MONTGOMERY COLLEGE STUDENT SERVICES CENTER

ROCKVILLE, MD

Building and Plant Energy & Emissions Analysis

Technical information courtesy of James Posey Associates

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

Architectural Engineering 481W | Senior Thesis

Technical Report 2

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Table of Contents

Executive Summary 3
Building Overview 3
Building Mechanical System Overview 5
Building Load Estimation 6
Design Conditions and Assumptions 6
Location 6
Building Construction 6
Electrical Service – Normal Power 7
Electrical Service – Emergency Power 8
Mechanical System Equipment 8
People Load 8
Load Calculation Results Commentary 9
Energy Consumption and Operating Costs 12
Energy Consumption 12
Annual Energy Cost Consumption 12
End Use Energy Consumption Breakdown 13
Monthly Electricity Consumption 14
Emissions 16
Annual Operating Costs 17
Fuel Consumption Costs 17
Monthly & Annual Energy Cost 17
Building Utility Cost per Square Foot 18
References: 19
Appendix: 20
Trace 20
Emission Factors for On-Site Combustion in a Commercial Boiler 35
Total Emission Factors for Delivered Electricity 35

Executive Summary

This report focuses on identifying major characteristics of the building's mechanical system, constructing and analyzing a load calculation model of the proposed design, and calculating annual energy consumption, monthly and yearly utility costs, and yearly particulate emissions. Design errors should be discovered and corrected as a result of this analysis.

The design documents were inspected for miscellaneous load sources, lighting densities, and other information for the load model constructed in Trane TRACE 700. Trace room templates were used as necessary in order to group room types to save time. Assumptions and the results from the Trace model are stated in this report. These findings are compared to the design engineer's model, which was also created in Trace.

This report also analyzes overall energy consumption, cost, and yearly emissions of the building. Charts and analysis of the results are included. These charts show building component loads, major sources of energy consumption, and total amount of emissions from those loads.

Building Overview

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.

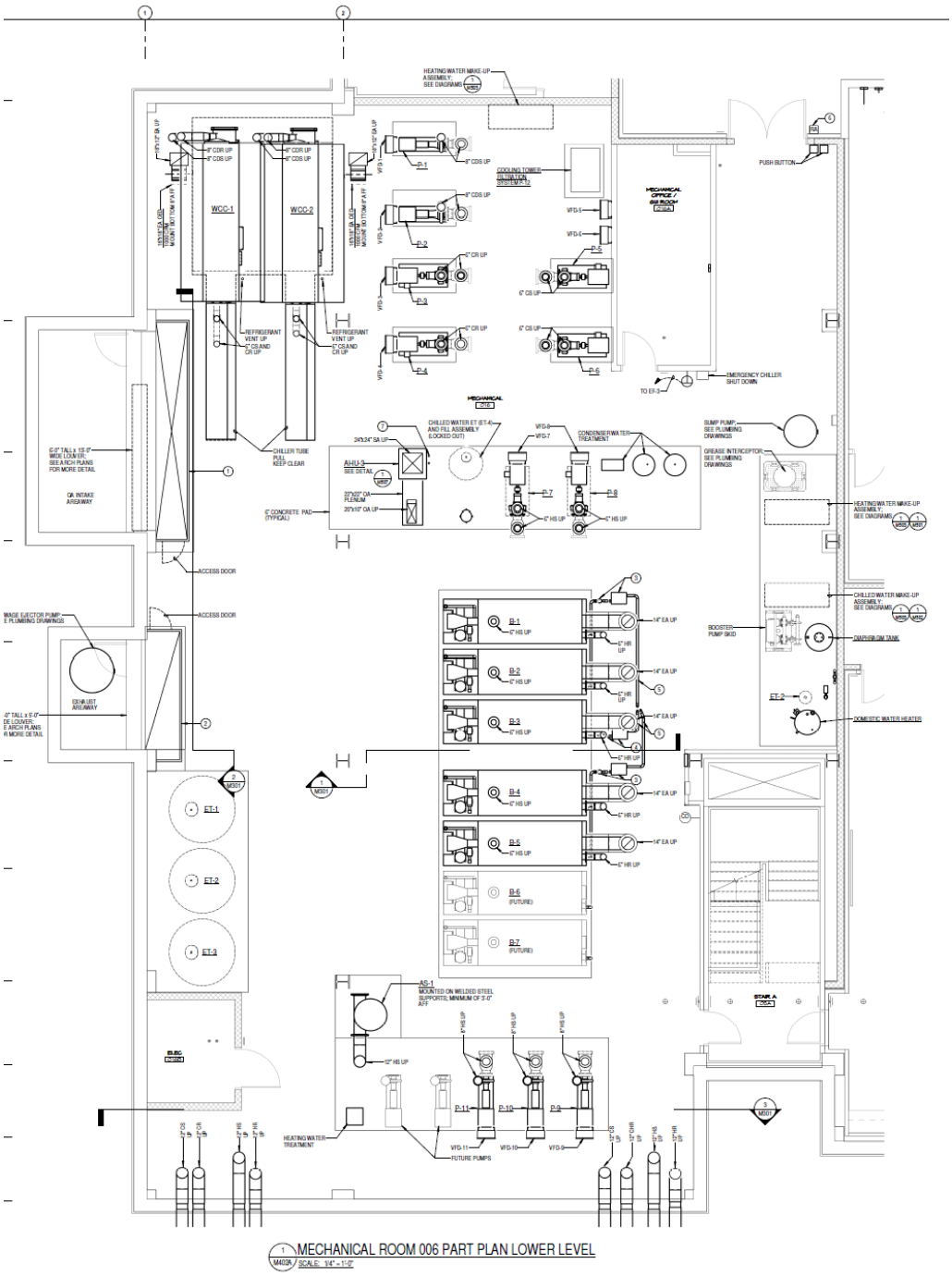

Figure 2. Mechanical Room Drawing – Courtesy of James Posey Associates

Building Mechanical System Overview

The 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 AERCO BMK-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; 170 degrees F heating water supply, and 140 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.

Building Load Estimation

Trane Trace was used to construct an accurate model of Montgomery College Student Services Center. The design engineer also used Trane Trace. The assumptions to construct the load model are stated below, along with occupancies, glazing properties, ventilation rates, wall constructions, weather information, electrical information, and other miscellaneous conditions. The results are then compared to those of the designer.

Design Conditions and Assumptions

Location

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 1. ASHRAE 2009 Fundamentals Handbook Rockville, MD Climate Data

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

Table 2. 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.

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 3. Building Construction

Electrical Service – Normal Power

Pepco will provide a new 3000 ampere service with a pad-mounted utility transformer on the west side of the building. This transformer will feed a new main distribution panelboard rated at 3000A, 480Y/277V, 3-phase, 4 wire, with bolt-on type branch circuit breakers. Building service will be provided at 480Y/27&V.

Design voltages will be as follows:

Item	Voltage
Service entrance	480Y/277 volt, 3-phase, 4 wire
Motors ½ HP and higher	480 volt, 3-phase, 3 wire
Motors smaller than ½ HP	277 volt, 1-phase
Lighting systems	277 volt, 1-phase
General receptacles	120 volt, 1-phase
Computer receptacles	120 volt, 1-phase

Table 4. Design Voltages for Normal Power

Design loads were developed as follows:

Load type	Unitary Load (W/sf)
Lighting	0.62
General receptacles	2.00
Computer receptacles	4.00
Mechanical equipment	8.00
Total	14.62

Table 5. Design Loads for Normal Power

Electrical Service – Emergency Power

Design voltages for the building's emergency power generation system will be 480Y/277 volt, 3-phase, 4 wire for mechanical equipment, 277 volt for lighting, and 120 volt for miscellaneous loads.

Load Type	Connected Load (kW)	Demand Load (kW)
Fire Pump (75HP)	69.0	69.0
Mechanical	39.8	39.8
Egress Lighting	31.9	31.9
Elevator	26.9	26.9
MDF/IDF Rooms	17.0	17.0
Receptacles	12.7	11.4
Fire Alarm/Security	2.0	1.6
Total	199.3	197.5

Table 6. Loads for Emergency Power

Mechanical System Equipment

Cooling

The cooling load will be met by two water-cooled chillers and cooling towers. The chillers will be located in the basement mechanical room, and the cooling towers will be located on the roof. They will be based on the Daiken Maglev Centrifugal chiller with variable frequency drive.

Heating

The heating load will be met by a new boiler plant consisting of five high-efficiency condensing boilers, with two additional boilers for redundancy, based on AERCO BMK-6000 boilers. They will be located in the basement mechanical room, and the plant will have a dedicated primary, variable secondary, and variable tertiary system.

Air Side

Two custom variable air volume air handling units will serve the Student Services Center and will be located on the roof. Single-duct VAV supply air terminal units with hydronic heating coils are anticipated for both space temperature and ventilation control for the building.

People Load

Space occupancies were determined to be as follows:

Space Type	Weekday Schedule (M-F)	Saturday Only
Student Activity	8:00 am to 10:00 pm	8:00 am to 12:00 pm (reduced occupancy)
Offices/ Meeting Areas	8:00 am to 5:00 pm	No occupancy
Classroom Areas	8:00 am to 10:00 pm	8:00 am to 12:00 pm (reduced occupancy)

Table 7. Occupancy Schedule

Ventilation rates were determined to be as follows:

Space Type	Design Ventilation Rate
Corridors	0.06 cfm/square foot
Classrooms & Computer Labs	10 cfm/person + 0.10 cfm/square foot
Office & Conference Spaces	5 cfm/person + 0.06 cfm/square foot
Multipurpose Assembly Spaces	5 cfm/person + 0.06 cfm/square foot
Lounges & Lobbies	5 cfm/person + 0.06 cfm/square foot

Table 8. Ventilation Rates

Heat gain of equipment, lighting, and people were determined to be as follows:

Space	Equipment (watts)	Lighting (watts/ft^2)	People (250 btu/hr sensible per person)
Computer Labs	100	0.6	33
Offices	100	0.6	1
Conference Room	500	0.6	8
Lobby/Lounge Areas	0	0.6	50
Corridors	0	0.6	ft^2 per person
Rest Rooms/ Storage Rooms	0	0.6	0
Data/IT Rooms	10,500	0.6	0
MDF Room	26,000	0.6	0

Table 9. Miscellaneous Heat Gains

Load Calculation Results Commentary

The energy model was created by modeling the building space geometry in Revit, exporting a GBXML file, and importing that same GBXML file into Trane Trace 700. Zones were modeled and sorted into three systems, a VAV system, a heating only system, and a transient system. The VAV system includes most of the zones, including offices, lockers, electrical rooms, restrooms, bathrooms, work rooms, IDF/MDF, classrooms, and testing rooms. The heating only system includes the mechanical room, fire pump room, storage spaces, stairs, and the vestibule. The transient system includes storage, elevator machine rooms, showers, and other similar intermediate spaces.

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. The building has a much higher required cooling load, with almost double the cooling CFM required. The occupancies of the building and internal loading decrease the required heating load during winter, which is a main contributor to the cooling load dominated building.

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 10. 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 11. Design Engineer's Load Calculations

Energy Consumption and Operating Costs

Energy Consumption

Annual Energy Cost Consumption

Figure 1 shows the distribution of the energy consumption for each component of Montgomery College Student Services Center. Receptacles by far consume the most energy annually, with cooling, lighting, and heating following. Figure 2 shows the data in the form of a pie chart in order to provide another way to visualize the data.

