The Pennsylvania State University
Steam Services Building

Final Thesis Report

AE 482: Architectural Engineering Thesis
April 22, 2019
Mitchell Seltzer, Mechanical Option
Dr. William Bahnfleth, Faculty Advisor

Abstract

Steam Services Building

Contractor: Alexander Building Construction Co
Architect: Buchart Horn Architects
Civil: Buchart Horn Architects
Structural: Buchart Horn Architects
MEP: Buchart Horn Architects
Interior: Diversified Design
Owner: The Pennsylvania State University

Construction

- 4 story, 33,000 square feet mixed-use building
- Features machine and shop rooms as well as office spaces, which requires significant noise reduction features.
- Modern design featuring precast stone and modified flemish bond brick facade. The facilities design is intended to complement the existing west campus steam plant and meant to tie into surrounding campus designs.
- 25 foot vertically spanning curtain wall windows on the east, south and west sides. Cantilevered design atop the all glass main lobby featuring floor to ceiling curtain walls on the first floor.

MEP

- One rooftop DOAS with an energy recovery unit, vertical fan coil units, blower coil units all tied into campus steam heat and cooling loops.
- A mini-split system with a condensing outside at ground level.
- Main electrical transformer ties into the existing steam plant providing a high voltage of 480/277v and a low voltage of 208/120v 3-phase, with distribution panels on each floor and different circuits each room.
- Emergency generator backup for egress and a wet pipe sprinkler system serving all floors.

Structural

- Concrete spread footings with CMU foundation walls on the south half.
- Concrete basement walls on the north half of the building with a concrete slab on grade.
- Steel superstructure with webbed floor joists.

Mitchell Seltzer | Mechanical **Steam Services Building**

Dr. William Bahnfleth **https://mps5404.wixsite.com/aethesis** **State College, PA**

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Executive Summary

The Pennsylvania State University New Steam Services Building At The West Campus Steam Plant is a 33,000 square foot multipurpose office building. The building sits within the West Campus Steam Plant's courtyard which previously housed the coal fired boilers, bag house and smoke stack. In 2016 the West Campus Steam Plant begun its transition from a coal fired system to a exclusively natural gas based system. After the plant's conversion to natural gas the university was able to demolish the boilers, bag house and smoke stack, providing the lot in which the New Steam Services Building is being constructed on.

The facility is being constructed by Alexander Building Construction Co. for the Energy Services division at Penn State University. The four story building features a spread footing foundation, a steel structure, and a decentralized HVAC system. The design and construction of the facility is extremely important to the Energy Services department as the building will largely serve as the center for students and visitors to understand the advanced operations that occur at the campus steam plants.

Within the multipurpose office building, the basement and North section of the first floor feature industrial shops spaces. These spaces will be used by the Penn State Steam Plant workers to fabricate, repair and assemble equipment that will be used next door in the West Campus Steam Plant. The second floor and the South portion of the first floor consist of office spaces as well as a break room, a training room, and storage spaces. A small section of the second floor and most of the third floor is currently shell space for future expansions.

The decentralized HVAC system features a dedicated outdoor air system with an energy recovery wheel. The system also features a split system for the telecom room. The building's heat is supplied by a steam line to shell and tube heat exchangers, and the heating and cooling is distributed through a four pipe heating and cooling system.

In the following report there will be two mechanical redesign proposals. First, active chilled beams will be installed, while utilizing the existing dedicated outdoor air system equipment. Next will be the Air Handling Unit Changeover-Bypass System with variable air volume boxes. Here, the dedicated outdoor air unit will be updated to the new air handling unit, and spaces served by fan coil units with the variable air volume boxes. Both proposals will include an analysis for cost, payback, and energy savings. In addition to the mechanical redesign proposals, there will also be two breadth topics that analyze the effects of the proposed air handling unit on both the structural and electrical systems.

