Mechanical Technical Report 3
Mechanical Systems Existing Conditions Evaluation

Suburban Wellness Center
Germantown, Maryland

Prepared by Cory J. Abramowicz
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Faculty Advisor: Dr. James Freihaut

Table of Contents

Cory J. Abramowicz
Mechanical Option
Faculty Advisor: Dr. James Freihaut

Executive Summary

The Suburban Wellness Community Center is a two story 57,200 square foot building which contains a variety of spaces. On the first level is a fitness center and on the second level are conference rooms, offices and private practicing doctor's offices. In the northwest corner of the first floor is the swimming pool area which consists of a large four lane lap pool, a therapy pool, public spa as well as a sauna and steam room. South of this room is the basketball court and racquetball courts which are two stories in height. In the center of the building are the men's and women's lockers rooms and a two story tall atrium with cardiovascular machines and the registration desk. The east side of the first floor holds the free weight rooms in the north and studio spaces for group exercise classes in the south. On the second story in the center of the north part of the building are restrooms and conference rooms. The southeast corner of the second story includes an imaging office which can perform X-Rays, MRIs and ultrasounds. The rest of the space on the second floor has yet to be leased out.

The ventilation rate procedure explained in ASHRAE Standard 62.1 Section 6.2 was used to evaluate the HVAC design of the SWC. The building envelope and lighting power density requirements explained in ASHRAE Standard 90.1 Sections 5 and 9 were also used to evaluate the design of the SWC. Trane Trace 700 was also used to build an energy model of the building for analysis and estimated annual expenses.

The calculations performed in this technical report show that the design for the SWC does not meet ASHRAE Standard 62.1 or 90.1. The outside air being supplied to the spaces is not adequate to meet the demand and the light power density is too high.

This report finds that although the SWC may have met the Standard in years past, it does not meet the current standard. Since each tenant has installed their own individual systems, it would be convenient to combine all the systems into one centralized location. Although the initial cost would be great, the energy savings in the future would pay for the difference in cost.

Design Objectives and Requirements

The Suburban Wellness Center is a multi-use facility located in Germantown Maryland. On the first floor is the HeathTrax Fitness Center which includes a gymnasium, circuit training area, free weight area, cardiovascular machine area, locker rooms, group exercise rooms, rehabilitation area and a child daycare. The second floor includes an imagery office which consists of rooms for patient treatment, an X-ray room, and an MRI room.

By teaming up with Suburban Hospital Systems, HealthTrax offers facilities and program that integrate fitness, wellness education, traditional medical services and rehabilitation to improve the help of the member. This gives a welcoming, centralized place for members of the community to achieve their personal fitness and health goals. For buildings that offer a variety of services, the mechanical system is a very important consideration. Each area has a specific criterion and for the SWC, this depends on the physical activity in each space. For areas that have high physical activity such as the spaces for cardiovascular machines, circuit training machines and free weights, the set point for the spaces must be set lower and the air changes must be increased. During the mechanical design, measures should also be taken to reduce moisture and odor migration to other spaces.

One space in particular that is important to take into consideration during the mechanical design process is the indoor swimming pool area. Air and water temperatures along with humidity are especially difficult to balance. Improper control usually results in an uncomfortable environment and structural damage due to the corrosive environment. A separate air handling unit and condensing unit should be used to condition the space because of its high need of dehumidification.

Outdoor and Indoor Design Considerations

The closest metropolitan area to Germantown, Maryland is Baltimore so the summer and winter conditions used for this building are for the Baltimore area. The winter dry bulb temperature is 13°F while the summer wet bulb and dry bulb temperatures are 77°F and 91°F respectively.

Figure 1 describes temperature and air change breakdown for each type of space in the Suburban Wellness Center.

Space	Mean Design Temperature Range (°F)	Air Changes Per Hour
Locker Rooms	72-78	10
Office Areas	72-78	6-12
Exercise and Spinning Studios	68-72	8-12
Public Spaces	72-78	6-12
Main Fitness, Strength Training and Free Weights	68-72	8-12
Laundry, Storage and Janitors Closet	72-78	10
Gym	68-72	8-12

Figure 1 – Space Design Temperature and ACH

Energy Sources and Rates

The primary energy used by the Suburban Wellness Center is electricity. The air handling unit and condenser combination and both rooftop units use electricity. Hot and cold water is supplied to tenants using electric domestic hot water heaters and coolers. The only other type of energy used in the building is natural gas which fires the boilers that heat the water from the pool. Both electricity and natural gas are supplied by Pepco Energy Services. There were no utility rebates discovered that could have been a cost factor.

Site Factors

The Suburban Wellness Center is located nearby the Germantown Maryland exit of Interstate 270 and as of now the area around the SWC is undeveloped. Any site factors that were taken into account when choosing the site have not been discovered.