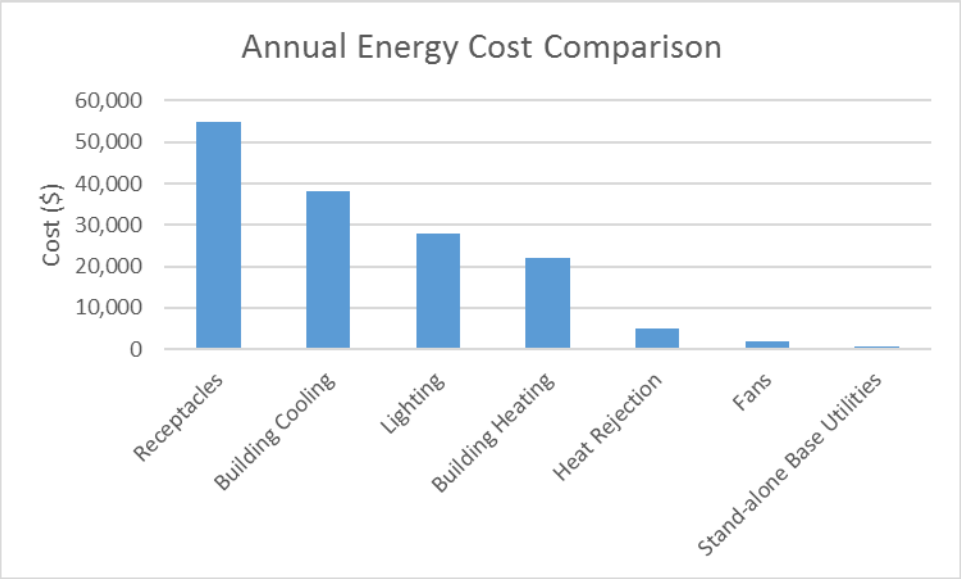

Figure 1. Annual Energy Cost Comparison Bar Graph

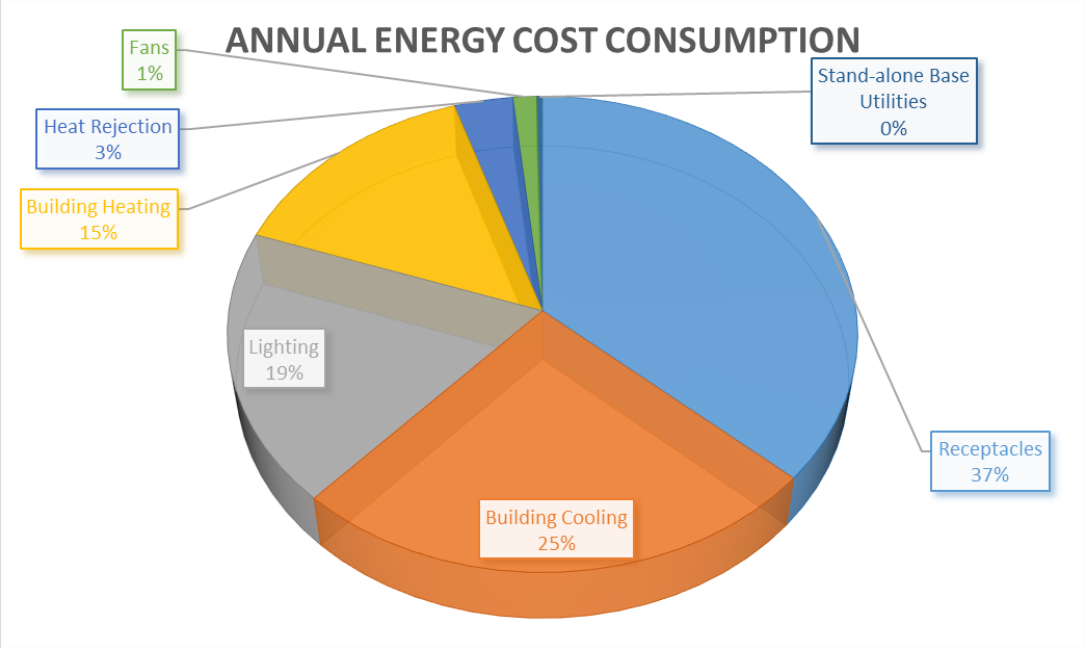

Figure 2. Annual Energy Cost Comparison Pie Chart

End Use Energy Consumption Breakdown

The building's distribution of energy usage and demand across a variety of equipment is shown below. The total energy usage is estimated at 1,800,000 kWh and the total demand is estimated at 820 kW.

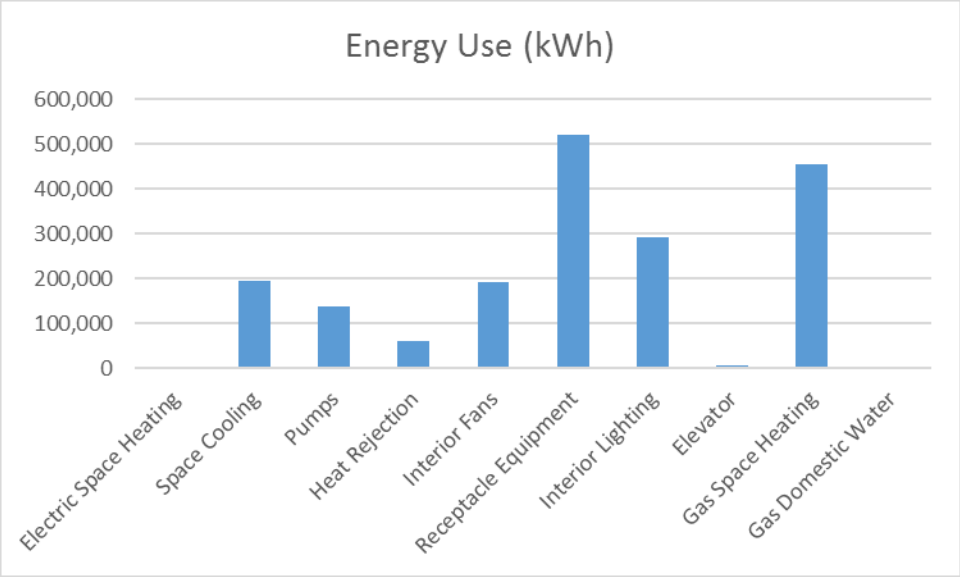

Figure 3. Energy Use Bar Graph

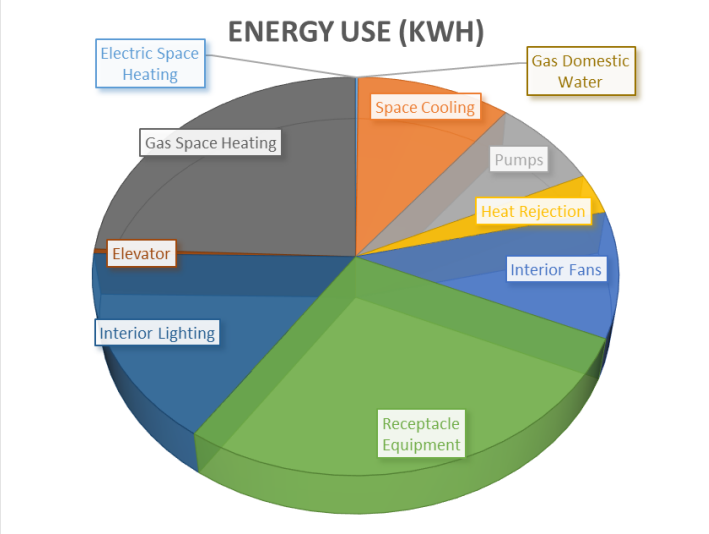

Figure 4. Energy Use Pie Chart

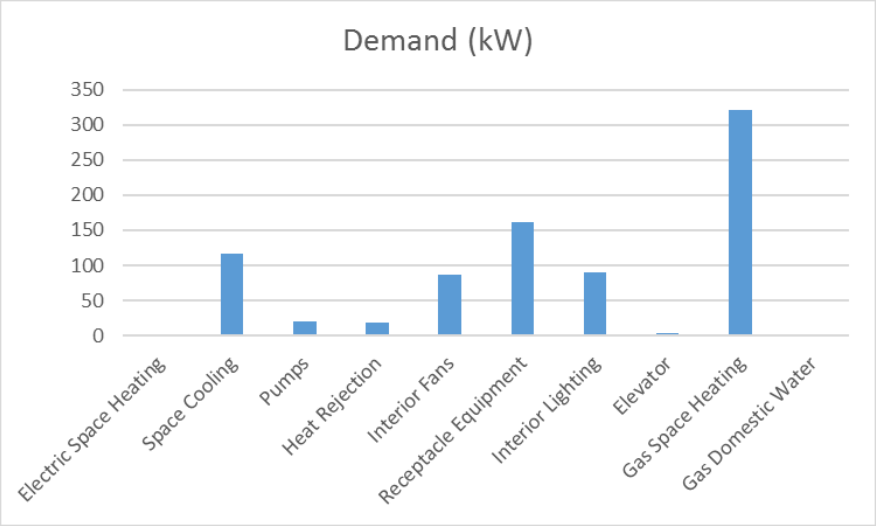

Figure 5. Energy Demand Bar Graph

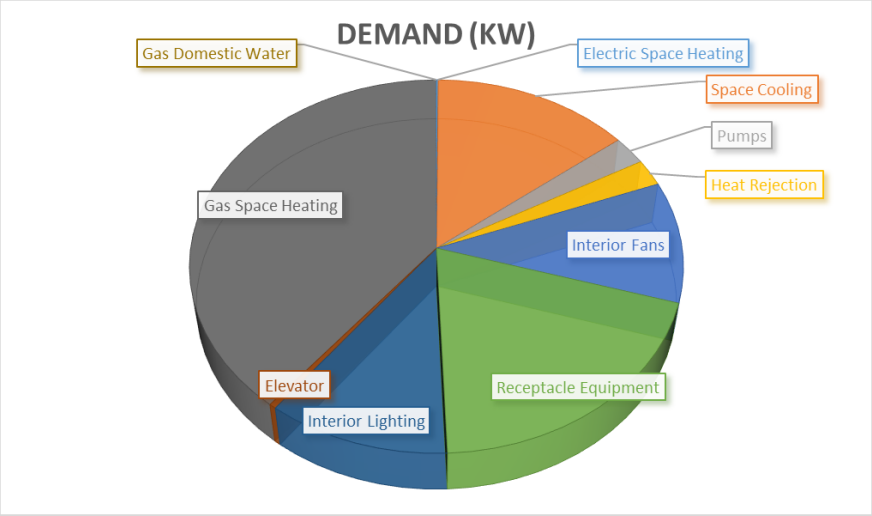

Figure 6. Energy Demand Pie Chart

Monthly Electricity Consumption

Figure 7 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 8, with the cooling load dominating the energy consumption. Utility loads dominate the annual energy consumption, as seen in figure 9. Gas consumption (shown in figure 10), contributes only a small amount to the energy usage of the building.

