Mechanical Systems Existing Conditions Report

Photo rendering courtesy of Hooper Shiles Architects

Philadelphia School District
Administration Headquarters
440 North Broad Street, Philadelphia, PA

Prepared for
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Table of Contents

Executive Summary

A system analysis was completed on Philadelphia School District (PSD) Administration Headquarters in Philadelphia, PA. Part I of the analysis focused on design objectives, cost concerns, site factors, indoor/outdoor conditions, load calculations, and energy use. Part II focused on what was installed in the administration building.

Prior to moving into this new location on 440 North Broad, PSD occupied four buildings in different locations. One of the main objectives was to move everyone into one building where it was easily accessed by both the employees and the public. This was accomplished by choosing this site which is very close to City Hall. Another objective was to keep their employees and visitors happy. Since most would agree that natural light has a big impact on someone's mood and ability to produce, the designers focused on a central atrium space that provided connectivity between both the 15th Street and Broad Street entrances, making the space inviting to workers and guests.

Choosing electricity as the primary energy source gives system with a cheap first cost and one that is easily manageable as well. This was a concern for the district because they wanted a reliable system that would require their maintenance engineers to provide little service to the equipment.

In Technical Assignment #2, Trane's Trace program was used to assess the building's energy usage and operating cost. The total kilowatt-hours used by the building was calculated to be 9,963,009 per year. The following chart gives the distribution of energy use by different components of the building.

Energy Consumption Breakdown	
primary heating	0.23%
primary cooling	31.06%
supply fans	5.25%
lighting	63.47%
Total	100.00%

The total estimated energy cost for the year in the Administration building is $419,177.84. Mechanical system operating cost is $153,137.97 per year, about 36.53% of the total operating cost.

The loads within the building were analyzed using Trace in Assignment #2. By trying to match what actually exists in the building after design, it was noticed that the air handling units were sized about 10% larger than estimated by the program, a common design practice.

The air handling unit system in the Administration Headquarters, comprised of 17 main units all equipped with an economizer and an evaporator coil for. The outdoor air is provided through a pressurized ducted shaft to the mechanical room where it is mixed freely with return air from the space. Variable fan powered boxes are provided with a reheat coil for heating. This system may have been cheaper initially, but may require more inefficient energy usage in the long run.

PART I: Mechanical System Design Conditions

Design Objective and Requirements

The Philadelphia School District Administration Headquarters was originally built as a printing facility in 1948. Three existing packaged air handling units were kept for core space while a total of 17 packaged DX units were added within the building. When designing the shell and core renovations a few main objectives were kept in mind. These objectives were first cost, maintenance, site, and the visual connectivity of both the 15th Street and Broad Street entrances via an atrium and natural light.

The packaged direct exchange air handling units on each floor are provided with individual waterside economizers and electric heating coils. Compared to an air side economizer, the water side economizer was chosen because of its lower initial cost and the need for less shaft and mechanical room space. The air- versus waterside economizer topic is further discussed in the "Cost and Site Factors" of this paper.

Electricity was chosen as the medium of heating rather than steam for ease of maintenance. A steam system would require maintenance engineers to replace valves and other parts of a steam system. They would have to do this during off business hours requiring the district to pay overtime or pay for another shift of workers. The electric system will require much less maintenance. With the electric heating coil combined in the packaged unit, installation would be easier as well.

PSD wanted to bring their administration together under one roof. Previously, they were spread out among four offices within Philadelphia. After managing to find 440 North Broad, they were able to centralize their system. Read more in the "Cost and Site Factors" part of this paper.

The atrium space was another driving factor in the initial design. The introduction of natural light was used as a visual connection between the 15th Street and Broad Street entrances. This served two purposes. It allowed the building to be more inviting to visitors and also would keep employees content with their work environment, a necessity in efficient production. The design of this space was costly, requiring much structural attention and special mechanical attention aimed at smoke purge. However, the aesthetics of the design were superior to the price of design.

Energy Sources and Rates

The source of energy for the Philadelphia School District Administration Headquarters is all electric provided by Philadelphia Electric Company. See rates in the following chart:

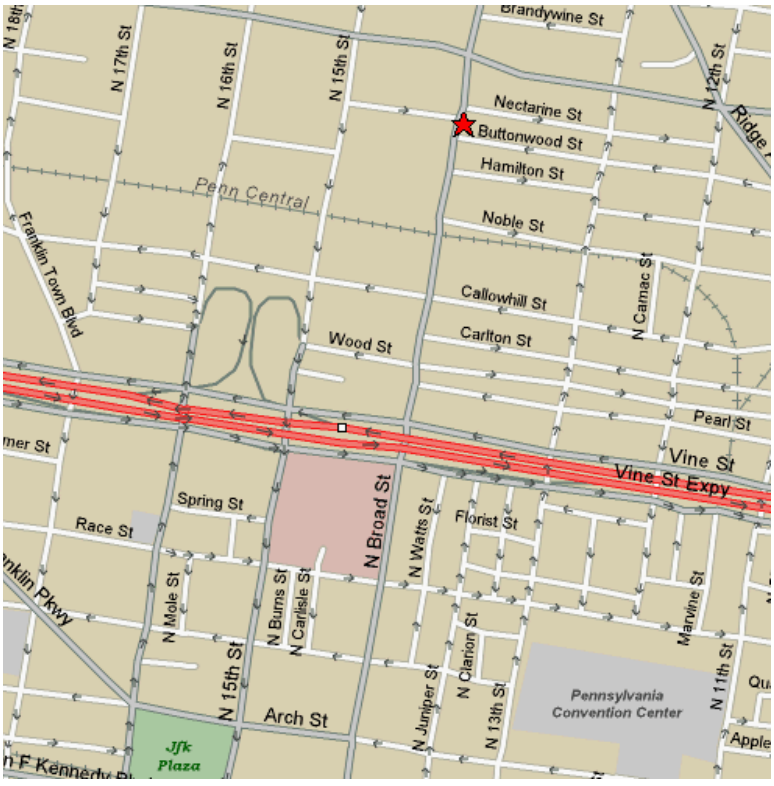
PECO Unbundled Rates [10/28/03]		
Fixed Distribution Service Charge		$286.86
Variable Distribution Service Charge		
Demand		$1.66
1st 150 hours of billed demand		$0.0088
2nd 150 hours of billed demand		$0.0052
All other KWH		$0.0016
Competitive Transition Charge		
Demand		$3.61
1st 150 hours of billed demand		$0.0194
2nd 150 hours of billed demand		$0.0115
All other KWH		$0.0038
Energy and Capacity Charge		
Demand		$5.91
1st 150 hours of billed demand		$0.0453
2nd 150 hours of billed demand		$0.0324
All other KWH		$0.0195
Transmission Charge		
Demand		$0.80
1st 150 hours of billed demand		$0.0043
2nd 150 hours of billed demand		$0.0025
All other KWH		$0.0008
TOU Adjustment	Summer June-Sept	Winter Oct-May
Off-Peak Credit	($0.0021)	($0.0021)
On-Peak Charge	$0.0057	$0.0022

The total estimated energy cost for the year in the Administration building is $419,177.84. Mechanical system operating cost is $153,137.97 per year, about 36.53% of the total operating cost.

Cost and Site Factors

When considering first cost, both air side and water side economizers were compared for the packaged direct exchange air handling units. Air side economizers would require large intake and relief louvers on the exterior of the building taking away windows and therefore natural light. Natural light was an important part in both objectives. With the school district using this building as an office building for its administration, it was important to keep spaces well lit with as much natural light as possible. Air side economizers would also require the splitting of condenser water and electrical risers requiring more shaft space and almost twice as many mechanical rooms. Although the air side economizer would not require the cooling tower to operate in the winter (less maintenance), the first cost of the system was the driving factor in design. The water side economizer cost less initially.

The site of the new School District Administration Headquarters building was important during the initial planning of this project. Originally the district had offices spread out at different locations within Philadelphia. The administration wanted all employees to work in one centralized easily accessible location. The new property is located on North Broad and 15th Street between Callowhill and Buttonwood Streets, six blocks north of City Hall and adjacent to the historic Inquirer Building. This centralized location is readily accessible since it is served by public transportation. Services will be more efficient since all administration will be located in one building.



Indoor/Outdoor Design Conditions

Design outdoor air conditions used were taken from the ASHRAE Handbook of Fundamentals 1997 for a location in Philadelphia, PA. The summer design temperature was 92°F dry bulb and 75°F wet bulb. The winter design dry bulb was 11°F.

Indoor design conditions were considered a typical 75°F and 50% relative humidity for all office spaces. Air is provided at 55°F by the air handling units and reheated by reheat coils to supply indoor spaces.

Ventilation Comparison

The required outdoor air intake flow was calculated using ASHRAE Standard 60.1 as a design guideline in Technical Assignment #1. All calculated outdoor air complied with the requirements of Standard 60.1.