Existing Conditions

The Penn State Steam Services Building currently has a mechanical system consisting of a decentralized HVAC system with a dedicated outdoor air system, which includes an energy recovery wheel. This system also includes a split system for the telecom room. Building side heating is performed via steam. The system is served by The Pennsylvania State University West Campus Steam Plant building through a steam line that goes through shell and tube heat exchangers that supplies the building through a hot water loop. This is connected to a series of 46 fan coil units, 2 blower coil units, 3 unit heaters, and a dedicated outdoor air system with hydronic coils. Refer to the image below for the Hot Water Diagram.

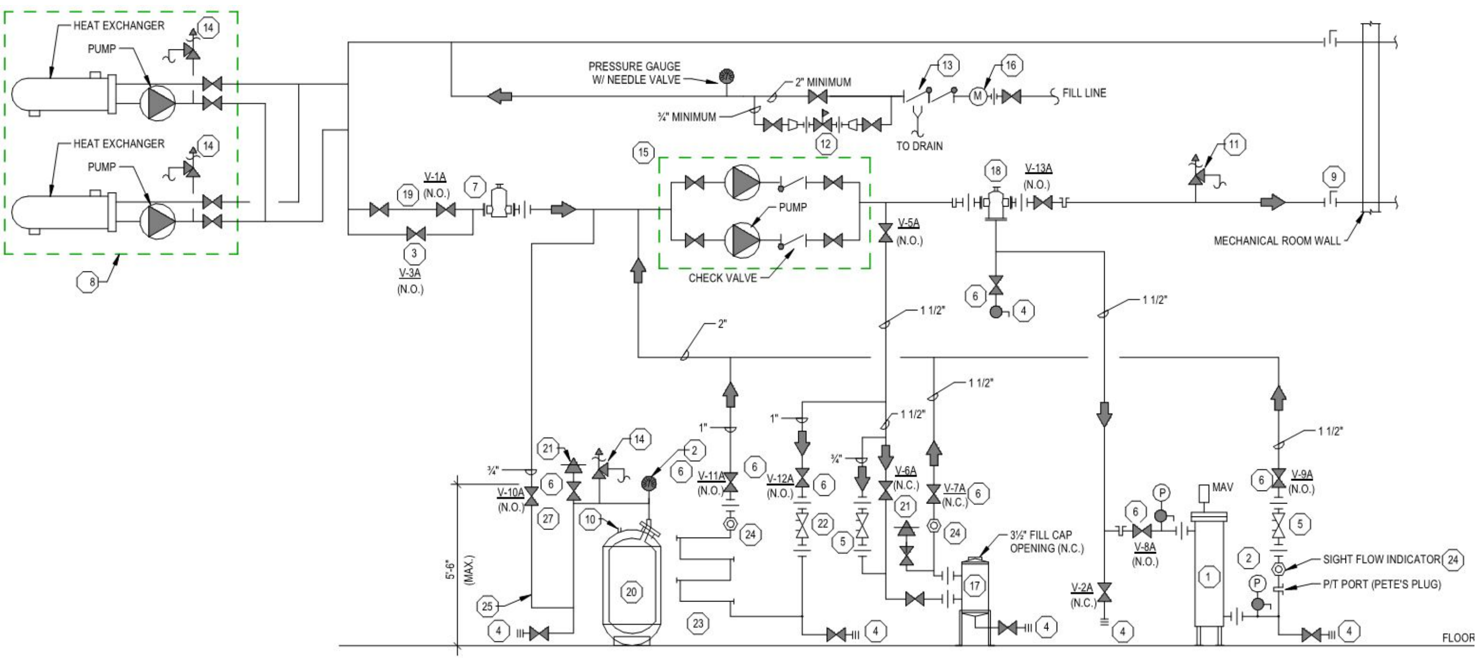

Figure 1: Hot Water Riser Diagram

Building side cooling is performed via chilled water. The system is served by The Pennsylvania State University West Campus Chiller building. Chilled water is supplied via a 3" Supply and Return line and pumped via Chilled Water Pumps from the pump room in the basement to a chilled water loop that is connected to a series of 46 fan coil units, 2 blower coil units, and a dedicated outdoor air system with hydronic coils. Refer to the image below for the Chilled Water Diagram.