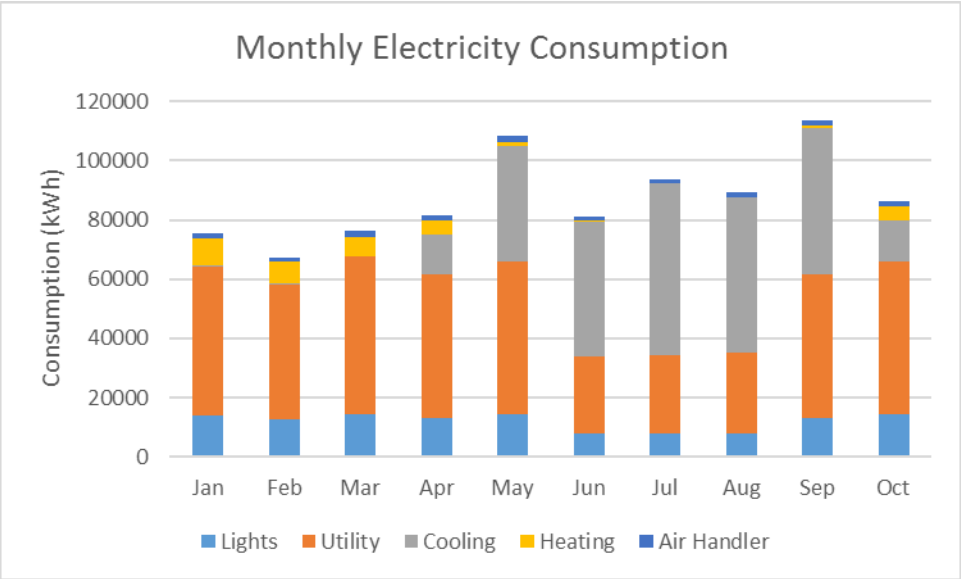

Figure 7. Monthly Electricity Consumption

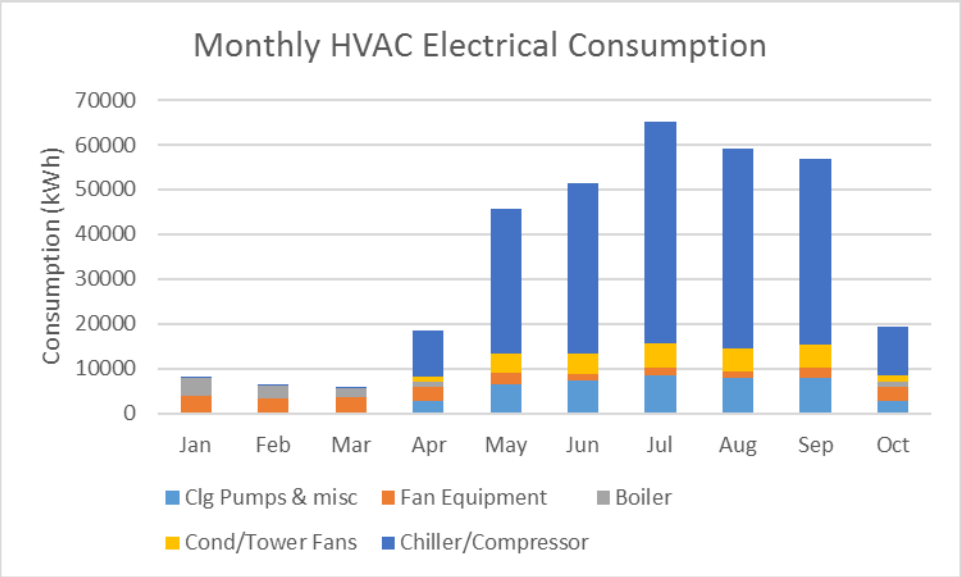

Figure 8. Monthly HVAC Electrical Consumption

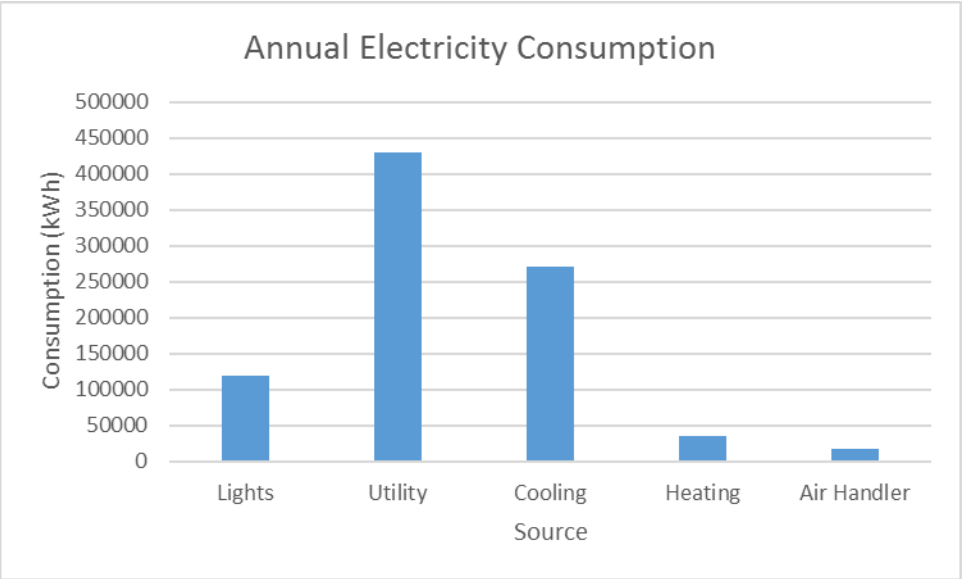

Figure 9. Annual Electricity Consumption

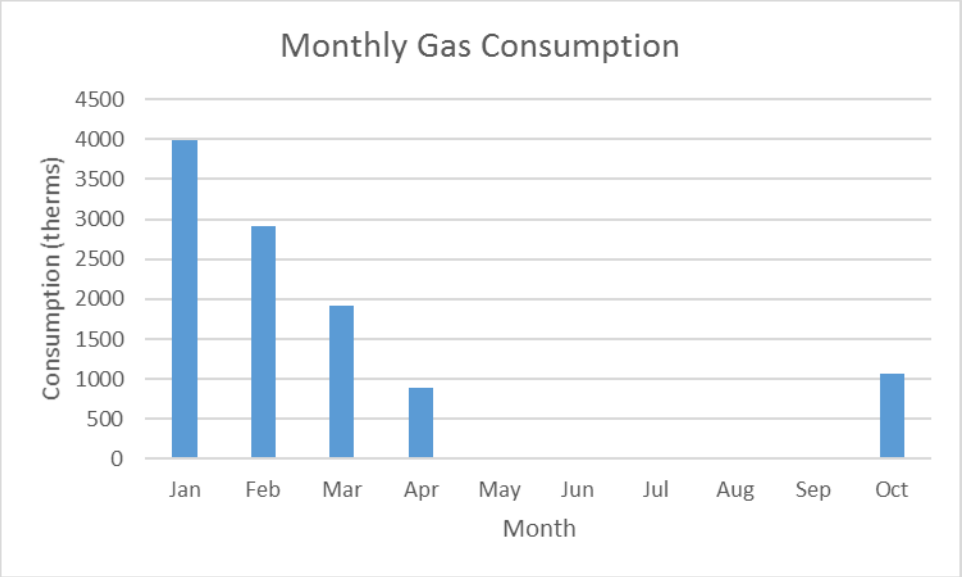

Figure 10. Monthly Gas Consumption

Emissions

There is little environmental impact of the Montgomery College Student Services Center. Yearly emissions for the building are approximately 6,482,686 million pounds of CO2, which is within safe limits. See Table 11 and the Appendix for emission factors used from the National Renewable Energy Laboratory, 2007 (NREAL).

Pollutant	Electricity Rate (lb/kWh)	Natural Gas Rate (lb/MCF)	Electricity (kWh/yr)	Natural Gas (MCF/yr)	Total Emissions (lb/yr)
CO2e	1.74	0.0123	1800000	1634	3132020
CO2	1.64	0.0122	1800000	1634	2952020
CH4	0.00359	0.0025	1800000	1634	6466.1
N2O	0.000087	0.0025	1800000	1634	160.7
NOX	0.003	0.111	1800000	1634	5581.4
SOX	0.00857	0.000632	1800000	1634	15427.0
CO	0.000854	0.0933	1800000	1634	1689.7
TNMOC	0.0000726	0.00613	1800000	1634	140.7
Lead	0.000000139	0.0000005	1800000	1634	0.25
Mercury	3.36E-08	0.000000026	1800000	1634	0.06
PM10	0.0000926	0.0084	1800000	1634	180.4
Solid Waste	0.205	0	1800000	1634	369000

Table 12. Annual Emissions

Annual Operating Costs

Fuel Consumption Costs

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 13. Fuel Consumption Costs

Monthly & Annual Energy Cost

Data for monthly and annual fuel costs of electricity and gas are shown below in figures 11 and 12, respectively. This building is dominated by electric usage, due mainly to the influence of the electric chillers. Natural gas is only used for heating, so its usage is much lower during the summer months.

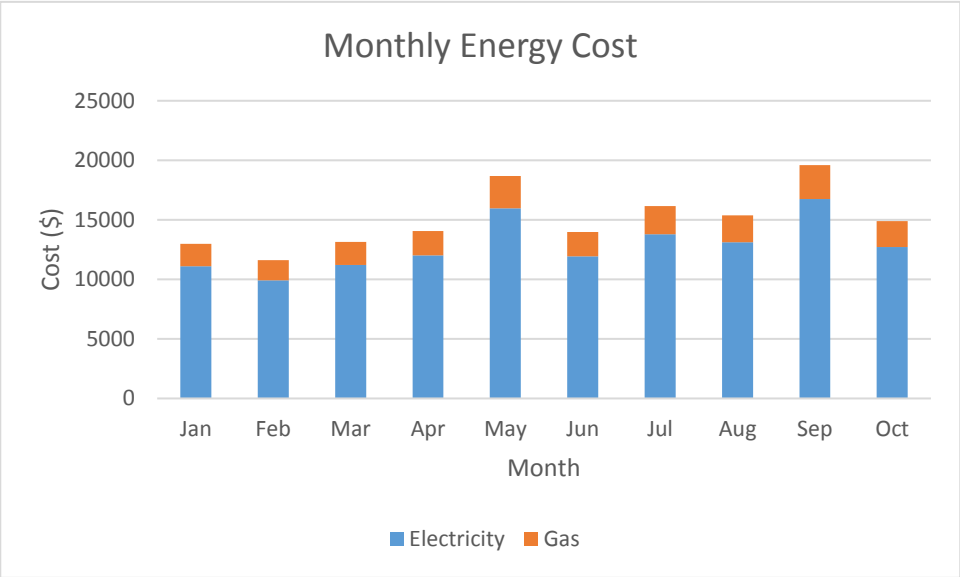

Figure 11. Monthly Energy Cost

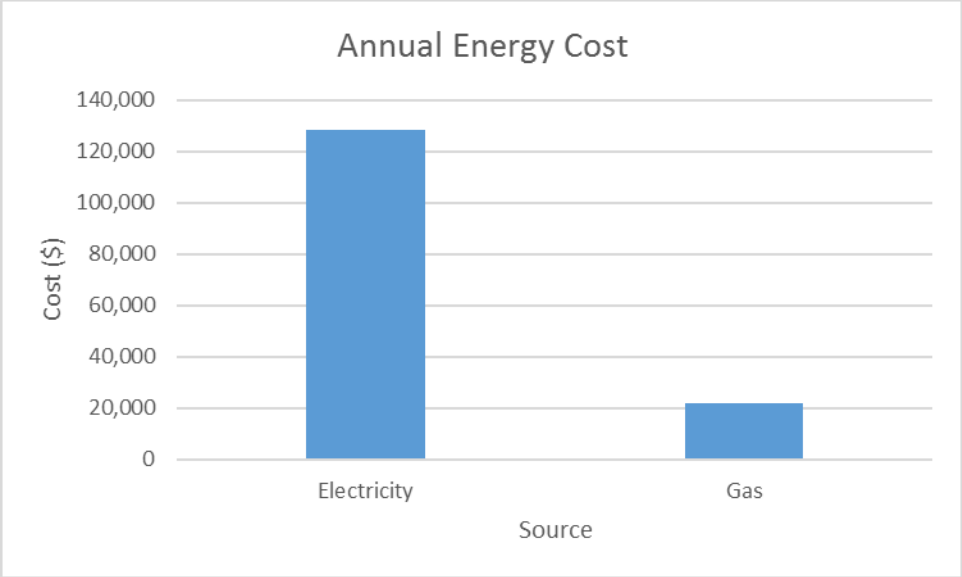

Figure 12. Annual Energy Cost

Building Utility Cost per Square Foot

By dividing the square footage of the building by the yearly cost of energy consumption, the total cost per square foot could be calculated. The results are displayed below in Table 14.

Building ft^2	**Cost/yr**	**Cost/(ft^2*yr)**
128,000	203,610	1.59

Table 14. Building Utility Cost per Square Foot

References:

ANSI/ASHRAE. (2007). *Standard 62.1-2007, Ventilation for Acceptable Indoor Air Quality.* Atlanta, GA. American Society of Heating Refrigeration and Air Conditioning Engineers, Inc.

ANSI/ASHRAE. (2007). *Standard 90.1-2007, Ventilation for Buildings Except Low Rise Residential.* Atlanta, GA. American Society of Heating Refrigeration and Air Conditioning Engineers, Inc.

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

Appendix:
Trace

EQUIPMENT ENERGY CONSUMPTION
By ACADEMIC

Alternative: 1 Proposed

Equipment - Utility	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct
	------- Monthly Consumption -------									
Lights										
Electric (kWh)	13,786.4	12,463.2	14,466.9	13,231.9	14,126.7	7,735.7	7,831.0	8,009.4	13,231.9	14,126.7
Peak (kW)	45.9	45.9	45.9	45.9	45.9	25.5	25.5	25.5	45.9	45.9
Misc. Ld										
Electric (kWh)	49,975.6	45,181.5	52,595.1	47,941.0	51,285.4	25,550.8	25,929.7	26,448.6	47,941.0	51,285.3
Peak (kW)	161.1	161.1	161.1	161.1	161.1	80.5	80.5	80.5	161.1	161.1
Cooling Coil Condensate										
Recoverable Water (1000gal)	0.0	0.0	0.0	0.1	0.6	0.0	0.0	0.0	0.8	0.0
Peak (1000gal/Hr)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Bsu 1: JPA - K12 - Elevator										
Electric (kWh)	582.8	527.3	638.3	555.0	610.5	610.5	555.0	638.3	555.0	610.5
Peak (kW)	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5
Bsu 2: JPA - K12 - Domestic Water										
Gas (therms)	1.4	1.2	1.5	1.3	1.4	1.4	1.3	1.5	1.3	1.4
Peak (therms/Hr)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Cpl 1: District Chilled Water [Sum of dsn coil capacities=283.0 tons]										
District Chilled Water [Clg Nominal Capacity/F.L.Rate=283.0 tons / 313.8 kW] (Cooling Equipment)										
Electric (kWh)	85.6	73.7	21.5	10,312.0	32,388.6	38,124.4	49,297.6	44,487.0	41,290.9	10,934.2
Peak (kW)	2.5	3.1	85.6	104.8	172.9	190.9	225.2	207.1	216.8	110.5
MZ packaged rooftop cond fan [Design Heat Rejection/F.L.Rate=372.2 tons / 31.27 kW]										
Electric (kWh)	10.7	9.2	2.7	1,356.0	4,053.6	4,459.5	5,608.8	5,121.7	5,136.6	1,443.0
Peak (kW)	0.3	0.4	11.4	13.3	20.2	20.6	23.5	21.9	24.4	14.0
JPA - 90.1-10 Var Vol Pump w Min Flow [F.L.Rate=12.45 kW] (Misc Accessory Equipment)										
Electric (kWh)	154.4	92.1	29.9	707.3	1,229.1	1,419.5	1,497.5	1,381.8	1,425.2	620.1
Peak (kW)	2.5	2.5	2.5	2.5	5.3	5.3	6.8	5.9	7.7	2.8
Cntl panel & interlocks - 0.1 KW [F.L.Rate=0.10 kW] (Misc Accessory Equipment)										
Electric (kWh)	6.2	3.7	1.2	28.4	49.1	57.0	57.0	54.9	50.7	24.9
Peak (kW)	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1