AHU Summary

Units	Zone Primary Airflow	**Outdoor Air Intake Flow Required**	Supplied Outdoor Air Fraction	**Outdoor Air Supplied**
	cfm	cfm		cfm
AHU1.1	28000.0	2425.0	0.10	2800.0
AHU1.2	28000.0	2425.0	0.10	2800.0
AHU1.3	28000.0	2500.0	0.10	2800.0
AHU1.4	28000.0	2500.0	0.10	2800.0
AHU1.5	28000.0	2687.5	0.10	2800.0
AHU2.1	31500.0	2800.0	0.10	3150.0
AHU2.2	31500.0	2800.0	0.10	3150.0
AHU2.3	31500.0	2800.0	0.10	3150.0
AHU2.4	31500.0	2800.0	0.10	3150.0
AHU3.1	35000.0	2800.0	0.10	3500.0
AHU3.2	35000.0	2800.0	0.10	3500.0
AHU3.3	35000.0	2800.0	0.10	3500.0
AHU3.4	35000.0	2800.0	0.10	3500.0
AHU3.5	32000.0	2725.0	0.10	3200.0
AHU4.1	35000.0	3450.0	0.10	3500.0
AHU5.1	28000.0	2068.8	0.10	2800.0
AHU5.2	28000.0	2068.8	0.10	2800.0

Design Load Comparison

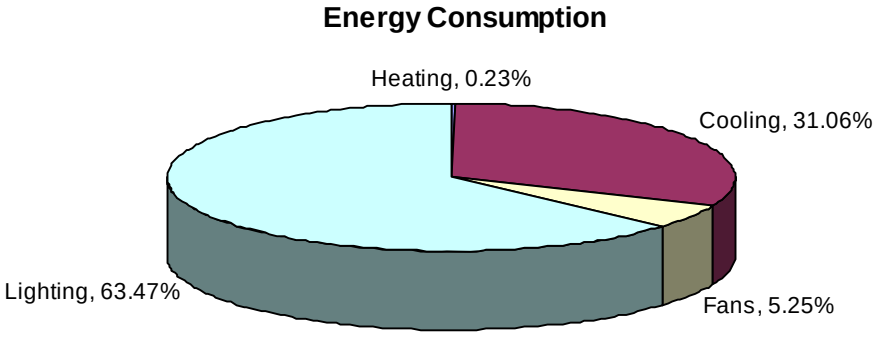
Trane's Trace program was used to calculate the building's cooling and ventilation load in Technical Assignment #2. Once these values were found, they were compared to those on the Air Handler Unit schedules from the design documents. The following chart shows a summary of the calculations. By trying to match what actually exists in the building after design in Trace, it was noticed that the air handling units were sized using the load in ton per space. Calculated airflow rates for the supply and ventilation air were higher than those scheduled because lighting loads were assumed to be 6 W/sf and the amount of people used in the simulation was higher than what was used to calculate the outdoor air. **Appendix B** shows more detailed results of the load calculations.

Energy Analysis Summary

		Load		Supply Air		Ventilation Air	
		Calculated	Scheduled	Calculated	Scheduled	Calculated	Scheduled
AHU	Space	ton	ton	cfm	cfm	cfm	cfm
1.1 & 1.2	1S	135.3	160	72755	56000	6713	5600
1.3 & 1.4	1N	144.2	160	79305	56000	6993	5600
1.5	1T	76.2	80	42083	28000	3846	2800
2.1 & 2.2	2S	161.4	180	86677	63000	8112	6300
2.3 & 2.4	2N	161.4	180	85981	63000	8112	6300
3.1 & 3.2	3S	166.9	200	89275	70000	8112	7000
3.3 & 3.4	3N	184.3	200	93138	70000	8112	7000
3.5	3T	85.1	90	43072	32000	3916	3200
4.1	4	147.1	100	78823	35000	6993	3500
5.1 & 5.2	5	124.9	160	63691	56000	5385	5600

Annual Energy Utilization Data

Because the Administration building was just opened for the current school year, actual energy data was not available. Energy utilization was estimated using Trane's Trace program in Technical Assignment #2. The Philadelphia School District Administration Headquarters building uses electricity as its source of energy. The engineer used electric heat for maintenance and operational reasons that suited the School District better than alternatives like steam. Since it is an office building a schedule based on a 8:00am to 6:00pm work period was assumed. Total kilowatt-hours used for the building was calculated to be 9,963,009 per year. Here is a simple pie chart showing energy consumption in the building and a more detailed spreadsheet explaining the same.