Design Ventilation Requirements

The ASHRAE Standard 62.1-2007 section 5 was used to carefully design for a number of important issues that could be harmful to the building's system or inhabitants. Some conditions that were taken into account were the prevention of the re-entry of contaminated air, prevention of mold growth, particulate filtration and dehumidification systems. Section 5.6.1 stipulates that any outdoor air intakes that are required as part of a forced air ventilation system, shall be located such that the shortest distance from the intake to any specific potential outdoor contaminant source shall be equal to or greater than the separation distance listed in Figure 2.

TABLE 5-1 Air Intake Minimum Separation Distance

Object	Minimum Distance, ft (m)
Significantly contaminated exhaust (Note 1)	15 (5)
Noxious or dangerous exhaust (Notes 2 and 3)	30 (10)
Vents, chimneys, and flues from combustion appliances and equipment (Note 4)	15 (5)
Garage entry, automobile loading area, or drive-in queue (Note 5)	15 (5)
Truck loading area or dock, bus parking/idling area (Note 5)	25 (7.5)
Driveway, street, or parking place (Note 5)	5 (1.5)
Thoroughfare with high traffic volume	25 (7.5)
Roof, landscaped grade, or other surface directly below intake (Notes 6 and 7)	1 (0.30)
Garbage storage/pick-up area, dumpsters	15 (5)
Cooling tower intake or basin	15 (5)
Cooling tower exhaust	25 (7.5)

Figure 2 – ASHRAE Standard 62.1-2007 Table 5-1

The distance from the exhaust air goosenecks to the corner of the roof top unit, where the outside air intake is located, must be a certain distance apart. Section 5.6.1 requires the distance between the outside air intake and exhaust air be at least 15 ft, which the SWC abides by with the shortest distance being 34 ft. Prevention of mold growth and particulate filtration are also important aspects in the design and upon looking at the specifications under the mechanical section, measures were taken to control both of these critical issues.

Another condition which could be of particular concern is section 5.10 Dehumidification systems. Section 5.10.1discusses the need for the relative humidity to be 65% or less which I thought would be an initial problem for my dehumidification system that conditions the supply air to the building swimming pool facility. However, upon reading further, Standard 62.1 notes an exception which includes showers, pools, spas as well as other areas which might need higher humidity conditions.

The ASHRAE Standard 62.1-2007 was used to calculate minimum ventilation rates for breathing zones and design outdoor air requirements. Table 6-1 includes a list of occupancy categories which reports the required minimum outdoor air rates per person and per square foot for those spaces. Since some of the spaces from the Suburban Wellness Center were not able to be categorized with this table, some assumptions were made and are to follow:

- Restrooms: 0.5 cfm/ft^2
- Locker Rooms: 0.5 cfm/ft^2

Some of the spaces in the building were not very clear to categorize and so when this came up, the more conservative approach was taken. Although many of the spaces in the doctor's offices could be categorized as office, they were categorized as medical procedure. The restrooms and locker rooms cfm/ft^2 is also conservative considering that the values for a swimming pool are 0.48 cfm/ft^2. To find the supply air quantity for each space, diffuser flow rates were read off from the mechanical floor plans designed. After these flow rates are summed, they are used to calculate the maximum outdoor air fraction (Zp).

Since all three of the units are important and each has different loads, all three were analyzed. Some of the design occupancies were provided by Meta Engineers and those that were not specified were tabulated using Standard 62.1-2007. Outdoor air requirements per person and per square foot were taken from the Standard 62.1-2007 and the supply air quantity was taken from the mechanical floor plans.

Discussion

The results of the ventilation calculations for the Suburban Wellness Center show that RTU-1 and AHU-1 comply with ASHRAE Standard 62.1-2007 however RTU-2 does not. RTU-1provides approximately 26% more outside air that what is required and AHU-1 supplies approximately 190% more outside air than what is required. While these two units both exceeded the outdoor air that is required, the total outdoor air for all the units did not meet the requirement. The overall system provides 22% below what is necessary according to Std. 62.1 mainly because RTU-2 under supplies outdoor air by 67%. Specific findings may be reviewed in Figure 3.

	Area (sq. ft.)	Req. OA (cfm)	Supply OA (cfm)	Vpz (cfm)	Vot (cfm)	Capacity (cfm)	Max Zp	% Above Vot
RTU-1	12204	3040	4240	19335	3378	32000	0.22	25.5%
RTU-2	26992	6591	5100	25510	15858	39000	0.88	-67.8%
AHU-1	4850	2328	7500	10500	2587	10500	0.22	189.9%
	44046	11960	16840	55345	21822	81500		-22.8%

Figure 3 – Overall Unit Performance Comparison

Originally when the Suburban Wellness Center was designed, the owners assumed the spaces as offices and had the mechanical systems designed accordingly. When Healthtrax was confirmed to move their fitness center into the first floor, this posed a problem. The Health Club category under the occupancy categories has a more stringent outdoor air requirement than the Office Space category. To counter this, a dehumidification unit was installed to condition air of the swimming pool area. Although this addition provided a lot of assistance in the recovery of outdoor air, the building mechanical system is still not up to requirement.