Project Name: Montgomery College Student Center
Dataset Name: 6352 - ENERGY-062415.TRC

TRACE® 700 v6.3.2 calculat
Alternative - 1 Equipment Energy C

EQUIPMENT ENERGY CONSUMPTION
By ACADEMIC

Alternative: 1 Proposed

Equipment - Utility	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct
	------- Monthly Consumption -------									
Cpl 1: District Chilled Water [Sum of dsn coil capacities=283.0 tons]										
JPA - Variable Volume Pump 30% Min [F.L.Rate=9.94 kW] (Cooling Plant Circulation Pump)										
Electric (kWh)	154.1	92.0	29.8	705.9	1,220.5	1,416.8	1,419.6	1,364.6	1,315.6	618.9
Peak (kW)	2.5	2.5	2.5	2.5	4.2	4.1	5.4	4.7	6.2	2.5
Cpl 2: No Cooling [Sum of dsn coil capacities=0 tons]										
Hpl 1: Boiler [Sum of dsn coil capacities=2,281 mbh]										
Boiler [Nominal Capacity/F.L.Rate=2,281 mbh / 25.35 Therms] (Heating Equipment)										
Gas (therms)	3,989.9	2,909.7	1,918.7	892.1	7.1	1.1	0.6	0.9	5.1	1,065.4
Peak (therms/Hr)	13.5	12.4	9.6	5.8	0.5	0.1	0.1	0.1	0.4	6.6
JPA - Variable Volume Pump 30% Min [F.L.Rate=14.91 kW] (Misc Accessory Equipment)										
Electric (kWh)	2,776.7	2,505.6	2,658.4	2,356.4	797.9	171.5	78.3	130.5	421.3	2,151.4
Peak (kW)	4.1	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7
Boiler forced draft fan [F.L.Rate=2.28 kW] (Misc Accessory Equipment)										
Electric (kWh)	1,697.6	1,533.3	1,626.9	1,442.1	488.3	105.0	47.9	79.9	257.8	1,316.6
Peak (kW)	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3
Cntl panel & interlocks - 0.5 KW [F.L.Rate=0.50 kW] (Misc Accessory Equipment)										
Electric (kWh)	372.0	336.0	356.5	316.0	107.0	23.0	10.5	17.5	56.5	288.5
Peak (kW)	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Hpl 2: No heat [Sum of dsn coil capacities=0.00 mbh]										
Cntl panel & interlocks - 0.5 KW [F.L.Rate=0.50 kW] (Misc Accessory Equipment)										
Electric (kWh)	305.5	322.0	356.5	339.0	0.0	162.0	217.5	233.0	287.0	197.0
Peak (kW)	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Sys 1: VAV										
JPA - 90.1 VAV Fan [DsnAirflow/F.L.Rate=111,847 cfm / 7.46 kW] (Main Clg Fan)										
Electric (kWh)	1,220.0	1,111.1	1,276.1	1,218.8	1,416.2	974.1	1,009.6	996.6	1,380.9	1,325.7
Peak (kW)	4.4	5.1	5.1	5.8	6.8	4.2	4.2	4.0	7.3	6.7
JPA - 90.1 VAV Fan [DsnAirflow/F.L.Rate=111,847 cfm / 3.73 kW] (Main Return Fan)										
Electric (kWh)	610.0	555.6	638.1	609.4	708.1	487.0	504.8	498.3	690.5	662.9
Peak (kW)	2.2	2.5	2.6	2.9	3.4	2.1	2.1	2.0	3.6	3.3

Project Name: Montgomery College Student Center
Dataset Name: 6352 - ENERGY-062415.TRC

TRACE® 700 v6.3.2 calculate
Alternative - 1 Equipment Energy C

EQUIPMENT ENERGY CONSUMPTION
By ACADEMIC

Alternative: 2 Baseline

Equipment - Utility	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct
	------- Monthly Consumption -------									
Lights										
Electric (kWh)	27,572.8	24,926.4	28,933.8	26,463.9	28,253.3	15,471.4	15,661.9	16,018.8	26,463.9	28,253.3
Peak (kW)	91.9	91.9	91.9	91.9	91.9	50.9	50.9	50.9	91.9	91.9
Misc. Ld										
Electric (kWh)	49,975.6	45,181.5	52,595.1	47,941.0	51,285.4	25,550.8	25,929.7	26,448.6	47,941.0	51,285.3
Peak (kW)	161.1	161.1	161.1	161.1	161.1	80.5	80.5	80.5	161.1	161.1
Cooling Coil Condensate										
Recoverable Water (1000gal)	0.7	0.5	0.5	0.4	0.4	0.1	0.1	0.1	0.7	0.5
Peak (1000gal/Hr)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Bsu 1: JPA - K12 - Elevator										
Electric (kWh)	582.8	527.3	638.3	555.0	610.5	610.5	555.0	638.3	555.0	610.5
Peak (kW)	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5
Bsu 2: JPA - K12 - Domestic Water										
Gas (therms)	1.4	1.2	1.5	1.3	1.4	1.4	1.3	1.5	1.3	1.4
Peak (therms/Hr)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Cpl 1: Chilled Water [Sum of dsn coil capacities=306.0 tons]										
Chilled Water [Clg Nominal Capacity/F.L.Rate=306.0 tons / 219.6 kW] (Cooling Equipment)										
Electric (kWh)	262.1	248.4	528.6	2,227.9	23,425.1	26,866.9	33,984.1	30,944.4	30,926.1	1,990.2
Peak (kW)	1.8	2.0	8.8	74.9	116.2	122.7	144.2	132.3	148.2	77.1
90.1 Min Cooling Tower [Design Heat Rejection/F.L.Rate=368.5 tons / 23.47 kW]										
Electric (kWh)	464.2	417.9	1,082.0	1,343.7	5,270.2	10,011.1	12,104.5	11,748.9	9,497.9	1,213.4
Peak (kW)	2.7	2.8	3.0	12.9	23.5	23.5	23.5	23.5	23.5	14.5
90.1 Min Cooling Tower										
Make Up Water (1000gal)	1.1	1.0	2.2	9.4	106.9	121.6	153.3	140.4	141.4	8.4
Peak (1000gal/Hr)	0.0	0.0	0.0	0.4	0.5	0.6	0.6	0.6	0.7	0.4
90.1-10 Min Var Vol Chilled Water Pump [F.L.Rate=13.47 kW] (Misc Accessory Equipment)										
Electric (kWh)	11.7	11.0	23.9	83.3	670.2	757.1	994.8	893.9	940.4	75.7
Peak (kW)	0.1	0.1	0.3	2.3	4.4	4.4	5.7	4.9	6.4	2.4

Project Name: Montgomery College Student Center
Dataset Name: 6352 - ENERGY-062415.TRC

TRACE® 700 v6.3.2 calculate
Alternative - 2 Equipment Energy C

EQUIPMENT ENERGY CONSUMPTION
By ACADEMIC

Alternative: 2 Baseline

Equipment - Utility	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct
	------- Monthly Consumption -------									
Cpl 1: Chilled Water [Sum of dsn coil capacities=306.0 tons]										
90.1 Min CV Cond Water Pump [F.L.Rate=17.44 kW] (Misc Accessory Equipment)										
Electric (kWh)	3,139.9	2,808.5	7,029.9	7,849.7	8,564.9	8,617.3	9,070.8	8,913.8	8,547.5	7,029.9
Peak (kW)	17.4	17.4	17.4	17.4	17.4	17.4	17.4	17.4	17.4	17.4
Cntl panel & interlocks - 1 KW [F.L.Rate=1 kW] (Misc Accessory Equipment)										
Electric (kWh)	180.0	161.0	403.0	450.0	491.0	494.0	520.0	511.0	490.0	403.0
Peak (kW)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
90.1 Min CV Chilled Water pump [F.L.Rate=0.00 kW] (Cooling Plant Circulation Pump)										
Electric (kWh)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Cpl 2: No Cooling [Sum of dsn coil capacities=0 tons]										
Hpl 1: Boiler [Sum of dsn coil capacities=2,664 mbh]										
Boiler [Nominal Capacity/F.L.Rate=2,664 mbh / 32.49 Therms] (Heating Equipment)										
Gas (therms)	4,565.9	3,389.8	2,264.4	1,051.3	29.0	25.1	24.8	24.1	25.2	1,259.6
Peak (therms/Hr)	13.1	12.1	9.6	5.9	1.8	0.3	0.2	0.2	1.0	7.1
90.1 Min CV Hot Water pump [F.L.Rate=2.02 kW] (Misc Accessory Equipment)										
Electric (kWh)	1,506.3	1,360.6	1,457.7	1,212.8	431.3	380.6	429.2	419.1	390.8	1,320.1
Peak (kW)	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
Make-up water - 5.18e-006 gal/btu (Misc Accessory Equipment)										
Make Up Water (1000gal)	10.3	9.3	9.9	8.3	2.9	2.6	2.9	2.9	2.7	9.0
Peak (1000gal/Hr)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Cntl panel & interlocks - 0.5 KW [F.L.Rate=0.50 kW] (Misc Accessory Equipment)										
Electric (kWh)	372.0	336.0	360.0	299.5	106.5	94.0	106.0	103.5	96.5	326.0
Peak (kW)	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Hpl 2: No Heat [Sum of dsn coil capacities=0.00 mbh]										
Cntl panel & interlocks - 0.5 KW [F.L.Rate=0.50 kW] (Misc Accessory Equipment)										
Electric (kWh)	321.0	336.0	372.0	125.0	51.0	48.0	71.5	55.5	92.5	128.5
Peak (kW)	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Sys 1: Basement										

EQUIPMENT ENERGY CONSUMPTION
By ACADEMIC

Alternative: 2 Baseline

Equipment - Utility	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct
	------- Monthly Consumption -------									
Sys 1: Basement										
90.1-07 Min VAV AF Centrifugal [DsnAirflow/F.L.Rate=6,318 cfm / 6.85 kW (**Orig F.L.Rate=16.17 kW)] (Main Clg Fan)										
Electric (kWh)	1,250.3	1,233.6	1,678.6	1,528.8	1,697.9	690.7	703.6	725.1	1,610.3	1,625.8
Peak (kW)	5.3	6.9	6.9	6.9	6.9	2.6	2.7	2.7	6.9	6.9
Sys 4: First Floor										
90.1-07 Min VAV AF Centrifugal [DsnAirflow/F.L.Rate=24,278 cfm / 25.32 kW (**Orig F.L.Rate=28.19 kW)] (Main Clg Fan)										
Electric (kWh)	3,244.8	2,943.8	3,379.9	3,439.0	3,952.3	3,098.3	3,236.6	3,315.8	4,176.4	3,977.0
Peak (kW)	15.9	20.6	20.7	23.2	22.2	15.8	17.7	19.2	25.3	25.0
Sys 5: Second Floor										
90.1-07 Min VAV AF Centrifugal [DsnAirflow/F.L.Rate=25,278 cfm / 26.36 kW (**Orig F.L.Rate=32.09 kW)] (Main Clg Fan)										
Electric (kWh)	4,079.2	3,742.9	4,494.4	4,924.4	6,102.4	3,653.0	3,766.8	3,545.4	5,583.9	5,039.9
Peak (kW)	14.6	18.2	21.2	26.4	26.4	16.1	16.0	15.8	26.4	23.5
Sys 6: Third Floor										
90.1-07 Min VAV AF Centrifugal [DsnAirflow/F.L.Rate=29,042 cfm / 30.29 kW (**Orig F.L.Rate=34.94 kW)] (Main Clg Fan)										
Electric (kWh)	4,532.2	4,235.3	5,187.2	5,519.5	6,585.1	3,424.9	3,560.9	3,502.4	6,409.6	5,972.2
Peak (kW)	19.6	22.5	25.4	29.6	29.5	15.1	14.7	14.9	30.3	30.3
Sys 7: Fourth Floor										
90.1-07 Min VAV AF Centrifugal [DsnAirflow/F.L.Rate=28,739 cfm / 29.97 kW (**Orig F.L.Rate=33.22 kW)] (Main Clg Fan)										
Electric (kWh)	3,799.2	3,513.5	4,250.5	4,724.3	5,470.0	3,913.3	4,134.7	3,956.6	5,455.7	5,199.4
Peak (kW)	18.5	21.1	27.3	30.0	30.0	21.7	21.6	21.1	30.0	30.0

Project Name: Montgomery College Student Center
Dataset Name: 6352 - ENERGY-062415.TRC

