			has special vestibule/walk off mat requirements. Since this is new construction, should be acheivable		CBHA/JPA
	IEQ 6.1	Controllability of Systems- Lighting	1	1			We can achieve this credit.		JPA
	IEQ 6.2	Controllability of Systems- Thermal Comfort	1	1			We will achieve this credit - we must provide comfort controls for 50% of the building occupants and in multi-occupant spaces		JPA
	IEQ 7.1	Thermal Comfort- Design	1	1			We will achieve this credits - we will show documentation that we comply with ASHRAE Standard 55 (this standards relates to clothing values of individuals and metabolic rates).		JPA
	IEQ 7.2	Thermal Comfort- Verification	1	1			Review with MCR		MCR /CSX
	IEQ 8.1	Daylight & Views- Daylight	1		1		will be up to how suites and spaces are laid out in design		
	IEQ 8.2	Daylight & Views- Views	1		1		will be up to how suites and spaces are laid out in design		
Innovation in Design	ID 1.1	Innovation in Design-	1		1				
	ID 1.2	Innovation in Design-	1		1				
	ID 1.2	Innovation in Design-	1		1				
	ID 1.2	Innovation in Design-	1		1				
	ID 1.3	Innovation in Design-	1		1				
	ID 2	LEED Accredited Professional	1	1					CBHA
Regional Priority	RP	Regional Priority for 20850 zip					can only get 4 of these, I've chosen the bottom 4		
	EAc2	On Site Renewable Energy	0				MC will likely not do this	1% of building energy = 1pt	
	MRc1.1	Building Reuse - maintain existing walls, floors and roof	0				new construction	maintain existing building - 55% = 1pt, 75% = 2pts, 95% = 3pts	
	MRc2	Construction Waste Management	1	1			need to achieve at least 50%	recycle construction debris, waste management plan 50% = 1pt, 75% = 2pts	
	SSc6.1	Stormwater Design - quantity control	1	1			should be able to get this		AMT
	WEc2	Innovative Wastewater Technologies	1	1			probably can get this with dual flush	reduce sewage water use by 50% with	JPA
	WEc3	Water Use Reduction	1		1		depends on design parameters, ? I think we'd need to hit 40% to achieve the cred	water saving above baseline - 30% = 2	JPA
	LEED Certified 40-49 Points Silver 50-59 Points Gold 60-79 Points Platinum 80+ Points		110	51	42	17		This project requires at least 50 points to become LEED Silver	

Figure 11. LEED Checklist – Part 2

Overall Mechanical System Evaluation

The mechanical engineer designing Montgomery College Student Services Center was successful in creating a comfortable and efficient space for students. Less than 5% of the building's total square footage is dedicated to mechanical equipment, not including duct shafts or roof space. The building meets requirements for heating, cooling, and ventilation as well. Construction won't be complete until March of 2019, so the true success of the building will not be known until that time.

The design is effective. Loud and large equipment, such as cooling towers and the large air handling units, were located on the roof in order to minimize their impact on occupants and the building's square footage. The mechanical room is located in the basement, thus ensuring that as many occupied rooms as possible can have exterior exposure. In addition, the mechanical room is laid out in an efficient manner so as to allow for expansion but keep it from using too much square footage. The design objectives seem to have been met and the design should allow for a space to be used for many years in the future.

References:

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ASHRAE (2009). 2012 ASHRAE Handbook – Fundamentals. Atlanta, GA: American Society of Heating Refrigeration and Air Conditioning Engineers, Inc.

Trane Trace 700

Montgomery College Student Services Center Construction Documents, James Posey Associates, 2016