Another major concern and possible reason for discrepancy is the way the Vot was calculated. The maximum Zp that was calculated for RTU-2 was 0.88 which is representing room B160 Men's Shower located in the men's locker rooms. Although there is only 200 cfm being supplied, 175 of the 200 cfm should be outdoor air. Since the amount of exhaust air exceeds the amount of air being supplied, this leads me to believe that the difference is being made up and therefore, conditioned air from other neighboring rooms are being drawn into the room B160. This could be hazardous because it causes pressurization in the spaces and leaves the ventilation airflow unbalanced.

Minimum Exhaust Rate									
Room #	Room	Az - Area	Function	# Units	Exhaust Rate cfm/unit	Exhaust Rate cfm/sqft	Req. Exhaust Rate	Designed Exhaust Rate	Complies
b144	Toilet Room	68	Restroom	1.00	70		70	75	Yes
b153	Women's Toilet	235	Restroom	6.00	70		420	660	Yes
b159	Men's Toilet	165	Restroom	6.00	70		420	675	Yes
b139	Family Changing	754	Locker Room			0.50	377	450	Yes
b140	Changing Room	28	Locker Room			0.50	14	50	Yes
b142	Changing Room	40	Locker Room			0.50	20	50	Yes
b143	Changing Room	40	Locker Room			0.50	20	75	Yes
b148	Women's Locker Room	680	Locker Room			0.50	340	0	No
b151	Changing Room	30	Locker Room			0.50	15	50	Yes
b152	Changing Room	30	Locker Room			0.50	15	50	Yes
b156	Men's Locker Room	935	Locker Room			0.50	468	0	No
b141	Janitor Closet	12	Storage			1.00	12	75	Yes
b150	Janitor Closet	17	Storage			1.00	17	75	Yes
b158	Janitor Closet	15	Storage			1.00	15	75	Yes

Figure 4 – Standard 62.1-2007 Minimum Exhaust Rate

Figure 4 reviews calculations conducted to check the minimum exhaust rates of some of the spaces in the Suburban Wellness Center. The restrooms, janitor closets, and changing rooms met these requirements however the locker rooms for both the men and women did not. The locker rooms did not have any exhaust fans installed. One of the possible reasons for this is a change in the standard within recent years. Since the standard that the building complied with dated back to 2001, there is a possibility that locker rooms were not supported.

Design Heating and Cooling Loads

ASHRAE Standard 90.1-2004 provides minimum requirements for energy-efficient buildings with the exception of low rise residential buildings. Section 5 of the ASHRAE Standard specifically focuses on the requirements for the building envelope.

In the Standard, there are two methods to go about checking for the building envelope compliance. The first is the Prescriptive Building Envelope Option which states that the total vertical fenestration must not exceed 50% of the gross wall area. Another restriction for this method is the total skylight area cannot surpass 5% of the total roof area. The second method is the Building Envelope Trade-Off Option is similar to the Prescriptive Building Envelope Option but says that the envelope performance factor of the proposed building has to be less than or equal to the envelope performance factor of the budget building.

The Suburban Wellness Center which is located in Germantown Maryland falls under the ASHRAE specified 5A climate zone. Table 5.5-5 of ASHRAE Standard 90.1-2004 was used to compare the required values with the installed values to check for compliance. In the table, there are three categories; Nonresidential, Residential and Semiheated. This building was evaluated under the nonresidential section.

Figure 5 shows that compliance for the R-values of the roof and walls has been reached for the Suburban Wellness Center. The R-values for the installed roof and walls materials were both found in the building specifications and the values for the R-values required were looked up in the ASHRAE Standard under Table 5.5-5.

	Roof Insulation Minimum R-Value	Walls Insulation Minimum R-Value	Floors (Slab on Grade) Unheated
Required	R-15 Continuous Insulation	R-7.6	N/A
Installed	R-15	R-20	N/A
Compliance	Yes	Yes	Yes

Figure 5 – R-Value Compliance

Figure 6 and 7 both show the compliance with the standard for vertical fenestration and roof fenestration. The percent total vertical fenestration has to be below 50% and the building meets this with a total vertical fenestration of 39.8%. For the roof, the percent total fenestration has to be below 5% and the Suburban Wellness Center meets this with a total fenestration of 1%. The results are reflected in table 4.2 and Table 4.3.