TRACE® 700 v6.3.2 calculate
Alternative - 2 Equipment Energy C

System Checksums

By ACADEMIC

Heating Only

COOLING COIL PEAK					CLG SPACE PEAK		HEATING COIL PEAK			
Peaked at Time:		Mo/Hr: 0 / 0			Mo/Hr: 0 / 0		Mo/Hr: Heating Design			
Outside Air:		OADB/WB/HR: 0 / 0 / 0			OADB: 0		OADB: 10			
	Space Sens. + Lat. Btu/h	Plenum Sens. + Lat Btu/h	Net Total Btu/h	Percent Of Total (%)	Space Sensible Btu/h	Percent Of Total (%)		Space Peak Space Sens Btu/h	Coil Peak Tot Sens Btu/h	Percent Of Total (%)
Envelope Loads							**Envelope Loads**			
Skylite Solar	0	0	0	0	0	0	Skylite Solar	0	0	0.00
Skylite Cond	0	0	0	0	0	0	Skylite Cond	0	0	0.00
Roof Cond	0	0	0	0	0	0	Roof Cond	0	-1,650	3.85
Glass Solar	0	0	0	0	0	0	Glass Solar	0	0	0.00
Glass/Door Cond	0	0	0	0	0	0	Glass/Door Cond	-22,587	-22,587	52.76
Wall Cond	0	0	0	0	0	0	Wall Cond	-4,760	-7,221	16.87
Partition/Door	0		0	0	0	0	Partition/Door	-3,331	-3,331	7.78
Floor	0		0	0	0	0	Floor	-274	-274	0.64
Adjacent Floor	0	0	0	0	0	0	Adjacent Floor	0	0	0
Infiltration	0		0	0	0	0	Infiltration	0	0	0.00
Sub Total ==>	0	0	0	0	0	0	*Sub Total ==>*	-30,952	-35,063	81.90
Internal Loads							**Internal Loads**			
Lights	0	0	0	0	0	0	Lights	0	0	0.00
People	0	0	0	0	0	0	People	0	0	0.00
Misc	0	0	0	0	0	0	Misc	0	0	0.00
Sub Total ==>	0	0	0	0	0	0	*Sub Total ==>*	0	0	0.00
Ceiling Load	0	0	0	0	0	0	**Ceiling Load**	-4,111	0	0.00
Ventilation Load	0	0	0	0	0	0	**Ventilation Load**	0	-284	0.66
Adj Air Trans Heat	0		0	0	0	0	**Adj Air Trans Heat**	0	0	0
Dehumid. Ov Sizing			0	0			**Ov/Undr Sizing**	-7,463	-7,463	17.43
Ov/Undr Sizing	0		0	0	0	0	**Exhaust Heat**		0	0.00
Exhaust Heat		0	0	0			**OA Preheat Diff.**		0	0.00
Sup. Fan Heat			0	0			**RA Preheat Diff.**		0	0.00
Ret. Fan Heat		0	0	0			**Additional Reheat**		0	0.00
Duct Heat Pkup		0	0	0						
Underflr Sup Ht Pkup			0	0			**Underflr Sup Ht Pkup**		0	0.00
Supply Air Leakage		0	0	0			**Supply Air Leakage**		0	0.00
Grand Total ==>	0	0	0	100.00	0	100.00	*Grand Total ==>*	-42,526	-42,809	100.00

COOLING COIL SELECTION

	Total Capacity ton	Total Capacity MBh	Sens Cap. MBh	Coil Airflow cfm	Enter DB °F	Enter WB °F	Enter HR gr/lb	Leave DB °F	Leave WB °F	Leave HR gr/lb
Main Clg	0.0	0.0	0.0	0	0.0	0.0	0.0	0.0	0.0	0.0
Aux Clg	0.0	0.0	0.0	0	0.0	0.0	0.0	0.0	0.0	0.0
Opt Vent	0.0	0.0	0.0	0	0.0	0.0	0.0	0.0	0.0	0.0
Total	0.0	0.0								

AREAS

	Gross Total	Glass ft²	Glass (%)
Floor	12,133		
Part	3,260		
Int Door	0		
ExFlr	204		
Roof	948	0	0
Wall	6,173	3,035	49
Ext Door	0	0	0

HEA

Main Htg
Aux Htg
Preheat
Humidif
Opt Vent
Total

Project Name: Montgomery College Student Center
Dataset Name: 6352 - ENERGY-062415.TRC

TRACE® 700 v6.3.2
Alternative - 1 Sy

System Checksums

By ACADEMIC

Transient

COOLING COIL PEAK

Peaked at Time: Mo/Hr: 10 / 12
Outside Air: OADB/WB/HR: 67 / 58 / 56

	Space Sens. + Lat. Btu/h	Plenum Sens. + Lat Btu/h	Net Total Btu/h	Percent Of Total (%)
Envelope Loads				
Skylite Solar	0	0	0	0
Skylite Cond	0	0	0	0
Roof Cond	0	1,337	1,337	10
Glass Solar	13,605	0	13,605	102
Glass/Door Cond	-2,469	0	-2,469	-18
Wall Cond	-132	-45	-177	-1
Partition/Door	-3,626		-3,626	-27
Floor	0		0	0
Adjacent Floor	0	0	0	0
Infiltration	0		0	0
Sub Total ==>	7,378	1,292	8,670	65
Internal Loads				
Lights	2,596	649	3,244	24
People	0	0	0	0
Misc	410	0	410	3
Sub Total ==>	3,005	649	3,654	27
Ceiling Load	2,151	-2,151	0	0
Ventilation Load	0	0	121	1
Adj Air Trans Heat	0		0	0
Dehumid. Ov Sizing			0	0
Ov/Undr Sizing	1,072		1,072	8
Exhaust Heat		-133	-133	-1
Sup. Fan Heat			0	0
Ret. Fan Heat		0	0	0
Duct Heat Pkup		0	0	0
Underflr Sup Ht Pkup			0	0
Supply Air Leakage		0	0	0
Grand Total ==>	13,606	-343	13,385	100.00

CLG SPACE PEAK

Mo/Hr: Sum of
OADB: Peaks

	Space Sensible Btu/h	Percent Of Total (%)
Envelope Loads		
Skylite Solar	0	0
Skylite Cond	0	0
Roof Cond	0	0
Glass Solar	13,605	97
Glass/Door Cond	-2,469	-18
Wall Cond	-132	-1
Partition/Door	-3,626	-26
Floor	0	0
Adjacent Floor	0	0
Infiltration	0	0
Sub Total ==>	7,378	52
Internal Loads		
Lights	2,719	19
People	0	0
Misc	410	3
Sub Total ==>	3,129	22
Ceiling Load	2,489	18
Ventilation Load	0	0
Adj Air Trans Heat	0	0
Ov/Undr Sizing	1,072	8
Grand Total ==>	14,068	100.00

HEATING COIL PEAK

Mo/Hr: Heating Design
OADB: 10

	Space Peak Space Sens Btu/h	Coil Peak Tot Sens Btu/h	Percent Of Total (%)
Envelope Loads			
Skylite Solar	0	0	0.00
Skylite Cond	0	0	0.00
Roof Cond	0	-492	23.88
Glass Solar	0	0	0.00
Glass/Door Cond	-1,201	-1,201	58.36
Wall Cond	-240	-314	15.24
Partition/Door	917	917	-44.56
Floor	-47	-47	2.27
Adjacent Floor	0	0	0
Infiltration	0	0	0.00
Sub Total ==>	-571	-1,136	55.19
Internal Loads			
Lights	0	0	0.00
People	0	0	0.00
Misc	0	0	0.00
Sub Total ==>	0	0	0.00
Ceiling Load	-551	0	0.00
Ventilation Load	0	-169	8.21
Adj Air Trans Heat	0	0	0
Ov/Undr Sizing	-855	-855	41.53
Exhaust Heat		102	-4.94
OA Preheat Diff.		0	0.00
RA Preheat Diff.		0	0.00
Additional Reheat		0	0.00
Underflr Sup Ht Pkup		0	0.00
Supply Air Leakage		0	0.00
Grand Total ==>	-1,977	-2,059	100.00

COOLING COIL SELECTION

	Total Capacity ton	Total Capacity MBh	Sens Cap. MBh	Coil Airflow cfm	Enter DB °F	Enter WB °F	Enter gr/lb	Leave DB °F	Leave WB °F	Leave gr/lb
Main Clg	0.0	0.0	0.0	0	0.0	0.0	0.0	0.0	0.0	0.0
Aux Clg	0.0	0.0	0.0	0	0.0	0.0	0.0	0.0	0.0	0.0
Opt Vent	0.0	0.0	0.0	0	0.0	0.0	0.0	0.0	0.0	0.0
Total	0.0	0.0								

AREAS

	Gross Total	Glass ft²	Glass (%)
Floor	3,059		
Part	1,200		
Int Door	0		
ExFlr	75		
Roof	514	0	0
Wall	419	172	41
Ext Door	0	0	0

HEA

Main Htg
Aux Htg
Preheat
Humidif
Opt Vent
Total

Project Name: Montgomery College Student Center
Dataset Name: 6352 - ENERGY-062415.TRC

TRACE® 700 v6.3.2
Alternative - 1 Sy

System Checksums

By ACADEMIC

VAV — Variable Volume Ref

COOLING COIL PEAK

Peaked at Time: Mo/Hr: 4 / 12
Outside Air: OADB/WB/HR: 68 / 57 / 52

	Space Sens. + Lat. Btu/h	Plenum Sens. + Lat Btu/h	Net Total Btu/h	Percent Of Total (%)
Envelope Loads				
Skylite Solar	0	0	0	0
Skylite Cond	0	0	0	0
Roof Cond	0	62,857	62,857	4
Glass Solar	551,747	0	551,747	34
Glass/Door Cond	-44,607	0	-44,607	-3
Wall Cond	-760	-877	-1,637	0
Partition/Door	-9,375		-9,375	-1
Floor	0		0	0
Adjacent Floor	0	0	0	0
Infiltration	0		0	0
Sub Total ==>	497,005	61,980	558,985	34
Internal Loads				
Lights	110,473	27,618	138,092	8
People	413,218	0	413,218	25
Misc	549,251	0	549,251	33
Sub Total ==>	1,072,942	27,618	1,100,561	67
Ceiling Load	19,492	-19,492	0	0
Ventilation Load	0	0	-245,330	-15
Adj Air Trans Heat	0		0	0
Dehumid. Ov Sizing			0	0
Ov/Undr Sizing	0		0	0
Exhaust Heat		-45,531	-45,531	-3
Sup. Fan Heat			182,808	11
Ret. Fan Heat		91,404	91,404	6
Duct Heat Pkup		0	0	0
Underflr Sup Ht Pkup			0	0
Supply Air Leakage		0	0	0
Grand Total ==>	1,589,440	115,980	1,642,898	100.00

CLG SPACE PEAK

Mo/Hr: 9 / 12
OADB: 80

	Space Sensible Btu/h	Percent Of Total (%)
Envelope Loads		
Skylite Solar	0	0
Skylite Cond	0	0
Roof Cond	0	0
Glass Solar	600,841	39
Glass/Door Cond	15,675	1
Wall Cond	9,110	1
Partition/Door	-4,296	0
Floor	0	0
Adjacent Floor	0	0
Infiltration	0	0
Sub Total ==>	621,330	41
Internal Loads		
Lights	110,473	7
People	229,498	15
Misc	549,251	36
Sub Total ==>	889,222	58
Ceiling Load	18,436	1
Ventilation Load	0	0
Adj Air Trans Heat	0	0
Ov/Undr Sizing	0	0
Grand Total ==>	1,528,989	100.00

HEATING COIL PEAK

Mo/Hr: Heating Design
OADB: 10

	Space Peak Space Sens Btu/h	Coil Peak Tot Sens Btu/h	Percent Of Total (%)
Envelope Loads			
Skylite Solar	0	0	0.00
Skylite Cond	0	0	0.00
Roof Cond	0	-56,303	2.88
Glass Solar	0	0	0.00
Glass/Door Cond	-300,995	-300,995	15.39
Wall Cond	-49,708	-71,681	3.67
Partition/Door	-10,746	-10,746	0.55
Floor	-709	-709	0.04
Adjacent Floor	0	0	0
Infiltration	0	0	0.00
Sub Total ==>	-362,158	-440,434	22.52
Internal Loads			
Lights	0	0	0.00
People	0	0	0.00
Misc	0	0	0.00
Sub Total ==>	0	0	0.00
Ceiling Load	-32,553	0	0.00
Ventilation Load	0	0	0.00
Adj Air Trans Heat	0	0	0
Ov/Undr Sizing	0	0	0.00
Exhaust Heat		43,027	-2.20
OA Preheat Diff.		-1,175,444	60.11
RA Preheat Diff.		-44,927	2.30
Additional Reheat		-337,778	17.27
Underflr Sup Ht Pkup		0	0.00
Supply Air Leakage		0	0.00
Grand Total ==>	-394,711	-1,955,557	100.00