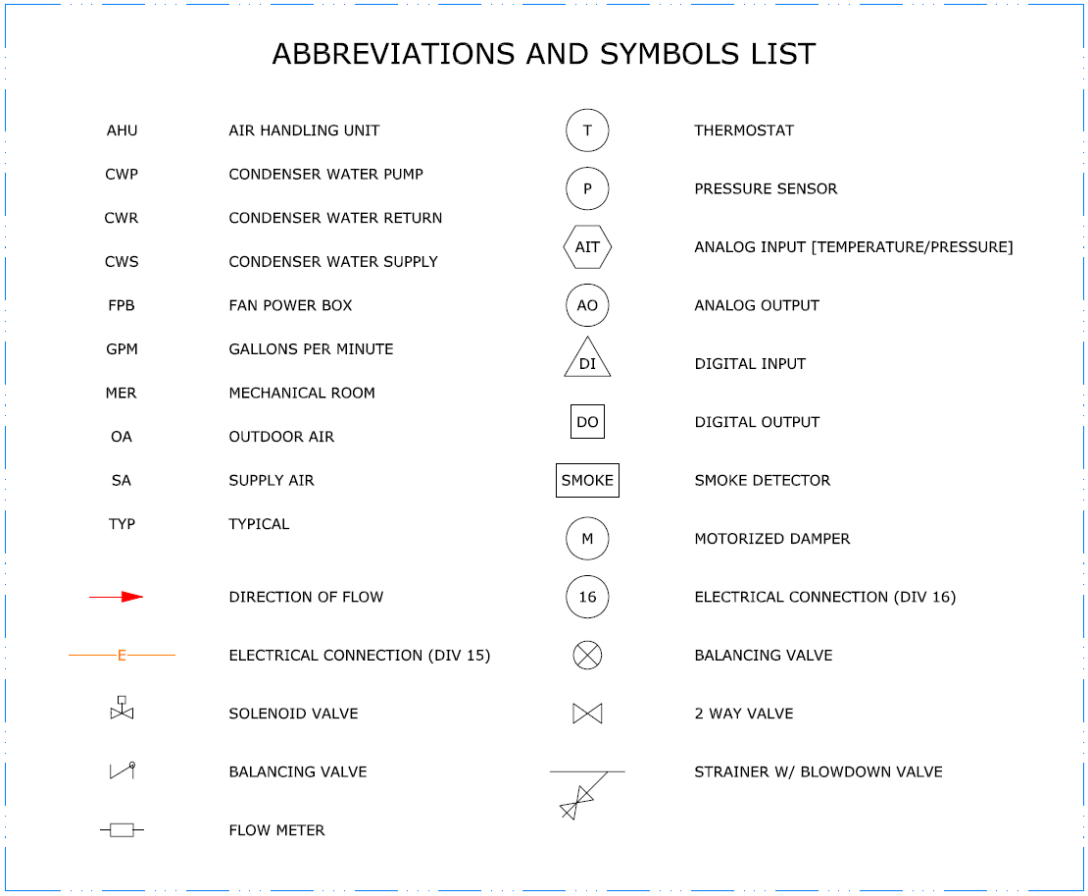


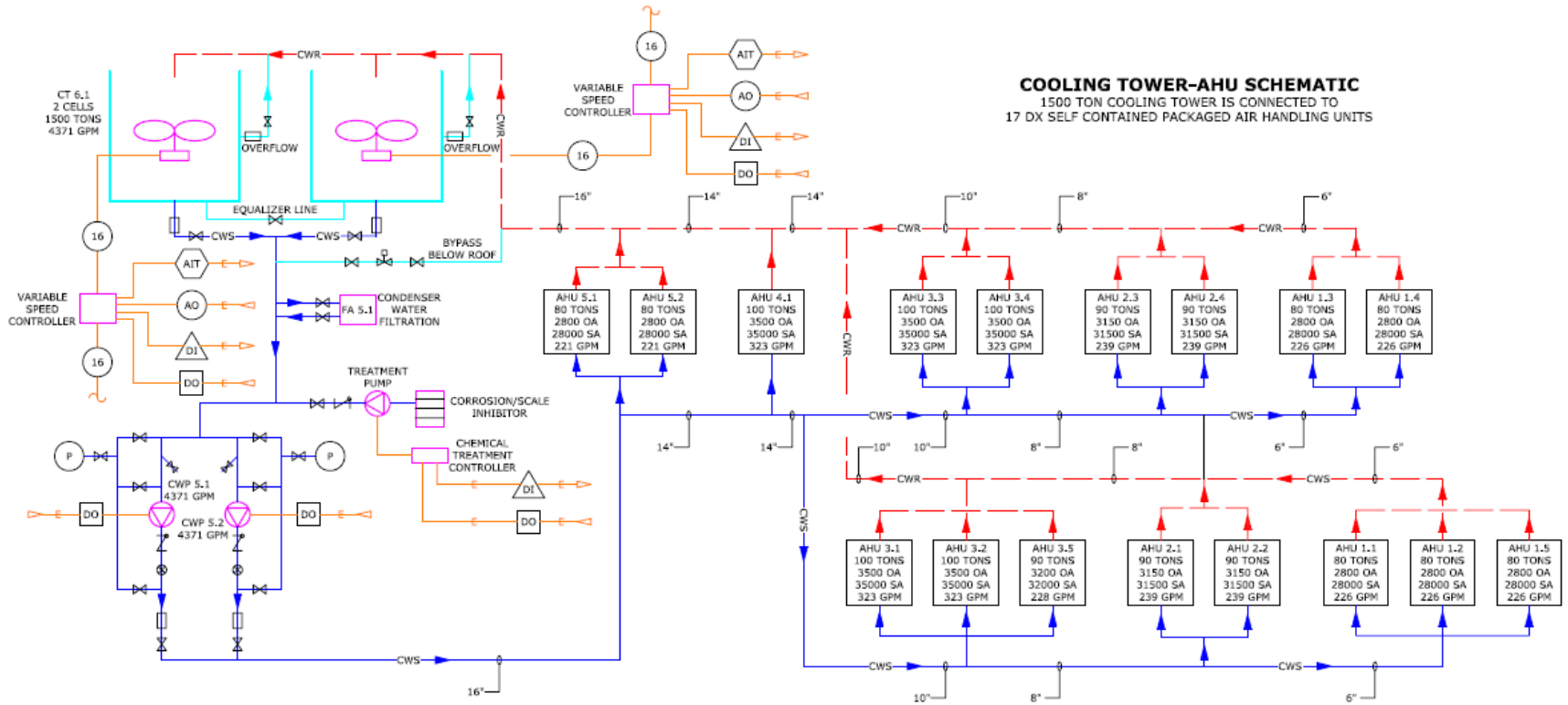
Energy Consumption Summary				
	Electric Consumption (kWh)	Water Consumption (1000 gals)	Percent of Total Energy %	Total Source Energy (kBtu/yr)
Primary Heating				
Primary Heating	22,886.6		0.23%	2,343.6
Primary Cooling				
Cooling Compressor	1,205,562.1		12.10%	123,449.9
Tower/Condenser Fans	530,514.4	6,765.2	5.32%	54,324.8
Condenser Pumps	1,357,507.6		13.63%	139,009.1
Other Cooling Accessories	723.2		0.01%	74.1
Cooling Subtotal	3,094,307.3	6,765.2	31.06%	316,857.8
Auxillary				
Supply Fans	522,585.5		5.25%	53,512.9
Circulation Pumps			0.00%	0.0
Base Utilities			0.00%	0.0
Auxillary Subtotal	522,585.5		5.25%	53,512.9
Lighting				
Lighting	6,323,229.0		63.47%	647,500.2
Totals	**9,963,008.4**	**6,765.2**	**100.00%**	**1,020,214.5**

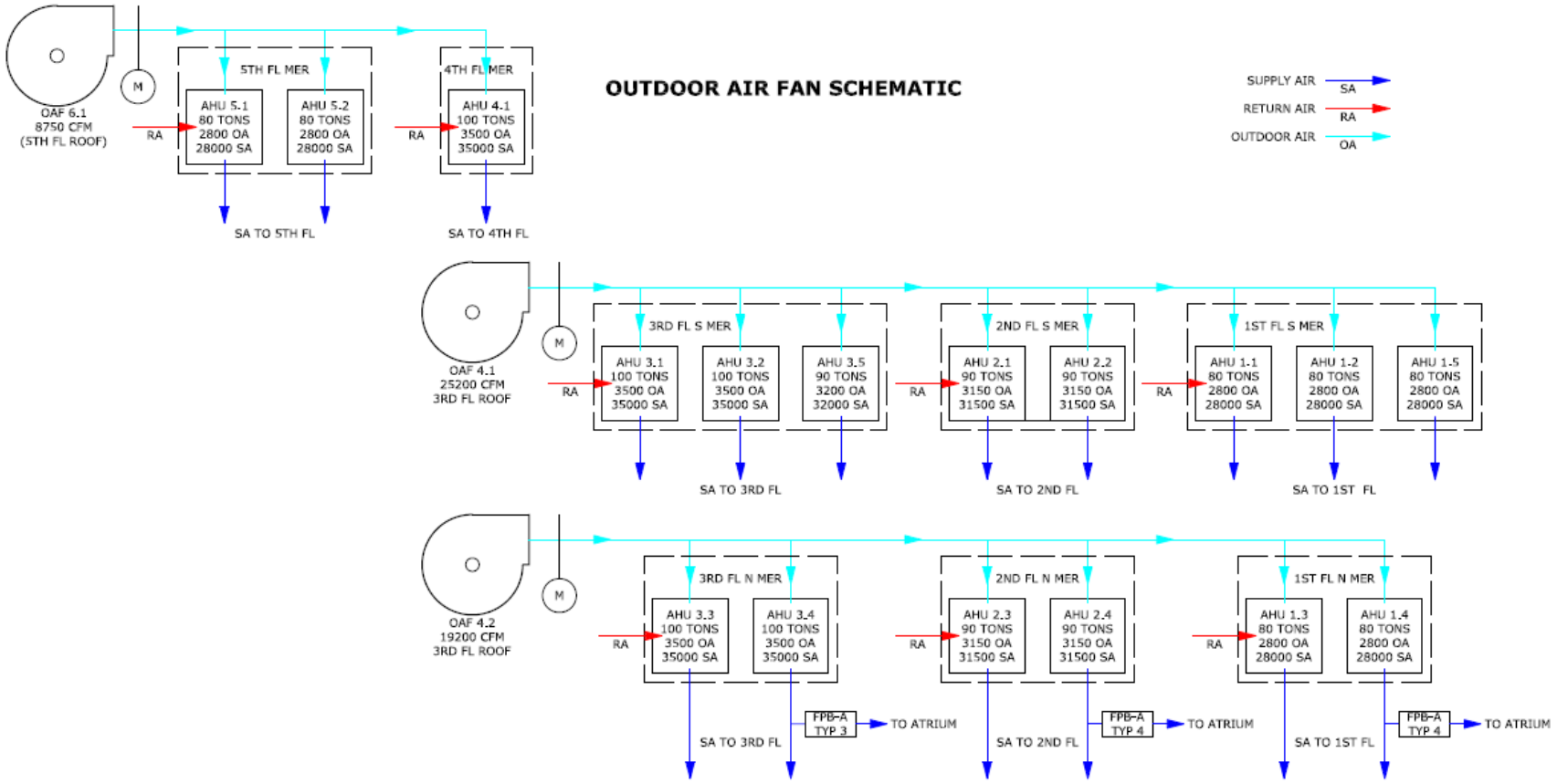
PART II: Conceptual Design of the Mechanical System

Schematic Drawings

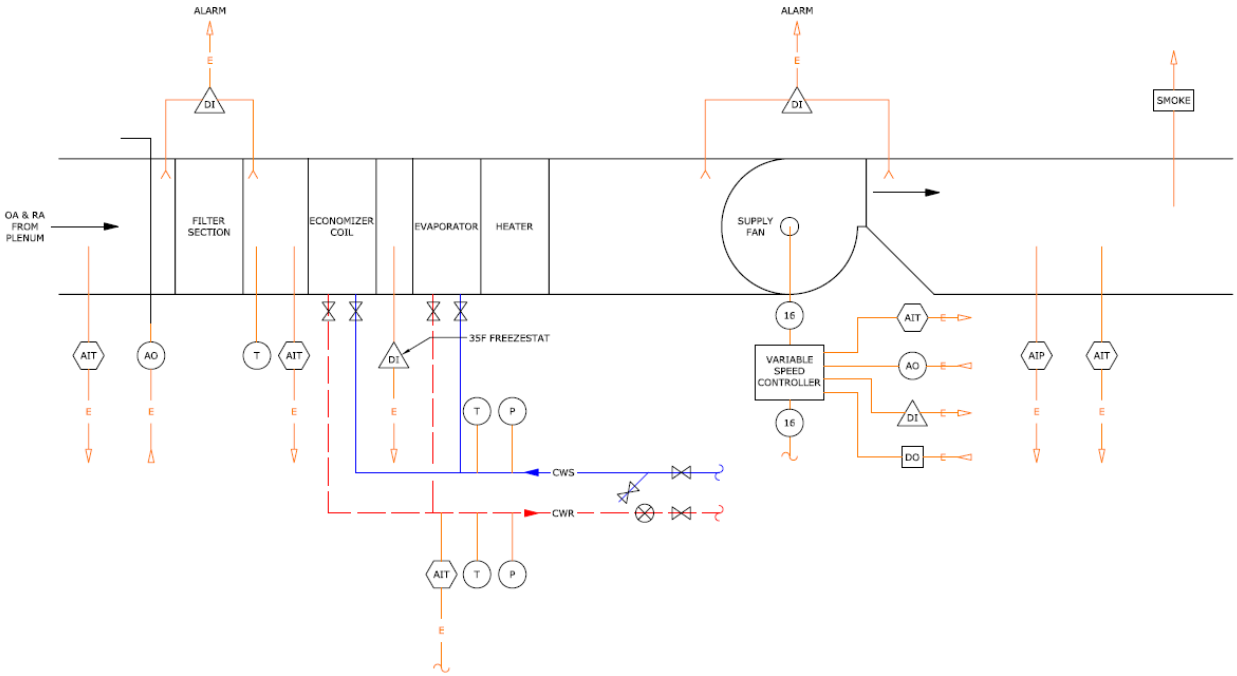
For the following schematics, the following abbreviations and symbols may be used:



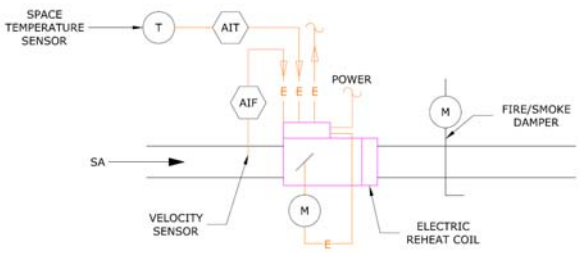

COOLING TOWER-AHU SCHEMATIC
1500 TON COOLING TOWER IS CONNECTED TO
17 DX SELF CONTAINED PACKAGED AIR HANDLING UNITS
CT 6.1
2 CELLS
1500 TONS
4371 GPM
OVERFLOW
OVERFLOW
CWR
EQUALIZER LINE
CWS
CWS
BYPASS
BELOW ROOF
VARIABLE
SPEED
CONTROLLER
AIT
AO
DI
DO
FA 5.1
CONDENSER
WATER
FILTRATION
TREATMENT
PUMP
CORROSION/SCALE
INHIBITOR
CHEMICAL
TREATMENT
CONTROLLER
CWP 5.1
4371 GPM
CWP 5.2
4371 GPM
AHU 5.1
80 TONS
2800 OA
28000 SA
221 GPM
AHU 5.2
80 TONS
2800 OA
28000 SA
221 GPM
AHU 4.1
100 TONS
3500 OA
35000 SA
323 GPM
AHU 3.3
100 TONS
3500 OA
35000 SA
323 GPM
AHU 3.4
100 TONS
3500 OA
35000 SA
323 GPM
AHU 2.3
90 TONS
3150 OA
31500 SA
239 GPM
AHU 2.4
90 TONS
3150 OA
31500 SA
239 GPM
AHU 1.3
80 TONS
2800 OA
28000 SA
226 GPM
AHU 1.4
80 TONS
2800 OA
28000 SA
226 GPM
AHU 3.1
100 TONS
3500 OA
35000 SA
323 GPM
AHU 3.2
100 TONS
3500 OA
35000 SA
323 GPM
AHU 3.5
90 TONS
3200 OA
32000 SA
228 GPM
AHU 2.1
90 TONS
3150 OA
31500 SA
239 GPM
AHU 2.2
90 TONS
3150 OA
31500 SA
239 GPM
AHU 1.1
80 TONS
2800 OA
28000 SA
226 GPM
AHU 1.2
80 TONS
2800 OA
28000 SA
226 GPM
AHU 1.5
80 TONS
2800 OA
28000 SA
226 GPM


OUTDOOR AIR FAN SCHEMATIC
SUPPLY AIR
SA
RETURN AIR
RA
OUTDOOR AIR
OA
OAF 6.1
8750 CFM
(5TH FL ROOF)
M
RA
5TH FL MER
AHU 5.1
80 TONS
2800 OA
28000 SA
AHU 5.2
80 TONS
2800 OA
28000 SA
SA TO 5TH FL
RA
4TH FL MER
AHU 4.1
100 TONS
3500 OA
35000 SA
SA TO 4TH FL
OAF 4.1
25200 CFM
3RD FL ROOF
M
RA
3RD FL S MER
AHU 3.1
100 TONS
3500 OA
35000 SA
AHU 3.2
100 TONS
3500 OA
35000 SA
AHU 3.5
90 TONS
3200 OA
32000 SA
SA TO 3RD FL
RA
2ND FL S MER
AHU 2.1
90 TONS
3150 OA
31500 SA
AHU 2.2
90 TONS
3150 OA
31500 SA
SA TO 2ND FL
RA
1ST FL S MER
AHU 1.1
80 TONS
2800 OA
28000 SA
AHU 1.2
80 TONS
2800 OA
28000 SA
AHU 1.5
80 TONS
2800 OA
28000 SA
SA TO 1ST FL
OAF 4.2
19200 CFM
3RD FL ROOF
M
RA
3RD FL N MER
AHU 3.3
100 TONS
3500 OA
35000 SA
AHU 3.4
100 TONS
3500 OA
35000 SA
SA TO 3RD FL
FPB-A
TYP 3
TO ATRIUM
RA
2ND FL N MER
AHU 2.3
90 TONS
3150 OA
31500 SA
AHU 2.4
90 TONS
3150 OA
31500 SA
SA TO 2ND FL
FPB-A
TYP 4
TO ATRIUM
RA
1ST FL N MER
AHU 1.3
80 TONS
2800 OA
28000 SA
AHU 1.4
80 TONS
2800 OA
28000 SA
SA TO 1ST FL
FPB-A
TYP 4
TO ATRIUM

TYPICAL SELF-CONTAINED AIR HANDLING UNIT



FAN POWER BOX TERMINAL UNIT DETAIL



System Operation Description

Cooling and Heating: McQuay's self contained direct exchange air handling units with electric heating coils are used to heat and cool all office space within the Philadelphia School District Administration Headquarters building. Within the air handler itself the condenser, compressor, and expansion valves are not in the supply air stream. This allows for easy access and maintenance. The components within the supply air stream are the filter, economizer coil, evaporator, heater and fan. See **Appendix A** for AHU layout within the building.

Cooling Tower/Chemical Treatment: A two-celled cooling tower provides condenser water at 85°F to an automatic chemical feed unit and a side stream filtration system where it is treated.

Condenser Pumps: Two condenser water pumps connected in parallel provide water to each air handler.

Outdoor Air Fans: Outdoor air fans provide outdoor air through plenum discharge with motorized damper control at each mechanical room.

Return Air Plenum: Return air is through plenum discharge as well.

Waterside Economizer: Each unit is equipped with a waterside economizer, which allows free cooling when the cooling tower water temperature is less than the unit entering air temperature by an adjustable value of 5-7°F. The economizer consists of one water coil and two two-way control valves. A control device modulates the control valves to satisfy the cooling demand whenever the entering water temperature is suitable (less than 50°F). When the entering water temperature is no longer suitable (greater than 50°F), the economized valves close and the unit is on 100% mechanical cooling.

Miscellaneous Heat: Electric cabinet heaters provide miscellaneous heat for the 15th Street and Broad Street lobbies. Electric baseboard heaters provide miscellaneous heat for the Broad Street foyer and ground floor toilet rooms. Unit heaters provide heat in the mechanical rooms.

Smoke Purge: Four smoke purge fans controlled by a motorized damper provide ventilation for the atrium space.