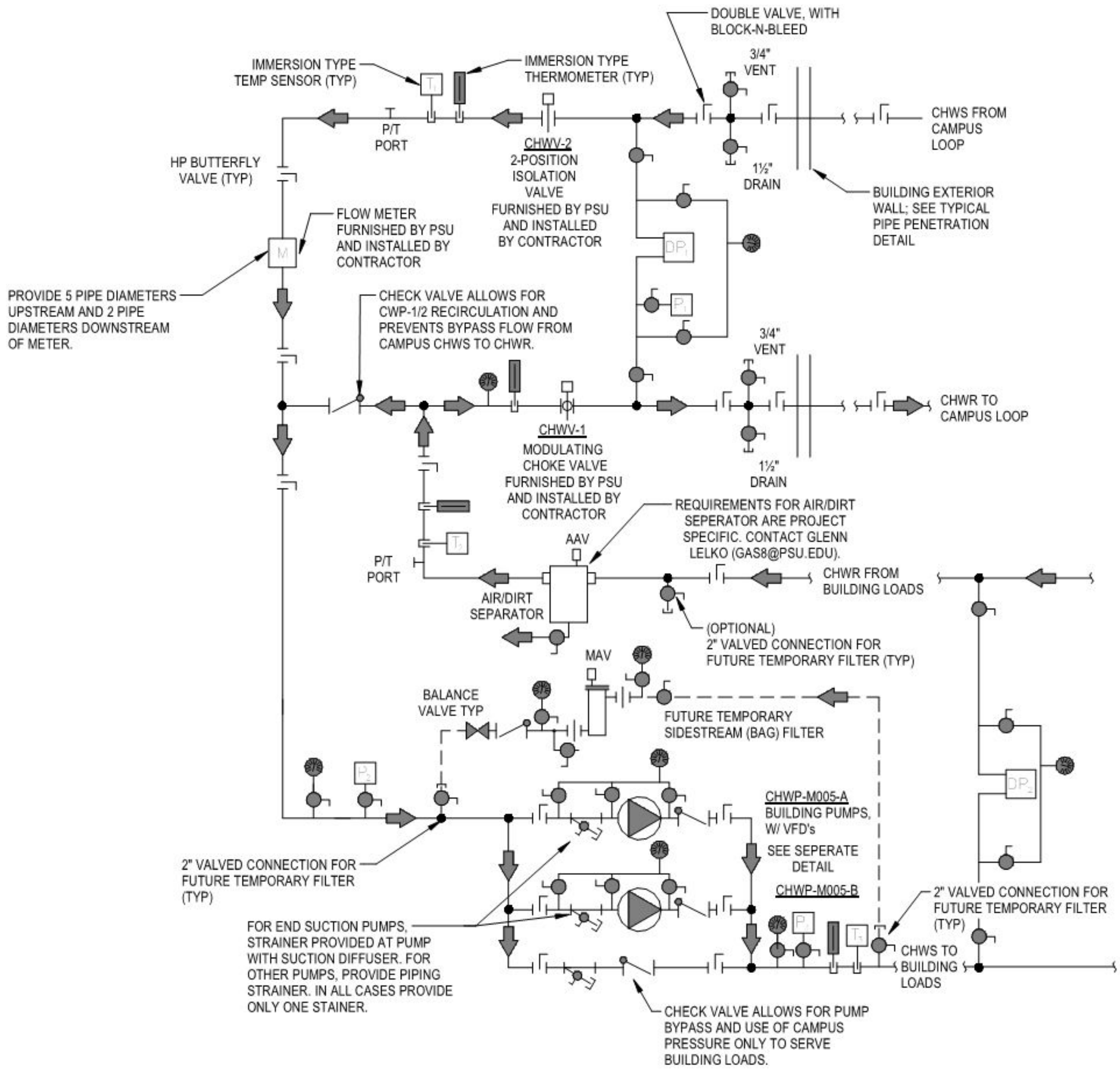

Figure 2: Chilled Water Riser Diagram

Building loads were found by performing an energy model of the building on the software Trane Trace. The following tables outline the building energy use, utility use, and building operation cost. These values will be the baseline used to determine the feasibility of the proposed mechanical designs.