COOLING COIL SELECTION

	Total Capacity ton	Total Capacity MBh	Sens Cap. MBh	Coil Airflow cfm	Enter DB °F	Enter WB °F	Enter HR gr/lb	Leave DB °F	Leave WB °F	Leave HR gr/lb
Main Clg	136.9	1,642.9	1,606.6	102,829	76.1	62.5	62.2	61.3	57.1	62.2
Aux Clg	0.0	0.0	0.0	0	0.0	0.0	0.0	0.0	0.0	0.0
Opt Vent	146.1	1,753.0	832.8	17,397	92.5	78.8	126.1	50.0	49.9	52.9
Total	283.0	3,395.9								

AREAS

	Gross Total ft²	Glass ft²	Glass (%)
Floor	103,825		
Part	7,528		
Int Door	0		
ExFlr	471		
Roof	24,456	0	0
Wall	40,074	17,240	43
Ext Door	0	0	0

HEA

Main Htg
Aux Htg
Preheat
Reheat
Humidif
Opt Vent
Total

Project Name: Montgomery College Student Center
Dataset Name: 6352 - ENERGY-062415.TRC

TRACE® 700 v6.3.2
Alternative - 1 Sy

System Checksums

By ACADEMIC

Basement — **System 7 - 2007 - Packaged RTU VAV Reh**

COOLING COIL PEAK

Peaked at Time: Mo/Hr: 4 / 16
Outside Air: OADB/WB/HR: 72 / 59 / 52

	Space Sens. + Lat. Btu/h	Plenum Sens. + Lat Btu/h	Net Total Btu/h	Percent Of Total (%)
Envelope Loads				
Skylite Solar	0	0	0	0
Skylite Cond	0	0	0	0
Roof Cond	0	0	0	0
Glass Solar	0	0	0	0
Glass/Door Cond	0	0	0	0
Wall Cond	0	0	0	0
Partition/Door	-9,375		-9,375	-7
Floor	0		0	0
Adjacent Floor	0	0	0	0
Infiltration	0		0	0
Sub Total ==>	-9,375	0	-9,375	-7
Internal Loads				
Lights	39,290	9,822	49,112	36
People	41,918	0	41,918	31
Misc	79,957	0	79,957	59
Sub Total ==>	161,164	9,822	170,987	126
Ceiling Load	4,128	-4,128	0	0
Ventilation Load	0	0	-15,741	-12
Adj Air Trans Heat	0		0	0
Dehumid. Ov Sizing			0	0
Ov/Undr Sizing	0		0	0
Exhaust Heat		-14,994	-14,994	-11
Sup. Fan Heat			4,516	3
Ret. Fan Heat		0	0	0
Duct Heat Pkup		0	0	0
Underflr Sup Ht Pkup			0	0
Supply Air Leakage		0	0	0
Grand Total ==>	155,917	-9,300	135,392	100.00

CLG SPACE PEAK

Mo/Hr: 9 / 16
OADB: 84

	Space Sensible Btu/h	Percent Of Total (%)
Envelope Loads		
Skylite Solar	0	0
Skylite Cond	0	0
Roof Cond	0	0
Glass Solar	0	0
Glass/Door Cond	0	0
Wall Cond	0	0
Partition/Door	-4,296	-3
Floor	0	0
Adjacent Floor	0	0
Infiltration	0	0
Sub Total ==>	-4,296	-3
Internal Loads		
Lights	39,290	28
People	23,288	16
Misc	79,957	56
Sub Total ==>	142,534	100
Ceiling Load	4,053	3
Ventilation Load	0	0
Adj Air Trans Heat	0	0
Dehumid. Ov Sizing		
Ov/Undr Sizing	0	0
Exhaust Heat		
Sup. Fan Heat		
Ret. Fan Heat		
Duct Heat Pkup		
Underflr Sup Ht Pkup		
Supply Air Leakage		
Grand Total ==>	142,292	100.00

HEATING COIL PEAK

Mo/Hr: Heating Design
OADB: 10

	Space Peak Space Sens Btu/h	Coil Peak Tot Sens Btu/h	Percent Of Total (%)
Envelope Loads			
Skylite Solar	0	0	0.00
Skylite Cond	0	0	0.00
Roof Cond	0	0	0.00
Glass Solar	0	0	0.00
Glass/Door Cond	0	0	0.00
Wall Cond	0	0	0.00
Partition/Door	-10,746	-10,746	4.73
Floor	-709	-709	0.31
Adjacent Floor	0	0	0
Infiltration	0	0	0.00
Sub Total ==>	-11,455	-11,455	5.05
Internal Loads			
Lights	0	0	0.00
People	0	0	0.00
Misc	0	0	0.00
Sub Total ==>	0	0	0.00
Ceiling Load	0	0	0.00
Ventilation Load	0	0	0.00
Adj Air Trans Heat	0	0	0
Ov/Undr Sizing	0	0	0.00
Exhaust Heat		7,968	-3.51
OA Preheat Diff.		-166,428	73.32
RA Preheat Diff.		-27,145	11.96
Additional Reheat		-29,916	13.18
Underflr Sup Ht Pkup		0	0.00
Supply Air Leakage		0	0.00
Grand Total ==>	-11,455	-226,976	100.00

COOLING COIL SELECTION

	Total Capacity ton	Total Capacity MBh	Sens Cap. MBh	Coil Airflow cfm	Enter DB °F	Enter WB °F	Enter HR gr/lb	Leave DB °F	Leave WB °F	Leave HR gr/lb
Main Clg	13.0	155.7	123.6	6,096	76.9	61.2	54.7	54.3	52.2	54.4
Aux Clg	0.0	0.0	0.0	0	0.0	0.0	0.0	0.0	0.0	0.0
Opt Vent	20.7	248.2	117.9	2,463	92.5	78.8	126.1	50.0	49.9	52.9
Total	33.7	403.9								

AREAS

	Gross Total	Glass ft²	Glass (%)	
Floor	17,965			**Main Htg**
Part	7,528			**Aux Htg**
Int Door	0			**Preheat**
ExFlr	471			**Reheat**
Roof	0	0	0	**Humidif**
Wall	0	0	0	**Opt Vent**
Ext Door	0	0	0	*Total*

HEA

Project Name: Montgomery College Student Center
Dataset Name: 6352 - ENERGY-062415.TRC

TRACE® 700 v6.3.2
Alternative - 2 Sy

System Checksums

By ACADEMIC

First Floor — **System 7 - 2007 - Packaged RTU VAV Reh**

COOLING COIL PEAK

Peaked at Time: Mo/Hr: 4 / 11
Outside Air: OADB/WB/HR: 65 / 56 / 51

	Space Sens. + Lat. Btu/h	Plenum Sens. + Lat Btu/h	Net Total Btu/h	Percent Of Total (%)
Envelope Loads				
Skylite Solar	0	0	0	0
Skylite Cond	0	0	0	0
Roof Cond	0	753	753	0
Glass Solar	170,633	0	170,633	52
Glass/Door Cond	-15,861	0	-15,861	-5
Wall Cond	577	204	781	0
Partition/Door	0		0	0
Floor	0		0	0
Adjacent Floor	0	0	0	0
Infiltration	0		0	0
Sub Total ==>	155,349	957	156,306	48
Internal Loads				
Lights	45,772	11,443	57,215	17
People	70,453	0	70,453	21
Misc	72,928	0	72,928	22
Sub Total ==>	189,153	11,443	200,596	61
Ceiling Load	2,768	-2,768	0	0
Ventilation Load	0	0	-42,118	-13
Adj Air Trans Heat	0		0	0
Dehumid. Ov Sizing			0	0
Ov/Undr Sizing	0		0	0
Exhaust Heat		-2,046	-2,046	-1
Sup. Fan Heat			16,288	5
Ret. Fan Heat		0	0	0
Duct Heat Pkup		0	0	0
Underflr Sup Ht Pkup			0	0
Supply Air Leakage		0	0	0
Grand Total ==>	347,270	7,586	329,026	100.00

CLG SPACE PEAK

Mo/Hr: 9 / 11
OADB: 78

	Space Sensible Btu/h	Percent Of Total (%)
Envelope Loads		
Skylite Solar	0	0
Skylite Cond	0	0
Roof Cond	0	0
Glass Solar	182,839	52
Glass/Door Cond	1,424	0
Wall Cond	3,807	1
Partition/Door	0	0
Floor	0	0
Adjacent Floor	0	0
Infiltration	0	0
Sub Total ==>	188,070	54
Internal Loads		
Lights	45,772	13
People	39,133	11
Misc	72,928	21
Sub Total ==>	157,833	45
Ceiling Load	2,957	1
Ventilation Load	0	0
Adj Air Trans Heat	0	0
Dehumid. Ov Sizing		
Ov/Undr Sizing	0	0
Exhaust Heat		
Sup. Fan Heat		
Ret. Fan Heat		
Duct Heat Pkup		
Underflr Sup Ht Pkup		
Supply Air Leakage		
Grand Total ==>	348,860	100.00

HEATING COIL PEAK

Mo/Hr: Heating Design
OADB: 10

	Space Peak Space Sens Btu/h	Coil Peak Tot Sens Btu/h	Percent Of Total (%)
Envelope Loads			
Skylite Solar	0	0	0.00
Skylite Cond	0	0	0.00
Roof Cond	0	-2,661	0.70
Glass Solar	0	0	0.00
Glass/Door Cond	-84,997	-84,997	22.45
Wall Cond	-16,292	-22,641	5.98
Partition/Door	0	0	0.00
Floor	0	0	0.00
Adjacent Floor	0	0	0
Infiltration	0	0	0.00
Sub Total ==>	-101,288	-110,299	29.13
Internal Loads			
Lights	0	0	0.00
People	0	0	0.00
Misc	0	0	0.00
Sub Total ==>	0	0	0.00
Ceiling Load	-3,838	0	0.00
Ventilation Load	0	0	0.00
Adj Air Trans Heat	0	0	0
Ov/Undr Sizing	0	0	0.00
Exhaust Heat		3,521	-0.93
OA Preheat Diff.		-193,927	51.22
RA Preheat Diff.		-4,031	1.06
Additional Reheat		-73,857	19.51
Underflr Sup Ht Pkup		0	0.00
Supply Air Leakage		0	0.00
Grand Total ==>	-105,126	-378,593	100.00

COOLING COIL SELECTION

	Total Capacity ton	Total Capacity MBh	Sens Cap. MBh	Coil Airflow cfm	Enter DB °F	Enter WB °F	Enter HR gr/lb	Leave DB °F	Leave WB °F	Leave HR gr/lb
Main Clg	31.5	378.4	323.7	21,988	74.9	62.2	62.5	61.6	56.5	59.4
Aux Clg	0.0	0.0	0.0	0	0.0	0.0	0.0	0.0	0.0	0.0
Opt Vent	24.1	289.2	137.4	2,870	92.5	78.8	126.1	50.0	49.9	52.9
Total	55.6	667.6								

AREAS

	Gross Total	Glass ft²	Glass (%)
Floor	22,538		
Part	0		
Int Door	0		
ExFlr	0		
Roof	1,130	0	0
Wall	9,639	3,711	39
Ext Door	0	0	0

HEA

Main Htg
Aux Htg
Preheat
Reheat
Humidif
Opt Vent
Total

Project Name: Montgomery College Student Center
Dataset Name: 6352 - ENERGY-062415.TRC

TRACE® 700 v6.3.2
Alternative - 2 Sy

System Checksums

By ACADEMIC

Fourth Floor — **System 7 - 2007 - Packaged RTU VAV Reh**

COOLING COIL PEAK

Peaked at Time: Mo/Hr: 4 / 16
Outside Air: OADB/WB/HR: 72 / 59 / 52

	Space Sens. + Lat. Btu/h	Plenum Sens. + Lat Btu/h	Net Total Btu/h	Percent Of Total (%)
Envelope Loads				
Skylite Solar	0	0	0	0
Skylite Cond	0	0	0	0
Roof Cond	0	27,342	27,342	6
Glass Solar	187,432	0	187,432	43
Glass/Door Cond	-6,110	0	-6,110	-1
Wall Cond	3,190	1,744	4,934	1
Partition/Door	0		0	0
Floor	0		0	0
Adjacent Floor	0	0	0	0
Infiltration	0		0	0
Sub Total ==>	184,512	29,086	213,598	50
Internal Loads				
Lights	45,224	11,306	56,531	13
People	120,322	0	120,322	28
Misc	87,491	0	87,491	20
Sub Total ==>	253,038	11,306	264,344	61
Ceiling Load	7,288	-7,288	0	0
Ventilation Load	0	0	-59,032	-14
Adj Air Trans Heat	0		0	0
Dehumid. Ov Sizing			0	0
Ov/Undr Sizing	0		0	0
Exhaust Heat		-7,231	-7,231	-2
Sup. Fan Heat			19,300	4
Ret. Fan Heat		0	0	0
Duct Heat Pkup		0	0	0
Underflr Sup Ht Pkup			0	0
Supply Air Leakage		0	0	0
Grand Total ==>	444,838	25,873	430,979	100.00