Equipment Schedules

Cooling Tower Schedule

COOLING TOWER SCHEDULE			
UNIT NUMBER			CT-6.1
LOCATION			5TH FL ROOF
TYPE			INDUCED-DRAFT
NOMINAL TONS			1500
NUMBER OF CELLS			2
WATER DATA	TEMPERATURE (F)	IN	95
		OUT	85
	TOTAL GPM		4371
	INLET PRESS DROP (PSI)		3.2
AMBIENT TEMPERATURE (F) WB			78 F WB
FANS DATA (EACH)	TOTAL NO. OF FANS		2
	CFM		310260
	TYPE DRIVE		BELT
MOTORS (EACH)	QUANTITY / HP EACH		2 @ 50 HP EA.
	ENCL. TYPE		TEAC
	VOLTS / PH / HZ		460 / 3 / 60
BASIN HEATER			2 @ 9 KW EA.
MANUFACTURER			EVAPCO
OPERATING WEIGHT (LBS)			43500
OVERALL DIMENSIONS (LxWxH)			24'-1-1/8"x18'x18'-6-1/2"
REMARKS:	3 PROBE ELECTRIC WATER LEVEL CONTROL EXTERNAL SERVICE PLATFORM W/ LADDER, LADDER EXTENSION SAFETY CASE, SAFETY CASE EXTENSION MOTOR DAVIT W/ BASE SUMP SWEEPER PIPING PROVIDE VARIABLE FREQUENCY DRIVE		

Filtration Schedule

FILTRATION SYSTEM SCHEDULE		
UNIT NO.		FA-5.1
SERVICE		CT-6.1
MANUFACTURER		LAKOS
FLOW (GPM)		825
PUMP HP		20
SYSTEM	INLET	8"
	OUTLET	6"
ELECTRICAL DATA		460 / 3 / 60

Pump Schedule

PUMP SCHEDULE			
UNIT NO.		CWP-5.1	CWP-5.2
SERVICE		CT-6.1	CT-6.1
GPM		4371	4371
HEAD (FT)		160	160
PUMP DATA	MANUFACTURER	BELL & GOSSETT	BELL & GOSSETT
	FRAME SIZE	444T	444T
	NPSH	20.9	20.9
MOTOR DATA	RPM	1770	1770
	BHP	231.73	231.73
	HP	250	250
	VFD	NO	NO
	ELECT.	460 / 3 / 60	460 / 3 / 60
WEIGHT (LB)		3080	3080
REMARK		INERTIA BASE	INERTIA BASE

Abbreviations:

CWP Condenser Water Pump

Fan Power Box Terminal Schedule

FAN POWER BOX TERMINAL UNIT SCHEDULE		
UNIT NO.		FPB-A
INLET DUCK SIZE (DIA.)		14"
AIR QUANTITY	MIN. CFM	900
	MAX. CFM	1500
FAN MOTOR HP		3/4
ELECTRICAL DATA		460 / 3 / 60
ELECTRICAL HEATING (KW)		19

Self Contained Packaged Unit Schedule – Floors 1 and 2

SELF CONTAINED PACKAGED UNIT SCHEDULE																		
UNIT NO.			AHU-1.1	AHU-1.2	AHU-1.3	AHU-1.4	AHU-1.5	AHU-2.1		AHU-2.2		AHU-2.3		AHU-2.4	
LOCATION			FL 1 S	FL 1 S	FL 1 N	FL 1 N	FL 1 T	FL 2 S		FL 2 S		FL 2 S		FL 2 S	
MANUFACTURER			MCQUAY	MCQUAY	MCQUAY	MCQUAY	MCQUAY	MCQUAY		MCQUAY		MCQUAY		MCQUAY	
SUPPLY FAN DATA	TOTAL CFM		28000	28000	28000	28000	28000	31500		31500		31500		31500	
	OA CFM		2800	2800	2800	2800	2800	3150		3150		3150		3150	
	RA CFM		25200	25200	25200	25200	25200	28350		28350		28350		28350	
	TOTAL S.P. (IN. WG.)		4.72	4.72	4.72	4.72	4.72	4.28		4.28		4.28		4.28	
	MIN. EXT. S.P. (IN. WG.)		2.3	2.3	2.3	2.3	2.3	2.3		2.3		2.3		2.3	
	FAN RPM		1814	1814	1814	1814	1814	1223		1223		1223		1223	
	VAR. SPEED DRIVE		YES	YES	YES	YES	YES	YES		YES		YES		YES	
	MOTOR	BHP	34.18	34.18	34.18	34.18	34.18	30.45		30.45		30.45		30.45	
		HP	40	40	40	40	40	40		40		40		40	
DX COOLING DATA / AIR DATA	COOLING CAPACITY	TOTAL MBH	1150074	1150074	1150074	1150074	1150074	1179820		1179820		1179820		1179820	
		SENS. MBH	802731	802731	802731	802731	802731	857069		857069		857069		857069	
		NOM. TON	80	80	80	80	80	90		90		90		90	
	ENTERING DB T (F)		80	80	80	80	80	80		80		80		80	
	ENTERING WB T (F)		67	67	67	67	67	67		67		67		67	
	LEAVING DB T (F)		53.7	53.7	53.7	53.7	53.7	55		55		55		55	
	LEAVING WB T (F)		53.6	53.6	53.6	53.6	53.6	54.9		54.9		54.9		54.9	
	MAX. P. D. (IN. WG.)		0.78	0.78	0.78	0.78	0.78	0.75		0.75		0.75		0.75	
ECONOMIZER COIL DATA	WATER FLOW RATE (GPM)		226	226	226	226	226	239		239		239		239	
	MAX. PRESSURE DROP (IN. FT. WG.)		38.86	38.86	38.86	38.86	38.86	18.85		18.85		18.85		18.85	
	AIR P. D. (IN. WG.)		0.47	0.47	0.47	0.47	0.47	0.46		0.46		0.46		0.46	
	ROWS / FPI		4/12	4/12	4/12	4/12	4/12	4/12		4/12		4/12		4/12	
COMPRESSOR DATA		# COMPR.	4	4	4	4	4	3	3	3	3	3	3	3	3
		HP EACH	20	20	20	20	20	13	15	13	15	13	15	13	15
CONDENSER COIL DATA	WATER FLOW RATE (GPM)		226	226	226	226	226	239		239		239		239	
	MAX. PRESSURE DROP (IN. FT. WG.)		10.26	10.26	10.26	10.26	10.26	5.99		5.99		5.99		5.99	
	WATER FLOW EWT / LWT (F)		85 / 97.7	85 / 97.7	85 / 97.7	85 / 97.7	85 / 97.7	85 / 96.8		85 / 96.8		85 / 96.8		85 / 96.8	
PREHEAT COIL DATA	ELECTRIC HEATING COIL CAPACITY (KW)		68	68	68	68	68	68		68		68		68	
FILTER DATA	TYPE		30% EFF.	30% EFF.	30% EFF.	30% EFF.	30% EFF.	30% EFF.		30% EFF.		30% EFF.		30% EFF.	
	THICKNESS (IN.)		4"	4"	4"	4"	4"	4"		4"		4"		4"	

Abbreviations:

AHU Air Handling Unit

Self Contained Packaged Unit Schedule – Floors 3, 4, and 5

SELF CONTAINED PACKAGED UNIT SCHEDULE																	
UNIT NO.			AHU-3.1		AHU-3.2		AHU-3.3		AHU-3.4		AHU-3.5	AHU-4.1		AHU-5.1		AHU-5.2	
LOCATION			FL 3 S		FL 3 S		FL 3 S		FL 3 S		FL 3 T	FL 3 S		FL 3 S		FL 3 S	
MANUFACTURER			MCQUAY		MCQUAY		MCQUAY		MCQUAY		MCQUAY	MCQUAY		MCQUAY		MCQUAY	
SUPPLY FAN DATA	TOTAL CFM		35000		35000		35000		35000		32000	35000		28000		28000	
	OA CFM		3500		3500		3500		3500		3200	3500		2800		2800	
	RA CFM		31500		31500		31500		31500		28800	31500		25200		25200	
	TOTAL S.P. (IN. WG.)		4.81		4.81		4.81		4.81		4.27	4.81		4.7		4.7	
	MIN. EXT. S.P. (IN. WG.)		2.3		2.3		2.3		2.3		2.3	2.3		2.3		2.3	
	FAN RPM		1333		1333		1333		1333		1233	1333		1812		1812	
	VAR. SPEED DRIVE		YES		YES		YES		YES		YES	YES		YES		YES	
	MOTOR	BHP	38.2		38.2		38.2		38.2		30.39	38.2		34.04		34.04	
		HP	40		40		40		40		40	40		40		40	
DX COOLING DATA / AIR DATA	COOLING CAPACITY	TOTAL MBH	1443423		1443423		1443423		1443423		1048558	1443423		996328		996328	
		SENS. MBH	1006078		1006078		1006078		1006078		830433	1006078		766342		766342	
		NOM. TON	100		100		100		100		90	100		80		80	
	ENTERING DB T (F)		80		80		80		80		80	80		80		80	
	ENTERING WB T (F)		67		67		67		67		67	67		67		67	
	LEAVING DB T (F)		53.6		53.6		53.6		53.6		52.8	53.6		51.9		51.9	
	LEAVING WB T (F)		53.5		53.5		53.5		53.5		52.6	53.5		51.8		51.8	
	MAX. P. D. (IN. WG.)		0.91		0.91		0.91		0.91		0.74	0.91		0.74		0.74	
ECONOMIZER COIL DATA	WATER FLOW RATE (GPM)		323		323		323		323		228	323		221		221	
	MAX. PRESSURE DROP (IN. FT. WG.)		32.2		32.2		32.2		32.2		23.96	32.2		27.47		27.47	
	AIR P. D. (IN. WG.)		0.55		0.55		0.55		0.55		0.46	0.55		0.47		0.47	
	ROWS / FPI		4/12		4/12		4/12		4/12		4/12	4/12		4/12		4/12	
COMPRESSOR DATA	# COMPR.		3	3	3	3	3	3	3	3	6	3	3	2	2	2	2
	HP EACH		15	20	15	20	15	20	15	20	13	15	20	15	20	15	20
CONDENSER COIL DATA	WATER FLOW RATE (GPM)		323		323		323		323		228	323		221		221	
	MAX. PRESSURE DROP (IN. FT. WG.)		6.78		6.78		6.78		6.78		6.62	6.78		11.72		11.72	
	WATER FLOW EWT / LWT (F)		85 / 96.1		85 / 96.1		85 / 96.1		85 / 96.1		85 / 96	85 / 96.1		85 / 96.1		85 / 96.1	
PREHEAT COIL DATA	ELECTRIC HEATING COIL CAPACITY (KW)		68		68		68		68		68	68		68		68	
FILTER DATA	TYPE		30% EFF.		30% EFF.		30% EFF.		30% EFF.		30% EFF.	30% EFF.		30% EFF.		30% EFF.	
	THICKNESS (IN.)		4"		4"		4"		4"		4"	4"		4"		4"	