Total Glass Area (sqft)	Total Wall Area (sqft)	% Total Vertical Fenestration	Compliance
8578	21528	39.8%	Yes

Figure 6 – Glass Area to Wall Area Compliance

Total Skylight Area (sqft)	Total Roof Area (sqft)	% Total Fenestration	Compliance
375	37224	1.0%	Yes

Figure 7 – Skylight Area to Roof Area Compliance

Figure 8 shows the compliance of the window U-values and SHGC values with the standard. Since the values could not be found in the specification or drawings, the manufacturer's website provided the U-values and SHGC values. The total vertical fenestration was 39.8% which falls under the 30.1-40% range for vertical glazing in Table 5.5-5 in the standard.

% Vertical Glazing 30.1-40.0%	Required	Installed	Compliance	Comments
Assembly Max U-Value for Fixed Windows	0.57	0.25	Yes	Windows are double pane (1/4" thick glass each) insulating float glass with Low E
Assembly Max SHGC for all orientations	0.39	0.31	Yes	
Assembly Max SHGC for North	0.49	0.31	Yes	

Figure 8 – U-Value and SHGC Compliance

Figure 9 shows the compliance of the skylight U-values and SHGC values with the standard.

0.0-2.0% Skylight	U-Value	SHGC	Compliance
Required	1.17	0.49	Yes
Actual	0.25	0.31	Yes

Figure 9 – U-value and SHGC value Compliance

Lighting - ASHRAE Standard 90.1-2004

The main goal of Section 9 of the ASHRAE Standard 90.1-2004 was to create a standard which optimized energy performance and occupancy comfort. By using this, designers are able to cut down on energy cost yet still provide adequate comfort to the occupants.

Although the Suburban Wellness Center was supposed to be analyzed under the 2004 of the standard, the SWC was designed under the 1999 edition. Both versions of the standard were used in the analysis of this building and so the results can be found below. The difference between the two editions is quite different. The 2004 version became 22% more strict for my building with the allowable lighting power density. Many of the values for the space in the 1999 edition were at least one tenth of a watt per square foot higher if not more. A Comparison of the standard's two editions can be found in Figure 7.

	2004	1999
Active Storage	0.8	1.1
Conference/Meeting/Multipurpose	1.3	1.5
Corridor/Transition	0.5	0.7
Dressing/Locker Room	0.6	0.8
Electrical/Mechanical	1.5	1.3
Exam/Treatment	1.5	1.6
Exercise Area	0.9	1.1
Laundry	0.6	0.7
Lobby	1.3	1.8
Lounge/Recreation	1.2	1.4
Office-Enclosed	1.1	1.5
Patient Room	0.7	1.2
Physical Therapy	0.9	1.9
Playing Area	1.4	1.9
Restroom	0.9	1.0

Figure 10 – Space by Space Method Category Comparison

Two methods were used to meet the compliance of ASHRAE Standard 90.1-2004. The Building Area Method gives a criterion for the entire building based on the majority use. The other method is the Space by Space Method which categorizes each space in the building and finds the allowable lighting power density that way. This way tends to be more precise since it looks at each space in the building instead of generalizing all the space like the Building Area Method.

At first, when the calculations were made, the Suburban Wellness Center did not meet the requirements of ASHRAE Standard 90.1-2004. Since the SWC is a fitness center on the first floor and doctor's office on the second floor, it could be categorized as either an exercise center or clinic according to the standard. The values for both of these categorizes are identical so when the Building Area Method was used, the lighting power density used was 1.00 watt per square foot. SWC did not meet this requirement because its LPD was 1.39 watts per square foot. After this discovery, I was a little surprised so since the building was designed in 2001, I looked at the 1999 version of the standard and found result to be a little different. The older version proved to be more lenient on lighting power density with a required LPD of 1.40. So with this data I concluded that the building was designed according to the 1999 edition of ASHRAE Standard 90.1. The Space by Space Method was also conducted. Since this method looks at each space specifically and doesn't make a generalization like the other method, I didn't expect this to make my argument for compliance any better. Space by Space compliance for was 1.32 W/SF and 1.03 W/SF for 1999 and 2004 respectively. The SWC LPD did not meet either of these and so compliance with the standard using this method was not met.

ASHRAE 90.1 Building Area Method		Compliance
1999 - Exercise Center	1.40	Yes
2004 - Exercise Center	1.00	No
Actual	1.39	

Figure 11 – Building Area Method Comparison

Trane Trace 700 was used during the energy analysis of the Suburban Wellness Center. The building drawings, specifications, and information taken from the manufacturer's website were used in the development of this building model. Schedules for the lighting and occupancy were set up based on the hours of operation for the building. The building purchases electricity from Pepco Holdings Inc. for $0.141 per kwh during the summer months from June to October and $0.122 per kwh during the winter months from November to May. A similar energy analysis was performed for this building however these files were not archived. Occupancy densities were calculated based on ASHRAE Standard 62.1-2007 number of people per 1000 square feet.