CLG SPACE PEAK

Mo/Hr: 9 / 16
OADB: 84

	Space Sensible Btu/h	Percent Of Total (%)
Envelope Loads		
Skylite Solar	0	0
Skylite Cond	0	0
Roof Cond	0	0
Glass Solar	198,683	46
Glass/Door Cond	17,316	4
Wall Cond	7,330	2
Partition/Door	0	0
Floor	0	0
Adjacent Floor	0	0
Infiltration	0	0
Sub Total ==>	223,330	52
Internal Loads		
Lights	45,224	10
People	66,832	15
Misc	87,491	20
Sub Total ==>	199,548	46
Ceiling Load	8,812	2
Ventilation Load	0	0
Adj Air Trans Heat	0	0
Ov/Undr Sizing	0	0
Grand Total ==>	431,689	100.00

HEATING COIL PEAK

Mo/Hr: Heating Design
OADB: 10

	Space Peak Space Sens Btu/h	Coil Peak Tot Sens Btu/h	Percent Of Total (%)
Envelope Loads			
Skylite Solar	0	0	0.00
Skylite Cond	0	0	0.00
Roof Cond	0	-47,004	7.95
Glass Solar	0	0	0.00
Glass/Door Cond	-122,699	-122,699	20.74
Wall Cond	-12,355	-19,054	3.22
Partition/Door	0	0	0.00
Floor	0	0	0.00
Adjacent Floor	0	0	0
Infiltration	0	0	0.00
Sub Total ==>	-135,055	-188,758	31.91
Internal Loads			
Lights	0	0	0.00
People	0	0	0.00
Misc	0	0	0.00
Sub Total ==>	0	0	0.00
Ceiling Load	-18,921	0	0.00
Ventilation Load	0	0	0.00
Adj Air Trans Heat	0	0	0
Ov/Undr Sizing	0	0	0.00
Exhaust Heat		18,652	-3.15
OA Preheat Diff.		-331,742	56.08
RA Preheat Diff.		-4,268	0.72
Additional Reheat		-85,477	14.45
Underflr Sup Ht Pkup		0	0.00
Supply Air Leakage		0	0.00
Grand Total ==>	-153,975	-591,593	100.00

COOLING COIL SELECTION

	Total Capacity ton	Total Capacity MBh	Sens Cap. MBh	Coil Airflow cfm	Enter DB °F	Enter WB °F	Enter HR gr/lb	Leave DB °F	Leave WB °F	Leave HR gr/lb
Main Clg	41.3	495.6	418.8	26,054	75.5	62.3	62.0	61.0	55.9	58.1
Aux Clg	0.0	0.0	0.0	0	0.0	0.0	0.0	0.0	0.0	0.0
Opt Vent	41.2	494.7	235.0	4,910	92.5	78.8	126.1	50.0	49.9	52.9
Total	82.5	990.4								

AREAS

	Gross Total ft²	Glass ft²	Glass (%)
Floor	20,830		
Part	0		
Int Door	0		
ExFlr	0		
Roof	20,830	0	0
Wall	10,430	5,358	51
Ext Door	0	0	0

HEA

Main Htg
Aux Htg
Preheat
Reheat
Humidif
Opt Vent
Total

Project Name: Montgomery College Student Center
Dataset Name: 6352 - ENERGY-062415.TRC

TRACE® 700 v6.3.2
Alternative - 2 Sy

System Checksums

By ACADEMIC

Heating Only

COOLING COIL PEAK					CLG SPACE PEAK		HEATING COIL PEAK			
Peaked at Time:		Mo/Hr: 0 / 0			Mo/Hr: 0 / 0		Mo/Hr: Heating Design			
Outside Air:		OADB/WB/HR: 0 / 0 / 0			OADB: 0		OADB: 10			
	Space Sens. + Lat. Btu/h	Plenum Sens. + Lat Btu/h	Net Total Btu/h	Percent Of Total (%)	Space Sensible Btu/h	Percent Of Total (%)		Space Peak Space Sens Btu/h	Coil Peak Tot Sens Btu/h	Percent Of Total (%)
Envelope Loads							**Envelope Loads**			
Skylite Solar	0	0	0	0	0	0	Skylite Solar	0	0	0.00
Skylite Cond	0	0	0	0	0	0	Skylite Cond	0	0	0.00
Roof Cond	0	0	0	0	0	0	Roof Cond	0	-1,645	3.35
Glass Solar	0	0	0	0	0	0	Glass Solar	0	0	0.00
Glass/Door Cond	0	0	0	0	0	0	Glass/Door Cond	-29,628	-29,628	60.41
Wall Cond	0	0	0	0	0	0	Wall Cond	-5,748	-8,711	17.76
Partition/Door	0		0	0	0	0	Partition/Door	-3,331	-3,331	6.79
Floor	0		0	0	0	0	Floor	-274	-274	0.56
Adjacent Floor	0	0	0	0	0	0	Adjacent Floor	0	0	0
Infiltration	0		0	0	0	0	Infiltration	0	0	0.00
Sub Total ==>	0	0	0	0	0	0	*Sub Total* ==>	-38,981	-43,589	88.88
Internal Loads							**Internal Loads**			
Lights	0	0	0	0	0	0	Lights	0	0	0.00
People	0	0	0	0	0	0	People	0	0	0.00
Misc	0	0	0	0	0	0	Misc	0	0	0.00
Sub Total ==>	0	0	0	0	0	0	*Sub Total* ==>	0	0	0.00
Ceiling Load	0	0	0	0	0	0	**Ceiling Load**	-4,608	0	0.00
Ventilation Load	0	0	0	0	0	0	**Ventilation Load**	0	-284	0.58
Adj Air Trans Heat	0		0	0	0	0	**Adj Air Trans Heat**	0	0	0
Dehumid. Ov Sizing			0	0			**Ov/Undr Sizing**	-5,170	-5,170	10.54
Ov/Undr Sizing	0		0	0	0	0	**Exhaust Heat**		0	0.00
Exhaust Heat		0	0	0			**OA Preheat Diff.**		0	0.00
Sup. Fan Heat			0	0			**RA Preheat Diff.**		0	0.00
Ret. Fan Heat		0	0	0			**Additional Reheat**		0	0.00
Duct Heat Pkup		0	0	0						
Underflr Sup Ht Pkup			0	0			**Underflr Sup Ht Pkup**		0	0.00
Supply Air Leakage		0	0	0			**Supply Air Leakage**		0	0.00
Grand Total ==>	0	0	0	100.00	0	100.00	*Grand Total* ==>	-48,759	-49,043	100.00

COOLING COIL SELECTION	Total Capacity ton	Total Capacity MBh	Sens Cap. MBh	Coil Airflow cfm	Enter DB °F	Enter WB °F	Enter HR gr/lb	Leave DB °F	Leave WB °F	Leave HR gr/lb
Main Clg	0.0	0.0	0.0	0	0.0	0.0	0.0	0.0	0.0	0.0
Aux Clg	0.0	0.0	0.0	0	0.0	0.0	0.0	0.0	0.0	0.0
Opt Vent	0.0	0.0	0.0	0	0.0	0.0	0.0	0.0	0.0	0.0
Total	0.0	0.0								

AREAS	Gross Total	Glass ft²	Glass (%)
Floor	12,133		
Part	3,260		
Int Door	0		
ExFlr	204		
Roof	948	0	0
Wall	6,173	3,035	49
Ext Door	0	0	0

HEA
Main Htg
Aux Htg
Preheat
Humidif
Opt Vent
Total

Project Name: Montgomery College Student Center
Dataset Name: 6352 - ENERGY-062415.TRC

TRACE® 700 v6.3.2
Alternative - 2 Sy

System Checksums

By ACADEMIC

Second Floor — **System 7 - 2007 - Packaged RTU VAV Reh**

COOLING COIL PEAK					CLG SPACE PEAK		HEATING COIL PEAK			
Peaked at Time:	Mo/Hr: 4 / 11				Mo/Hr: 9 / 11		Mo/Hr: Heating Design			
Outside Air:	OADB/WB/HR: 65 / 56 / 51				OADB: 78		OADB: 10			
	Space Sens. + Lat. Btu/h	Plenum Sens. + Lat Btu/h	Net Total Btu/h	Percent Of Total (%)	Space Sensible Btu/h	Percent Of Total (%)		Space Peak Space Sens Btu/h	Coil Peak Tot Sens Btu/h	Percent Of Total (%)
Envelope Loads							**Envelope Loads**			
Skylite Solar	0	0	0	0	0	0	Skylite Solar	0	0	0.00
Skylite Cond	0	0	0	0	0	0	Skylite Cond	0	0	0.00
Roof Cond	0	1,686	1,686	0	0	0	Roof Cond	0	-5,876	1.30
Glass Solar	137,764	0	137,764	37	133,315	36	Glass Solar	0	0	0.00
Glass/Door Cond	-18,555	0	-18,555	-5	1,689	0	Glass/Door Cond	-99,550	-99,550	22.02
Wall Cond	561	276	837	0	3,558	1	Wall Cond	-14,638	-21,371	4.73
Partition/Door	0		0	0	0	0	Partition/Door	0	0	0.00
Floor	0		0	0	0	0	Floor	0	0	0.00
Adjacent Floor	0	0	0	0	0	0	Adjacent Floor	0	0	0
Infiltration	0		0	0	0	0	Infiltration	0	0	0.00
Sub Total ==>	119,769	1,962	121,731	33	138,562	37	*Sub Total ==>*	-114,187	-126,797	28.05
Internal Loads							**Internal Loads**			
Lights	47,608	11,902	59,510	16	47,608	13	Lights	0	0	0.00
People	89,303	0	89,303	24	49,613	13	People	0	0	0.00
Misc	135,573	0	135,573	37	135,573	36	Misc	0	0	0.00
Sub Total ==>	272,483	11,902	284,385	77	232,793	62	*Sub Total ==>*	0	0	0.00
Ceiling Load	2,829	-2,829	0	0	3,193	1	**Ceiling Load**	-4,893	0	0.00
Ventilation Load	0	0	-51,587	-14	0	0	**Ventilation Load**	0	0	0.00
Adj Air Trans Heat	0		0	0	0	0	**Adj Air Trans Heat**	0	0	0
Dehumid. Ov Sizing			0	0			**Ov/Undr Sizing**	0	0	0.00
Ov/Undr Sizing	0		0	0	0	0	**Exhaust Heat**		4,448	-0.98
Exhaust Heat		-1,608	-1,608	0			**OA Preheat Diff.**		-237,852	52.61
Sup. Fan Heat			17,767	5			**RA Preheat Diff.**		-2,988	0.66
Ret. Fan Heat		0	0	0			**Additional Reheat**		-88,876	19.66
Duct Heat Pkup		0	0	0						
Underflr Sup Ht Pkup			0	0			**Underflr Sup Ht Pkup**		0	0.00
Supply Air Leakage		0	0	0			**Supply Air Leakage**		0	0.00
Grand Total ==>	395,081	9,427	370,688	100.00	374,549	100.00	***Grand Total ==>***	-119,081	-452,065	100.00

COOLING COIL SELECTION

	Total Capacity ton	Total Capacity MBh	Sens Cap. MBh	Coil Airflow cfm	Enter DB °F	Enter WB °F	Enter HR gr/lb	Leave DB °F	Leave WB °F	Leave HR gr/lb
Main Clg	35.5	426.3	362.8	23,986	74.6	62.0	62.3	61.2	56.1	58.6
Aux Clg	0.0	0.0	0.0	0	0.0	0.0	0.0	0.0	0.0	0.0
Opt Vent	29.6	354.7	168.5	3,520	92.5	78.8	126.1	50.0	49.9	52.9
Total	65.1	781.0								

AREAS

	Gross Total	Glass ft²	Glass (%)
Floor	22,004		
Part	0		
Int Door	0		
ExFlr	0		
Roof	2,496	0	0
Wall	9,946	4,347	44
Ext Door	0	0	0

HEA

Main Htg
Aux Htg
Preheat
Reheat
Humidif
Opt Vent
Total

Project Name: Montgomery College Student Center
Dataset Name: 6352 - ENERGY-062415.TRC

TRACE® 700 v6.3.2
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System Checksums