Abbreviations:

AHU Air Handling Unit

Fan Schedules :: Inline Exhaust Fan Schedules

EXHAUST [INLINE] FAN SCHEDULE									
UNIT NO.		EF-1.1	EF-1.2	EF-2.1	EF-2.2	EF-3.1	EF-3.2	EF-4.1	EF-4.2
SERVICE		FL 1 W ELEC RM	FL 1 E ELEC RM	FL 2 W ELEC RM	FL 2 E ELEC RM	FL 3 W ELEC RM	FL 3 E ELEC RM	FL 4 W ELEC RM	FL 4 E ELEC RM
CFM		500	500	500	500	500	500	500	500
SP IN. WG.		0.375	0.375	0.375	0.375	0.375	0.375	0.375	0.375
MANUFACTURER		LOREN COOK	LOREN COOK	LOREN COOK	LOREN COOK	LOREN COOK	LOREN COOK	LOREN COOK	LOREN COOK
RPM		1375	1375	1375	1375	1375	1375	1375	1375
MOTOR	BHP	-	-	-	-	-	-	-	-
	HP	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25
	VFD	NO	NO	NO	NO	NO	NO	NO	NO
	ELEC.	120 / 1 / 60	120 / 1 / 60	120 / 1 / 60	120 / 1 / 60	120 / 1 / 60	120 / 1 / 60	120 / 1 / 60	120 / 1 / 60
ROOF EXH.									
PROPELLER									
CENTRIFUGAL									
INLINE		X	X	X	X	X	X	X	X
REMARK									

EXHAUST [INLINE] FAN SCHEDULE							
UNIT NO.		EF-5.1	EF-5.2	EF-6.1	EF-6.2	EF-6.3	EF-G.3
SERVICE		FL 5 W ELEC RM	FL 5 E ELEC RM	ELEV MACH RM	ELEV MACH RM	PUMP RM	GR FL EMR
CFM		500	500	2000	2000	1450	500
SP IN. WG.		0.375	0.375	0.25	0.25	0.35	0.375
MANUFACTURER		LOREN COOK	LOREN COOK	LOREN COOK	LOREN COOK	LOREN COOK	LOREN COOK
RPM		1375	1375	1416	1416	1215	1375
MOTOR	BHP	-	-	-	-	-	-
	HP	0.25	0.25	0.5	0.5	0.25	0.25
	VFD	NO	NO	NO	NO	NO	NO
	ELEC.	120 / 1 / 60	120 / 1 / 60	120 / 1 / 60	120 / 1 / 60	120 / 1 / 60	120 / 1 / 60
ROOF EXH.							
PROPELLER							
CENTRIFUGAL							
INLINE		X	X	X	X	X	X
REMARK				ROOF CURB, BACK DRAFT DAMPER			

Abbreviations:

EF Exhaust Fan

Fan Schedules :: Roof Exhaust Smoke Purge Fan Schedule

SMOKE PURGE [ROOF EXHAUST] FAN SCHEDULE					
UNIT NO.		SPF-4.1	SPF-4.2	SPF-4.3	SPF-4.4
SERVICE		ATRIUM	ATRIUM	ATRIUM	ATRIUM
CFM		20000	20000	20000	20000
SP IN. WG.		0.75	0.75	0.75	0.75
MANUFACTURER		GREEN HECK	GREEN HECK	GREEN HECK	GREEN HECK
RPM		418	418	418	418
MOTOR	BHP	4.89	4.89	4.89	4.89
	HP	7.5	7.5	7.5	7.5
	VFD	NO	NO	NO	NO
	ELEC.	460 / 3 / 60	460 / 3 / 60	460 / 3 / 60	460 / 3 / 60
ROOF EXH.		X	X	X	X
PROPELLER					
CENTRIFUGAL					
INLINE					
REMARKS		U.L. LISTED FOR SMOKE CONTROL PREFABRICATED ROOF CURB W/ RAISED CANT MOTORIZED DAMBER			

Abbreviations:

SPF Smoke Purge Fan

Fan Schedules :: Roof Exhaust Toilet Fan Schedule

TOILET [ROOF] EXHAUST FAN SCHEDULE				
UNIT NO.		TX-4.1	TX-6.1	TX-6.2
SERVICE		FL 1-5 N TOILET	FL 1-5 S TOILET	FL 1-5 E TOILET
CFM		4500	7100	6900
SP IN. WG.		0.5	1	1
MANUFACTURER		LOREN COOK	LOREN COOK	LOREN COOK
RPM		781	776	767
MOTOR	BHP	0.88	2.28	2.2
	HP	1	3	3
	VFD	NO	NO	NO
	ELEC.	460 / 3 / 60	460 / 3 / 60	460 / 3 / 60
ROOF EXH.		X	X	X
PROPELLER				
CENTRIFUGAL				
INLINE				
REMARK		ROOF CURB, BACK DRAFT DAMPER		

Abbreviations:

TX Toilet Exhaust

Fan Schedules :: Propeller Exhaust Fan Schedule

EXHAUST [PROPELLER] FAN SCHEDULE					
UNIT NO.		EF-B2.1	EF-B2.2	EF-G.1	EF-G.2
SERVICE		BASEMENT LVL		GROUND LVL	
CFM		3700	3700	3300	3300
SP IN. WG.		0.7	0.7	0.75	0.7
MANUFACTURER		LOREN COOK		LOREN COOK	
RPM		919	919	1424	899
MOTOR	BHP	1.26	1.26	1.09	1.2
	HP	1.5	1.5	1.5	1.5
	VFD	NO	NO	NO	NO
	ELEC.	460 / 3 / 60	460 / 3 / 60	460 / 3 / 60	460 / 3 / 60
ROOF EXH.					
PROPELLER		X	X	X	X
CENTRIFUGAL					
INLINE					
REMARKS		OSHA WIRE GUARD, WALL COLLAR WALL SHUTTER, WEATHER HOOD			

Abbreviations:

EF Exhaust Fan

Fan Schedules :: Centrifugal Outdoor Air Fan Schedule

OUTDOOR AIR [CENTRIFUGAL] FAN SCHEDULE				
UNIT NO.		OAF-4.1	OAF-4.2	OAF-6.1
SERVICE		FL 1, 2, 3 S MER	FL 1, 2, 3 N MER	FL 4, 5 MER
CFM		25200	19200	8750
SP IN. WG.		0.95	0.95	0.9
MANUFACTURER		LOREN COOK	LOREN COOK	LOREN COOK
RPM		571	603	928
MOTOR	BHP	6.648	4.604	2.33
	HP	7.5	5	3
	VFD	NO	NO	NO
	ELEC.	460 / 3 / 60	460 / 3 / 60	460 / 3 / 60
ROOF EXH.				
PROPELLER				
CENTRIFUGAL		X	X	X
INLINE				
REMARKS		ROOF CURB, FILTER, MOTORIZED DAMPER 120 / 1 / 60		

Abbreviations:

OAF Outdoor Air Fan

System Critique

The Philadelphia School District decided to go with an all electric system. This provides many benefits to the district, including maintenance and operation. The self contained air handling units make the system easy to maintain with its condensers, expansion valves, and compressors outside of the supply air stream.

The atrium adds a welcoming feel to this old printing facility, however, something could have been done with operable skylights to provide natural ventilation. This would have to be looked carefully into because smoke purge is such an important part of designing an atrium space.

Steam was the other alternative to electric when planning this project. Although predicted to be slightly cheaper in first cost, it was decided against because of the maintainability it would require. Using electricity as the primary energy source can be inefficient. Other systems like under floor air distribution and even steam may be more efficient. Measuring first cost versus life cycle cost for these systems may allow a client to look at other options for future energy and thus monetary savings.