Cooling Load By Source					
Envelope Loads (Btus/Hr)	AHU-1	RTU-1	RTU-2	Total	% of Total Load
Roof	0	9,868	10,055	19,923	**1.44%**
Glass Solar	25,469	27,244	83,938	136,652	**9.90%**
Internal Loads (Btus/Hr)					
Lights	24,669	51,407	128,085	204,161	**14.79%**
People	208,314	374,879	436,710	1,019,903	**73.87%**
Total (Btus/Hr)	258,453	463,398	658,788	1,380,639	**100.00%**

Figure 12 – Cooling Load by Source

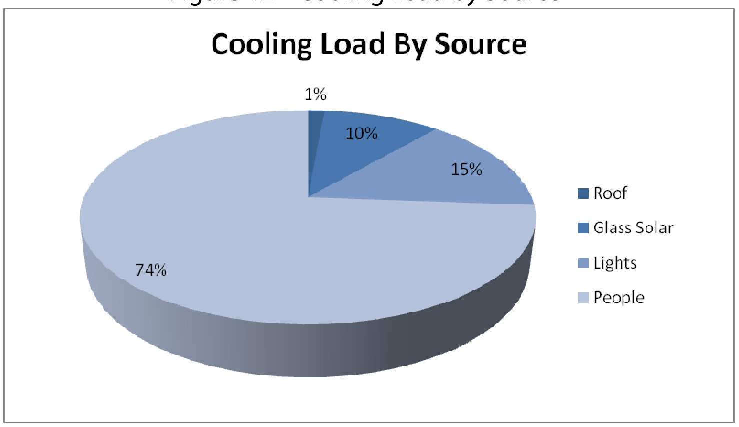

Figure 13 – Cooling Load By Source

Heating Load By Source					
Envelope Loads (Btus/Hr)	AHU-1	RTU-1	RTU-2	Total	% of Total Load
Skylite Cond	0	6015	0	6,015	**4.02%**
Roof Cond	0	24731	26962	51,693	**34.53%**
Glass Cond	10,310	12,618	50,692	73,620	**49.17%**
Wall Cond	2,101	9,591	6,695	18,387	**12.28%**
Total (Btus/Hr)	12,411	52,955	84,349	149,715	**100.00%**

Figure 14 – Heating Load By Source

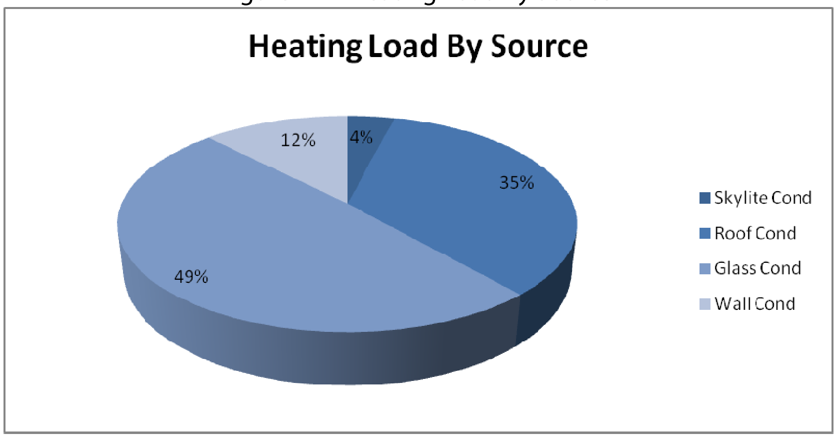

Figure 15 – Heating Load By Source

Annual Energy Use

	Cooling SF/Ton	Cooling CFM/Ton	Cooling CFM/SF	Heating CFM/SF
AHU-1	241.93	225.54	0.93	0.93
RTU-1	273.99	252.44	0.92	0.28
RTU-2	479.12	164.83	0.34	0.12

Figure 16 – Cooling and Heating Breakdown

Month	Monthly Utility Costs
January	$3,851.91
February	$3,484.18
March	$4,216.34
April	$4,395.77
May	$5,348.48
June	$6,516.09
July	$6,066.27
August	$6,784.41
September	$5,691.33
October	$5,527.86
November	$4,547.29
December	$3,668.14
Total	$60,098.07