By ACADEMIC

Third Floor — **System 7 - 2007 - Packaged RTU VAV Reh**

COOLING COIL PEAK

Peaked at Time: Mo/Hr: 4 / 12
Outside Air: OADB/WB/HR: 68 / 57 / 52

	Space Sens. + Lat. Btu/h	Plenum Sens. + Lat Btu/h	Net Total Btu/h	Percent Of Total (%)
Envelope Loads				
Skylite Solar	0	0	0	0
Skylite Cond	0	0	0	0
Roof Cond	0	0	0	0
Glass Solar	126,771	0	126,771	31
Glass/Door Cond	-12,187	0	-12,187	-3
Wall Cond	2,458	1,006	3,464	1
Partition/Door	0		0	0
Floor	0		0	0
Adjacent Floor	0	0	0	0
Infiltration	0		0	0
Sub Total ==>	117,042	1,006	118,048	29
Internal Loads				
Lights	43,113	10,778	53,891	13
People	91,328	0	91,328	23
Misc	173,494	0	173,494	43
Sub Total ==>	307,934	10,778	318,713	79
Ceiling Load	2,102	-2,102	0	0
Ventilation Load	0	0	-51,321	-13
Adj Air Trans Heat	0		0	0
Dehumid. Ov Sizing			0	0
Ov/Undr Sizing	0		0	0
Exhaust Heat		-2,118	-2,118	-1
Sup. Fan Heat			19,645	5
Ret. Fan Heat		0	0	0
Duct Heat Pkup		0	0	0
Underflr Sup Ht Pkup			0	0
Supply Air Leakage		0	0	0
Grand Total ==>	427,078	7,565	402,967	100.00

CLG SPACE PEAK

Mo/Hr: 9 / 12
OADB: 80

	Space Sensible Btu/h	Percent Of Total (%)
Envelope Loads		
Skylite Solar	0	0
Skylite Cond	0	0
Roof Cond	0	0
Glass Solar	142,094	34
Glass/Door Cond	5,068	1
Wall Cond	6,484	2
Partition/Door	0	0
Floor	0	0
Adjacent Floor	0	0
Infiltration	0	0
Sub Total ==>	153,646	36
Internal Loads		
Lights	43,113	10
People	50,738	12
Misc	173,494	41
Sub Total ==>	267,344	63
Ceiling Load	2,248	1
Ventilation Load	0	0
Adj Air Trans Heat	0	0
Ov/Undr Sizing	0	0
Grand Total ==>	423,239	100.00

HEATING COIL PEAK

Mo/Hr: Heating Design
OADB: 10

	Space Peak Space Sens Btu/h	Coil Peak Tot Sens Btu/h	Percent Of Total (%)
Envelope Loads			
Skylite Solar	0	0	0.00
Skylite Cond	0	0	0.00
Roof Cond	0	0	0.00
Glass Solar	0	0	0.00
Glass/Door Cond	-87,580	-87,580	19.43
Wall Cond	-16,740	-23,819	5.28
Partition/Door	0	0	0.00
Floor	0	0	0.00
Adjacent Floor	0	0	0
Infiltration	0	0	0.00
Sub Total ==>	-104,321	-111,399	24.71
Internal Loads			
Lights	0	0	0.00
People	0	0	0.00
Misc	0	0	0.00
Sub Total ==>	0	0	0.00
Ceiling Load	-2,506	0	0.00
Ventilation Load	0	0	0.00
Adj Air Trans Heat	0	0	0
Ov/Undr Sizing	0	0	0.00
Exhaust Heat		4,041	-0.90
OA Preheat Diff.		-245,496	54.46
RA Preheat Diff.		-4,008	0.89
Additional Reheat		-93,945	20.84
Underflr Sup Ht Pkup		0	0.00
Supply Air Leakage		0	0.00
Grand Total ==>	-106,826	-450,809	100.00

COOLING COIL SELECTION

	Total Capacity ton	Total Capacity MBh	Sens Cap. MBh	Coil Airflow cfm	Enter DB °F	Enter WB °F	Enter HR gr/lb	Leave DB °F	Leave WB °F	Leave HR gr/lb
Main Clg	38.6	463.4	393.2	26,520	74.8	62.2	62.6	61.4	56.4	59.2
Aux Clg	0.0	0.0	0.0	0	0.0	0.0	0.0	0.0	0.0	0.0
Opt Vent	30.5	366.1	173.9	3,633	92.5	78.8	126.1	50.0	49.9	52.9
Total	69.1	829.5								

AREAS

	Gross Total	Glass ft²	Glass (%)
Floor	20,489		
Part	0		
Int Door	0		
ExFlr	0		
Roof	0	0	0
Wall	10,059	3,824	38
Ext Door	0	0	0

HEA

Main Htg
Aux Htg
Preheat
Reheat
Humidif
Opt Vent
Total

Project Name: Montgomery College Student Center
Dataset Name: 6352 - ENERGY-062415.TRC

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System Checksums

By ACADEMIC

Transient

COOLING COIL PEAK

Peaked at Time: Mo/Hr: 10 / 12
Outside Air: OADB/WB/HR: 67 / 58 / 56

	Space Sens. + Lat. Btu/h	Plenum Sens. + Lat Btu/h	Net Total Btu/h	Percent Of Total (%)
Envelope Loads				
Skylite Solar	0	0	0	0
Skylite Cond	0	0	0	0
Roof Cond	0	332	332	2
Glass Solar	14,494	0	14,494	89
Glass/Door Cond	-3,139	0	-3,139	-19
Wall Cond	-161	-48	-208	-1
Partition/Door	-3,918		-3,918	-24
Floor	0		0	0
Adjacent Floor	0	0	0	0
Infiltration	0		0	0
Sub Total ==>	7,277	284	7,561	47
Internal Loads				
Lights	5,504	1,376	6,879	42
People	0	0	0	0
Misc	410	0	410	3
Sub Total ==>	5,913	1,376	7,289	45
Ceiling Load	1,315	-1,315	0	0
Ventilation Load	0	0	126	1
Adj Air Trans Heat	0		0	0
Dehumid. Ov Sizing			0	0
Ov/Undr Sizing	1,382		1,382	9
Exhaust Heat		-130	-130	-1
Sup. Fan Heat			0	0
Ret. Fan Heat		0	0	0
Duct Heat Pkup		0	0	0
Underflr Sup Ht Pkup			0	0
Supply Air Leakage		0	0	0
Grand Total ==>	15,886	215	16,227	100.00

CLG SPACE PEAK

Mo/Hr: Sum of
OADB: Peaks

	Space Sensible Btu/h	Percent Of Total (%)
Envelope Loads		
Skylite Solar	0	0
Skylite Cond	0	0
Roof Cond	0	0
Glass Solar	14,961	92
Glass/Door Cond	-3,529	-22
Wall Cond	-161	-1
Partition/Door	-3,918	-24
Floor	0	0
Adjacent Floor	0	0
Infiltration	0	0
Sub Total ==>	7,354	45
Internal Loads		
Lights	5,764	36
People	0	0
Misc	410	3
Sub Total ==>	6,174	38
Ceiling Load	1,266	8
Ventilation Load	0	0
Adj Air Trans Heat	0	0
Ov/Undr Sizing	1,382	9
Exhaust Heat		
OA Preheat Diff.		
RA Preheat Diff.		
Additional Reheat		
Underflr Sup Ht Pkup		
Supply Air Leakage		
Grand Total ==>	16,176	100.00

HEATING COIL PEAK

Mo/Hr: Heating Design
OADB: 10

	Space Peak Space Sens Btu/h	Coil Peak Tot Sens Btu/h	Percent Of Total (%)
Envelope Loads			
Skylite Solar	0	0	0.00
Skylite Cond	0	0	0.00
Roof Cond	0	-491	19.69
Glass Solar	0	0	0.00
Glass/Door Cond	-1,576	-1,576	63.15
Wall Cond	-290	-379	15.18
Partition/Door	917	917	-36.76
Floor	-47	-47	1.88
Adjacent Floor	0	0	0
Infiltration	0	0	0.00
Sub Total ==>	-996	-1,576	63.14
Internal Loads			
Lights	0	0	0.00
People	0	0	0.00
Misc	0	0	0.00
Sub Total ==>	0	0	0.00
Ceiling Load	-563	0	0.00
Ventilation Load	0	-169	6.77
Adj Air Trans Heat	0	0	0
Ov/Undr Sizing	-853	-853	34.16
Exhaust Heat		102	-4.08
OA Preheat Diff.		0	0.00
RA Preheat Diff.		0	0.00
Additional Reheat		0	0.00
Underflr Sup Ht Pkup		0	0.00
Supply Air Leakage		0	0.00
Grand Total ==>	-2,411	-2,496	100.00

COOLING COIL SELECTION

	Total Capacity ton	Total Capacity MBh	Sens Cap. MBh	Coil Airflow cfm	Enter DB °F	Enter WB °F	Enter HR gr/lb	Leave DB °F	Leave WB °F	Leave HR gr/lb
Main Clg	0.0	0.0	0.0	0	0.0	0.0	0.0	0.0	0.0	0.0
Aux Clg	0.0	0.0	0.0	0	0.0	0.0	0.0	0.0	0.0	0.0
Opt Vent	0.0	0.0	0.0	0	0.0	0.0	0.0	0.0	0.0	0.0
Total	0.0	0.0								

AREAS

	Gross Total	Glass ft²	Glass (%)
Floor	3,059		
Part	1,200		
Int Door	0		
ExFlr	75		
Roof	514	0	0
Wall	419	172	41
Ext Door	0	0	0

HEA

Main Htg
Aux Htg
Preheat
Humidif
Opt Vent
Total

Project Name: Montgomery College Student Center
Dataset Name: 6352 - ENERGY-062415.TRC

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Emission Factors for On-Site Combustion in a Commercial Boiler

Source: National Renewable Energy Laboratory (2007)

Table 8 Emission Factors for On-Site Combustion in a Commercial Boiler (lb of pollutant per unit of fuel)

Pollutant (lb)	Commercial Boiler					
	Bituminous Coal *	Lignite Coal **	Natural Gas	Residual Fuel Oil	Distillate Fuel Oil	LPG
	1000 lb	1000 lb	1000 ft^3 ***	1000 gal	1000 gal	1000 gal
CO_{2e}	2.74E+03	2.30E+03	1.23E+02	2.56E+04	2.28E+04	1.35E+04
CO_2	2.63E+03	2.30E+03	1.22E+02	2.55E+04	2.28E+04	1.32E+04
CH_4	1.15E-01	2.00E-02	2.50E-03	2.31E-01	2.32E-01	2.17E-01
N_2O	3.68E-01	ND †	2.50E-03	1.18E-01	1.19E-01	9.77E-01
NO_X	5.75E+00	5.97E+00	1.11E-01	6.41E+00	2.15E+01	1.57E+01
SO_X	1.66E+00	1.29E+01	6.32E-04	4.00E+01	3.41E+01	0.00E+00
CO	2.89E+00	4.05E-03	9.33E-02	5.34E+00	5.41E+00	2.17E+00
VOC	ND †	ND †	6.13E-03	3.63E-01	2.17E-01	3.80E-01
Lead	1.79E-03	6.86E-02	5.00E-07	1.51E-06	ND †	ND †
Mercury	6.54E-04	6.54E-04	2.60E-07	1.13E-07	ND †	ND †
PM10	2.00E+00	ND †	8.40E-03	4.64E+00	1.88E+00	4.89E-01

* from the U.S. LCI data module: Bituminous Coal Combustion in an Industrial Boiler (NREL 2005)
** from the U.S. LCI data module: Lignite Coal Combustion in an Industrial Boiler (NREL 2005)
*** Gas volume at 60°F and 14.70 psia.
† no data available

Total Emission Factors for Delivered Electricity

Table 3 Total Emission Factors for Delivered Electricity (lb of pollutant per kWh of electricity)

Pollutant (lb)	National	Eastern	Western	ERCOT	Alaska	Hawaii
CO_{2e}	1.67E+00	1.74E+00	1.31E+00	1.84E+00	1.71E+00	1.91E+00
CO_2	1.57E+00	1.64E+00	1.22E+00	1.71E+00	1.55E+00	1.83E+00
CH_4	3.71E-03	3.59E-03	3.51E-03	5.30E-03	6.28E-03	2.96E-03
N_2O	3.73E-05	3.87E-05	2.97E-05	4.02E-05	3.05E-05	2.00E-05
NO_X	2.76E-03	3.00E-03	1.95E-03	2.20E-03	1.95E-03	4.32E-03
SO_X	8.36E-03	8.57E-03	6.82E-03	9.70E-03	1.12E-02	8.36E-03
CO	8.05E-04	8.54E-04	5.46E-04	9.07E-04	2.05E-03	7.43E-03
TNMOC	7.13E-05	7.26E-05	6.45E-05	7.44E-05	8.40E-05	1.15E-04
Lead	1.31E-07	1.39E-07	8.95E-08	1.42E-07	6.30E-08	1.32E-07
Mercury	3.05E-08	3.36E-08	1.86E-08	2.79E-08	3.80E-08	1.72E-07
PM10	9.16E-05	9.26E-05	6.99E-05	1.30E-04	1.09E-04	1.79E-04
Solid Waste	1.90E-01	2.05E-01	1.39E-01	1.66E-01	7.89E-02	7.44E-02