References

McQuay Catalog information:
http://www.mcquay.com/mcquaybiz/literature/lit_aa_sc/Brochures/ASP31-153.pdf
http://www.mcquay.com/eprise/main/McQuayBiz/Lit_AA_SC/Catalogs/Cat860-5_screen.pdf

Mapquest, Map of 440 N Broad St Philadelphia, PA

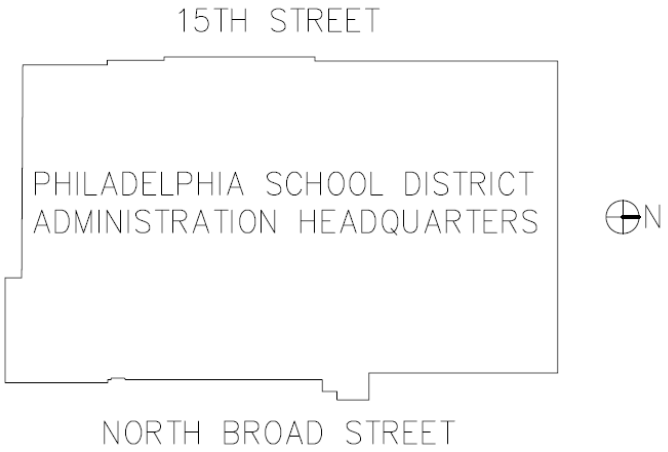
CannonDesign, Documents for Philadelphia School District Administration Headquarters.

Hooper Shiles Architects, Documents and rendering for Philadelphia School District Administration Headquarters.

Past Penn State AE Thesis Technical Reports

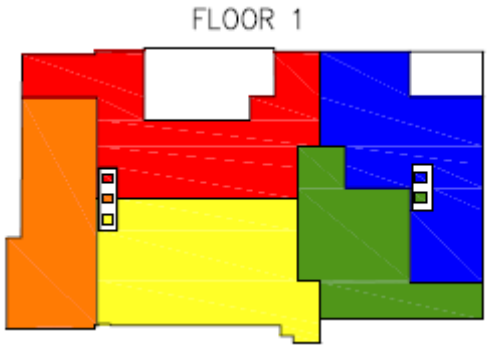
Appendix A: Building AHU Systems Overview

The Administration building has a total **footprint area** of **161,000 square feet** (SF) with a total **gross area** of **848,000 SF**.



The building has a parallel fan-powered VAV system and is supplied by 17 new air handling units (AHUs) with supply air totaling 529,000 cubic feet per minute (CFM). Individual units are contained in mechanical rooms on the floor it is supplying. An example of an AHU's schedule number is 1.4, where 1 is the floor number and 4 is the unit's number on that floor. The following is a color-coded schedule of the unit layout by floor:

Floors 1 through 3 are broken up by a north half and a south half, each with its own mechanical room. The **first floor** has 5 AHUs, two serving the south half, two serving the north half and one serving the south tenant space (a double height space). The later AHU rises through a shaft to serve the space from the second floor ceiling.

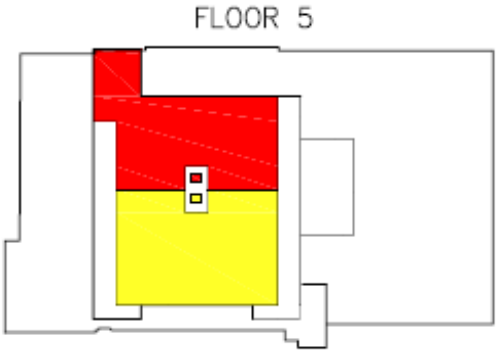


Four AHUs serve the **second floor**: two serving the south half and two serving the north half.

The **third floor** has 4 AHUs, two serving the south half, two serving the north half and one serving the south tenant space (above the tenant space on the first floor).

One AHU serves the entire **fourth floor**.

The **fifth floor** has 2 AHUs, one serving the east half and one serving the west half.



A new architectural feature in the building is the **three story atrium** between floors 1 and 3. This space is served by AHU 4 on each floor (1, 2, and 3). It receives 15,000 CFM in total from these three air handling units.

Appendix B: Trace Energy Analysis

Load / Airflow Summary

By ae

Description **		Floor Area ft²	People #	Coil Cooling Sensible Btu/h	Coil Cooling Total Btu/h	Space Design Max SA cfm	Air Changes ach/hr	VAV Minimum SA cfm	Main Coil Heating Sensible Btu/h	Heating Fan Max SA cfm	Percent OA Clg	Percent OA Htg	ASHRAE 62-89 OA fraction
FL-1 north	Rm/Zn Tot	50,000	349.7	1,486,382	1,731,268	79,317	7.61	0	0	0	8.8		
FL-1 NORTH	Sys Tot/Ave	50,000	349.7	1,486,382	1,731,268	79,317			0	0	8.8		
FL-1 NORTH	Sys Block	50,000	349.7	1,486,382	1,731,269	79,317			0	0	8.8		
FL-1 south	Rm/Zn Tot	48,000	335.7	1,388,268	1,623,499	72,787	7.28	0	0	0	9.2		
FL-1 SOUTH	Sys Tot/Ave	48,000	335.7	1,388,268	1,623,499	72,787			0	0	9.2		
FL-1 SOUTH	Sys Block	48,000	335.7	1,388,268	1,623,499	72,787			0	0	9.2		
FL-2 north	Rm/Zn Tot	58,000	405.6	1,654,524	1,938,535	86,613	7.17	0	0	0	9.4		
FL-2 NORTH	Sys Tot/Ave	58,000	405.6	1,654,524	1,938,535	86,613			0	0	9.4		
FL-2 NORTH	Sys Block	58,000	405.6	1,654,524	1,938,535	86,613			0	0	9.4		
FL-2 south	Rm/Zn Tot	58,000	405.6	1,655,716	1,939,938	86,812	7.18	0	0	0	9.3		
FL-2 SOUTH	Sys Tot/Ave	58,000	405.6	1,655,716	1,939,938	86,812			0	0	9.3		
FL-2 SOUTH	Sys Block	58,000	405.6	1,655,716	1,939,938	86,812			0	0	9.3		
FL-3 north	Rm/Zn Tot	58,000	405.6	1,938,663	2,210,844	93,260	7.72	0	0	0	8.7		
FL-3 NORTH	Sys Tot/Ave	58,000	405.6	1,938,663	2,210,844	93,260			0	0	8.7		
FL-3 NORTH	Sys Block	58,000	405.6	1,938,663	2,210,844	93,260			0	0	8.7		
FL-3 south	Rm/Zn Tot	58,000	405.6	1,730,733	2,002,881	89,318	7.39	0	0	0	9.1		
FL-3 SOUTH	Sys Tot/Ave	58,000	405.6	1,730,733	2,002,881	89,318			0	0	9.1		
FL-3 SOUTH	Sys Block	58,000	405.6	1,730,733	2,002,881	89,318			0	0	9.1		
FL-4	Rm/Zn Tot	50,000	349.7	1,530,480	1,765,111	78,987	10.53	0	0	0	8.9		
FL-4	Sys Tot/Ave	50,000	349.7	1,530,480	1,765,111	78,987			0	0	8.9		
FL-4	Sys Block	50,000	349.7	1,530,480	1,765,111	78,987			0	0	8.9		
FL-5	Rm/Zn Tot	38,500	269.2	1,318,426	1,499,119	63,814	11.05	0	0	0	8.4		
FL-5	Sys Tot/Ave	38,500	269.2	1,318,426	1,499,119	63,814			0	0	8.4		
FL-5	Sys Block	38,500	269.2	1,318,426	1,499,119	63,814			0	0	8.4		
tenant-fl1	Rm/Zn Tot	27,500	192.3	778,757	913,447	42,081	3.57	0	0	0	9.1		
TENANT FL-1	Sys Tot/Ave	27,500	192.3	778,757	913,447	42,081			0	0	9.1		
TENANT FL-1	Sys Block	27,500	192.3	778,757	913,447	42,081			0	0	9.1		
tenant-fl3	Rm/Zn Tot	28,000	195.8	889,943	1,021,424	43,081	3.59	0	0	0	9.1		
TENANT FL-3	Sys Tot/Ave	28,000	195.8	889,943	1,021,424	43,081			0	0	9.1		
TENANT FL-3	Sys Block	28,000	195.8	889,943	1,021,424	43,081			0	0	9.1		
Atrium	Rm/Zn Tot	7,220	216.8	416,063	567,951	16,379	2.90	0	-369,431	6,024	26.5	0.0	

** This report does not display heating only systems.

Project Name: 440 N. BOARD STREET
Dataset Name: C:\Documents and Settings\jla250\Desktop\Energy.TRC

TRACE® 700 v4.1 calculated at 03:48 PM on 10/25/2005
Alternative - 1 Load/Airflow Summary report page 1