Figure 17 – Monthly Utility Costs

Schematics

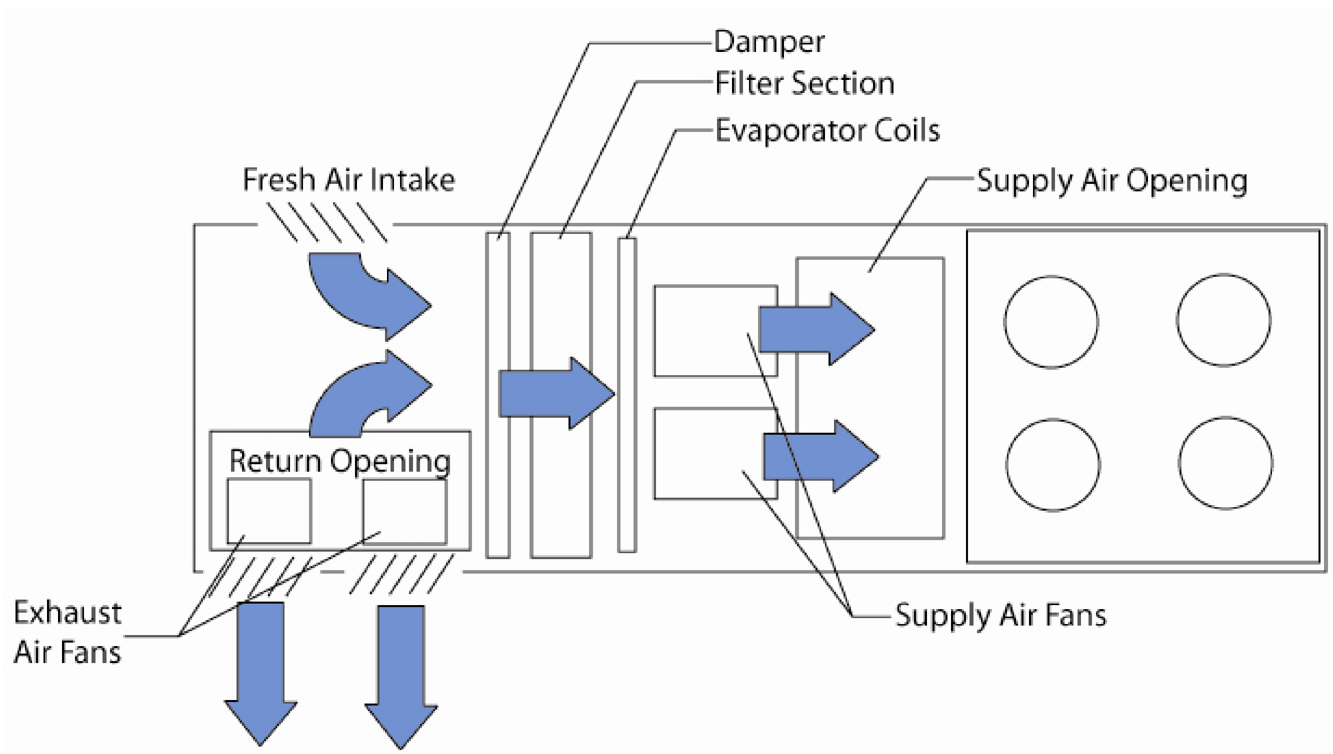

Figure 18 – Typical Rooftop Unit Flow Diagram

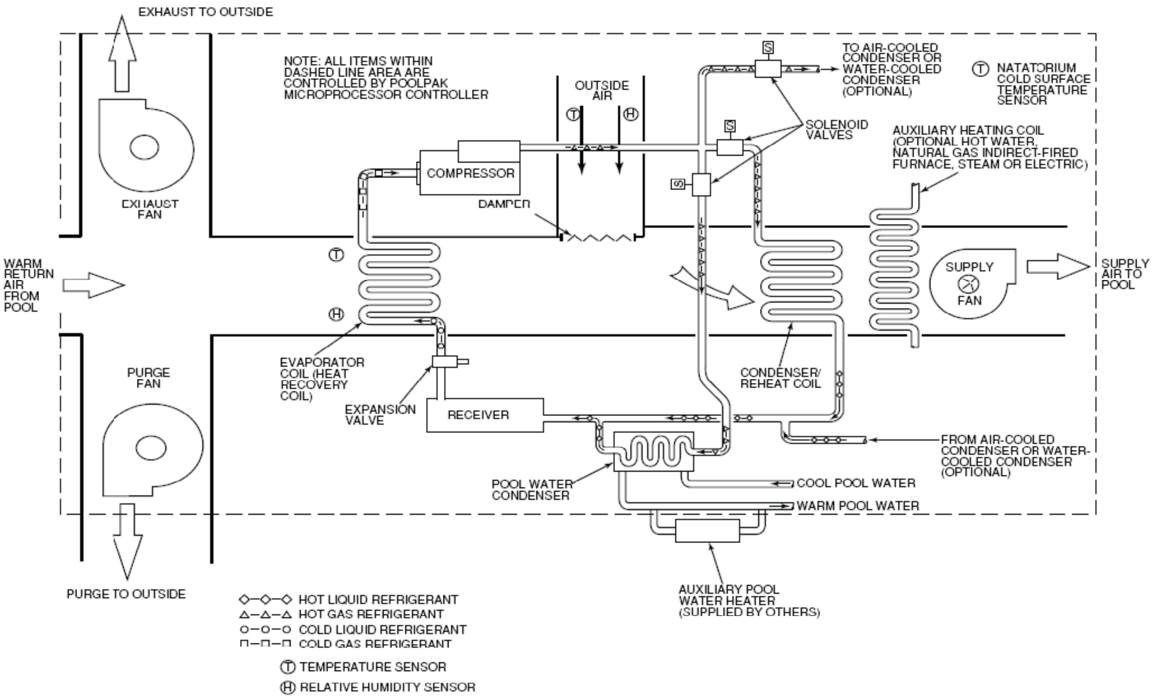

Figure 19 – AHU-1 Flow Diagram

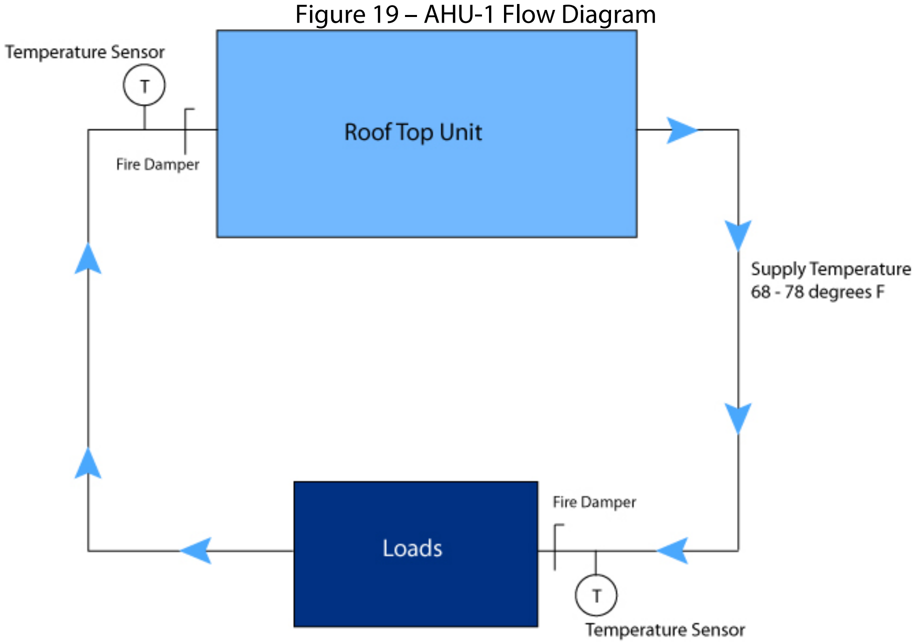

Figure 20 – Airside Flow Diagram

Schedules

Air Handling Unit													
General		Cooling Coil					Heating Coil			Damper Settings			
Unit	Fan CFM	FV	EDB	EWB	LDB	LWB	FV	EDB	LDB	Min. OA CFM	Max. OA CFM	Min. Relief CFM	Max. Relief CFM
AHU-1	10500	525	84.5	72	74	65.5	700	70	82	2100	7500	2100	7500

Condenser										
General			Compressor				Condenser Fan			
Unit	Capacity BTUH	Ambient Air Temperature	No.	HP	FLA	LRA	No.	HP	FLA (ea.)	LRA (ea)
CU-1	275,000	95° F	1	10	18.1	117	3	1	1.8	9
			1	15	26.3	178				

Rooftop Unit														
	Evaporator Fan						100% Exhaust Fan					Compressor		
Unit	CFM	ESP	RPM	BHP	No.	MHP	ESP	RPM	BHP	No.	MHP	No.	KW	RLA
RTU-1	32000	4.5	746	36.07	2	25.5	1	672	20.58	1	10	4	16.4	27.3
										1	15	2	11	18.2
RTU-2	39000	4.5	762	47.52	2	30.5	1	771	33.81	2	20	8	17.3	27.3

Rooftop Unit										
Condenser Fan					Cooling Capacity				Ambient Outdoor Temp. DB	OA CFM
Unit	CFM	No.	HP	FLA	Total BTUH	Sensible BTUH	EDB	EWB		
RTU-1	32000	8	1	14.4	1057088	886415	78.9	64.4	95° F	4240
RTU-2	39000	12	1	21.6	1349562	1143813	78.6	64.2	95° F	5100

Split System Heat Pump													
Indoor AHU													
General			OA CFM	Fan Data		Des. Temp		Ambient Temp.	Unit Capacity		Auxiliary Heat		
Unit	CFM	ESP		No.	MHP	°F DB	°F WB		Sens.MBH	Total MBH	KW	Volts	Phase
AC-1	950	0.03	0	1	0.33	80	67	95	19.7	29	4.8	208	1

Split System Heat Pump										
Outdoor Heat Pump Unit										
General	Heat Capacity		Compressor Data			Condenser Fan Data			Min. Circ. Amps	Max Fuse Size
Unit	MBH	OAT	No.	RLA	LRA	No.	HP	FLA		
HP-1	29	95	1	13	79	1	0.25	15	18	30

System Operation

Rooftop Units:
Each rooftop air conditioning unit is provided with an electric control system designed for direct exchange rooftop variable air volume application. The outside air economizer uses outside air to provide natural ventilation cooling to the entire building. The rooftop units are also equipped with variable speed fan drives. These modulate the speed of the supply air fans used for CFM control in the VAV system.