Load / Airflow Summary

By ae

Description **		Floor Area ft²	People #	Coil Cooling Sensible Btu/h	Coil Cooling Total Btu/h	Space Design Max SA cfm	Air Changes ach/hr	VAV Minimum SA cfm	Main Coil Heating Sensible Btu/h	Heating Fan Max SA cfm	Percent OA Clg	Percent OA Htg	ASHRAE 62-89 OA fraction
Atrium	Sys Tot/Ave	7,220	216.8	416,063	567,951	16,379			-369,431	6,024	26.5	0.0	
Atrium	Sys Block	7,220	216.8	416,063	567,951	16,379			-369,431	6,024	26.5	0.0	
Broad St lobby	Rm/Zn Tot	4,600	138.1	209,295	260,575	9,053	9.46	0	-169,477	9,053	15.2	0.0	
BROAD ST LOBBY	Sys Tot/Ave	4,600	138.1	209,295	260,575	9,053			-169,477	9,053	15.2	0.0	
BROAD ST LOBBY	Sys Block	4,600	138.1	209,295	260,575	9,053			-169,477	9,053	15.2	0.0	
15 ST LOBBY	Rm/Zn Tot	5,838	83.4	138,248	194,429	5,164	4.25	0	-94,700	5,164	32.3	0.0	
15 ST LOBBY	Sys Tot/Ave	5,838	83.4	138,248	194,429	5,164			-94,700	5,164	32.3	0.0	
15 ST LOBBY	Sys Block	5,838	83.4	138,248	194,429	5,164			-94,700	5,164	32.3	0.0	

** This report does not display heating only systems.

Project Name: 440 N. BOARD STREET
Dataset Name: C:\Documents and Settings\jla250\Desktop\Energy.TRC

TRACE® 700 v4.1 calculated at 03:48 PM on 10/25/2005
Alternative - 1 Load/Airflow Summary report page 2

ENGINEERING CHECKS

By ae

Description	Type	COOLING % OA	COOLING cfm/ft²	COOLING cfm/ton	COOLING ft²/ton	COOLING Btu/hr·ft²	HEATING % OA	HEATING cfm/ft²	HEATING Btu/hr·ft²	Floor Area ft²
FL-1 north	Zone	8.82	1.59	549.8	346.6	34.63		0.00	-7.10	50,000
FL-1 NORTH	System - Parallel Fan-Powered VAV	8.82	1.59	549.8	346.6	34.63		0.00	-4.64	50,000
FL-1 south	Zone	9.22	1.52	538.0	354.8	33.82		0.00	-7.08	48,000
FL-1 SOUTH	System - Parallel Fan-Powered VAV	9.22	1.52	538.0	354.8	33.82		0.00	0.00	48,000
FL-2 north	Zone	9.37	1.49	536.2	359.0	33.42		0.00	-7.08	58,000
FL-2 NORTH	System - Parallel Fan-Powered VAV	9.37	1.49	536.2	359.0	33.42		0.00	0.00	58,000
FL-2 south	Zone	9.34	1.50	537.0	358.8	33.46		0.00	-7.07	58,000
FL-2 SOUTH	System - Parallel Fan-Powered VAV	9.34	1.50	537.0	358.8	33.46		0.00	0.00	58,000
FL-3 north	Zone	8.70	1.61	506.2	314.8	38.12		0.00	-19.19	58,000
FL-3 NORTH	System - Parallel Fan-Powered VAV	8.70	1.61	506.2	314.8	38.12		0.00	0.00	58,000
FL-3 south	Zone	9.08	1.54	535.1	347.5	34.53		0.00	-7.09	58,000
FL-3 SOUTH	System - Parallel Fan-Powered VAV	9.08	1.54	535.1	347.5	34.53		0.00	0.00	58,000
FL-4	Zone	8.85	1.58	537.0	339.9	35.30		0.00	-7.10	50,000
FL-4	System - Parallel Fan-Powered VAV	8.85	1.58	537.0	339.9	35.30		0.00	0.00	50,000
FL-5	Zone	8.44	1.66	510.8	308.2	38.94		0.00	-19.69	38,500
FL-5	System - Parallel Fan-Powered VAV	8.44	1.66	510.8	308.2	38.94		0.00	0.00	38,500
tenant-fl1	Zone	9.14	1.53	552.8	361.3	33.22		0.00	-7.10	27,500
TENANT FL-1	System - Parallel Fan-Powered VAV	9.14	1.53	552.8	361.3	33.22		0.00	0.00	27,500
tenant-fl3	Zone	9.09	1.54	506.1	329.0	36.48		0.00	-18.31	28,000
TENANT FL-3	System - Parallel Fan-Powered VAV	9.09	1.54	506.1	329.0	36.48		0.00	0.00	28,000
Atrium	Zone	26.48	2.27	346.1	152.5	78.66	0.00	0.83	-79.49	7,220
Atrium	System - Parallel Fan-Powered VAV	26.48	2.27	346.1	152.5	78.66	0.00	0.83	-32.15	7,220
Broad St lobby	Zone	15.24	1.97	416.9	211.8	56.65	0.00	1.97	-36.84	4,600
BROAD ST LOBBY	System - Packaged Terminal Air Conditioner	15.24	1.97	416.9	211.8	56.65	0.00	1.97	0.00	4,600
15 ST LOBBY	Zone	32.30	0.88	318.7	360.3	33.30	0.00	0.88	-16.22	5,838
15 ST LOBBY	System - Packaged Terminal Air Conditioner	32.30	0.88	318.7	360.3	33.30	0.00	0.88	0.00	5,838
15 ST LOBYY HEAT	Zone	0.00	0.00	0.0	0.0	0.00	0.00	4.59	-281.21	200
15ST LOBBY HEAT	System - Unit Heaters	0.00	0.00	0.0	0.0	0.00	0.00	4.59	-281.21	200
BROAD ST LOBBY HEAT	Zone	0.00	0.00	0.0	0.0	0.00	0.00	2.99	-183.34	300
BROAD ST LOBBY HEAT	System - Unit Heaters	0.00	0.00	0.0	0.0	0.00	0.00	2.99	-183.34	300

Project Name: 440 N. BOARD STREET
Dataset Name: C:\Documents and Settings\jla250\Desktop\Energy.TRC

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Alternative - 1 Page 1 of Engineering Checks Report

SYSTEM SUMMARY

DESIGN AIRFLOW QUANTITIES

By ae

System Description	System Type	MAIN SYSTEM Outside Airflow cfm	MAIN SYSTEM Cooling Airflow cfm	MAIN SYSTEM Heating Airflow cfm	MAIN SYSTEM Return Airflow cfm	MAIN SYSTEM Exhaust Airflow cfm	Auxiliary System Supply Airflow cfm	Room Exhaust Airflow cfm
FL-1 NORTH	Parallel Fan-Powered VAV	6,993	79,317	0	79,317	6,993	0	0
FL-1 SOUTH	Parallel Fan-Powered VAV	6,713	72,787	0	72,787	6,713	0	0
FL-2 NORTH	Parallel Fan-Powered VAV	8,112	86,613	0	86,613	8,112	0	0
FL-2 SOUTH	Parallel Fan-Powered VAV	8,112	86,812	0	86,812	8,112	0	0
FL-3 NORTH	Parallel Fan-Powered VAV	8,112	93,260	0	93,260	8,112	0	0
FL-3 SOUTH	Parallel Fan-Powered VAV	8,112	89,318	0	89,318	8,112	0	0
FL-4	Parallel Fan-Powered VAV	6,993	78,987	0	78,987	6,993	0	0
FL-5	Parallel Fan-Powered VAV	5,385	63,814	0	63,814	5,385	0	0
TENANT FL-1	Parallel Fan-Powered VAV	3,846	42,081	0	42,081	3,846	0	0
TENANT FL-3	Parallel Fan-Powered VAV	3,916	43,081	0	43,081	3,916	0	0
Atrium	Parallel Fan-Powered VAV	4,336	16,379	6,024	16,379	4,336	0	0
BROAD ST LOBBY	Packaged Terminal Air Conditioner	1,380	9,053	9,053	9,053	1,380	0	0
15 ST LOBBY	Packaged Terminal Air Conditioner	1,668	5,164	5,164	5,164	1,668	0	0
15ST LOBBY HEAT	Unit Heaters	0	0	917	0	25	0	0
BROAD ST LOBBY HEAT	Unit Heaters	0	0	897	0	19	0	0
Totals		73,678	766,665	22,054	766,665	73,722	0	0

Note: Airflows on this report are not additive because they are each taken at the time of their respective peaks. To view the balanced system design airflows, see the appropriate Checksums report (Airflows section).

Project Name: 440 N. BOARD STREET
Dataset Name: C:\Documents and Settings\jla250\Desktop\Energy.TRC

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Alternative - 1 Design Airflow Quantities report page 1