When the ambient conditions fall below the outdoor enthalpy control setpoints, the economizer and the return air dampers modulate to maintain the correct discharge air temperature. When the ambient conditions are above the outdoor enthalpy control setpoint, only mechanical cooling is used and the economizer outdoor air dampers remain in the minimum position. If the economizer alone cannot bring the discharge air temperature to the desired level, the mechanical cooling is activated. When the ambient condition is below the outdoor enthalpy control setpoint, the first stage of mechanical cooling is activated while the outdoor air damper remains open to take advantage of the natural cooling. When further cooling is required, the second stage of mechanical cooling is activated and the outdoor air dampers are partially closed. When the cooling load is reduced, the individual stages of mechanical and economizer cooling are deactivated until cooling is no longer needed.

When heat is needed in the system, the air is conditioned using the electric heat located within the VAV boxes. Re-circulated air and outdoor air is mixed in the rooftop unit and then supplied to the spaces. If the temperature of the air being supplied is too low, the VAV box electric heat is used to bring the air to the desired temperature.

While the building is unoccupied, the mechanical system goes through a night heating setback and cooling shutdown. During this process, first the occupied heating setpoint is set to 55°F. Then the cooling system is shut down and finally, the outdoor air dampers located on the rooftop unit are closed. This process allows building owners to save energy while the building is unoccupied and thus not needing conditioned air. Due to this process, the system must then go through a morning warm-up. During the morning warm-up, after the unoccupied period, the outdoor air damper is held closed by a return air temperature sensor until the space temperature approaches the occupied setpoint of 68°F.

The pool room is controlled by an Efficient Air Systems Inc. system with a 25 ton condensing unit. A microprocessor controller is used to monitor indoor and outdoor temperatures, humidity, room pressure, pool and boiler water temperatures, CO_2 levels, and adjust operating parameters as needed. The system also utilizes a heat pipe recovery design to recover heat from the exhausted air. During the high summer outdoor temperatures, the condensing unit controls the pool air temperature to two degrees above the large pool temperature.

Located on the first floor, a split system heat pump conditions the elevator mechanical room. This is a very minor system in building since it solely conditions the mechanical room located behind the elevator shaft. The two part system consists of an air handling unit in the mechanical room and a heat pump on the roof of the building. A refrigerant line runs between the two system components and acts as a median for heating and cooling.

Operating History

Any useful building history was unavailable.

System Critique

The outside air circulation is a very important criterion when designing the mechanical system for a fitness center. Often times when a person is going through an intense workout, they emit a much higher level of CO_2. If this high level of CO_2 air is then re-circulated without the correct proportion of outside air, this can be hazardous to a person's heath. Coincidentally, with too much re-circulated air, the body odor that person is giving off will migrate from space to space. A guideline designers follow to prevent this is ASHRAE 62.1. This specifies how much outside air should be supplied to the space depending on the type of space. After checking the air handling unit and both rooftop units for compliance, one of the rooftop units was found to not be supplying enough outside air. All the systems supply an adequate amount of conditioned air to the spaces; however RTU-2 which is located on the south side of the building is not supplying enough outside air.

A technique of design which is becoming more popular in fitness centers is installing CO_2 sensors. As CO_2 levels rise with the increase of people working out, there is more demand for outside air to be supplied to the system. With these sensors installed, when the CO_2 gets to a certain level, the rooftop unit will introduce more outside air into the system by opening the outside air dampers more. Currently in the SWC, the only system that has a CO_2 sensor established is AHU-1 which only serves the swimming pool area.

Finally, the mechanical system in the Suburban Wellness Center was designed with the primary goal of being able to separate the monthly energy bill to its tenants with ease. The air handling unit and condenser combination supply conditioned air to the swimming pool area while the two rooftop units supply conditioned air to the rest of the building. Each tenant has their own electric domestic hot water heater and cooler and the two gas fired pool heaters are monitored and paid for by HealthTrax. This makes separating the monthly bill easy for the owner and reassures the tenant that they are paying their fair share however in the interest of saving energy this is not the best option.

Centralizing the mechanical system would decrease the monthly energy costs for electricity. The initial costs for the boiler, chillers and monitoring system would be higher than they were with the individual components, but over time the savings in monthly energy costs would pay it off. These energy savings along with increased outside air going into the system and increased CO_2 monitoring would gain points toward a LEED certification for the building; One goal that was originally not considered by the owner.

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