Table 1: Total Energy Use per Year

Total Building Energy per Year (kBtu/yr)	6,458,112.00
Total Source Energy per Year (kBtu/yr)	12,619,165.00

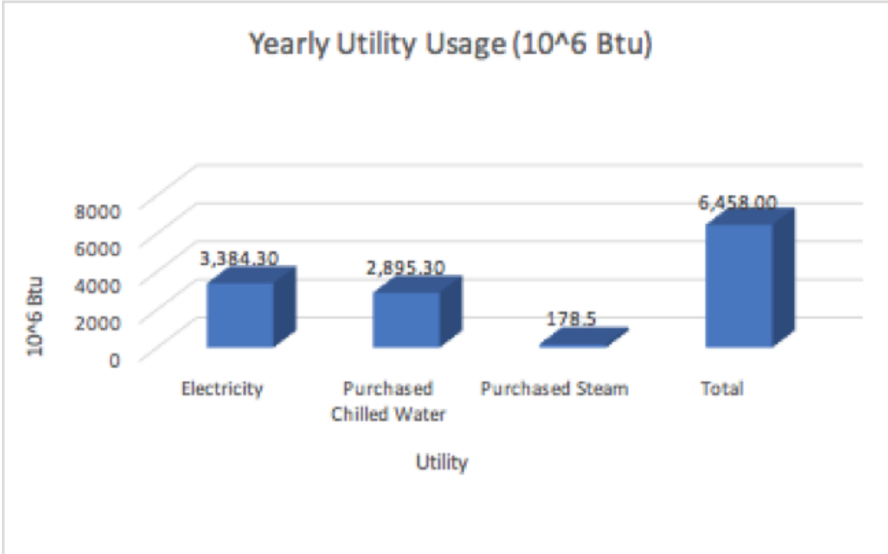

Figure 3: Yearly Utility Usage

Table 2: Monthly Utility Usage

	Electric (kWh)	Steam (therms)	Chilled Water (therms)
January	82,938	390	2,269
February	74,896	344	2,058
March	82,878	297	2,489
April	80,195	173	2,578
May	83,002	62	2,099
June	80,459	59	2,588
July	83,105	71	3,159
August	83,245	66	2,206
September	80,386	34	2,079
October	82,918	91	2,346
November	80,195	164	2,514
December	82,879	324	2,340

Table 3: Energy and Life Cycle Cost

Energy Cost per Year	$ 97,633.00
Initial Cost	$ 215,000.00
Maintenance Cost per Year	$ 6,363.65
15 Year Life Cycle Cost	$ 1,774,949.00

To keep the existing air-water system of the current mechanical system, active chilled beams were chosen as the first mechanical redesign proposal. Active chilled beams work by the two thermodynamic properties of radiation and convection, and provide heating and cooling to spaces with necessary additional ventilation from the air handling unit.

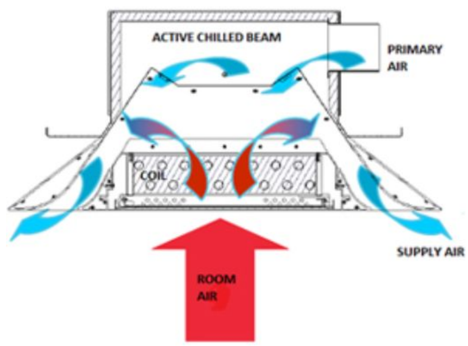

Figure 4: Active Chilled Beam Schematic

To calculate the number and size of the active chilled beams required for the building, Trane Trace was first used to find the total load of the chilled beams. Using their load selection, the loads for each room were determined and entered into Titus Teams's Active Chilled Beams selection software. In addition to these the latent load, sensible load, heating load, and airflow for each room was entered. Once the software was run it yielded CBAL-12 type active chilled beams at 2', 4', 6', and 8'.

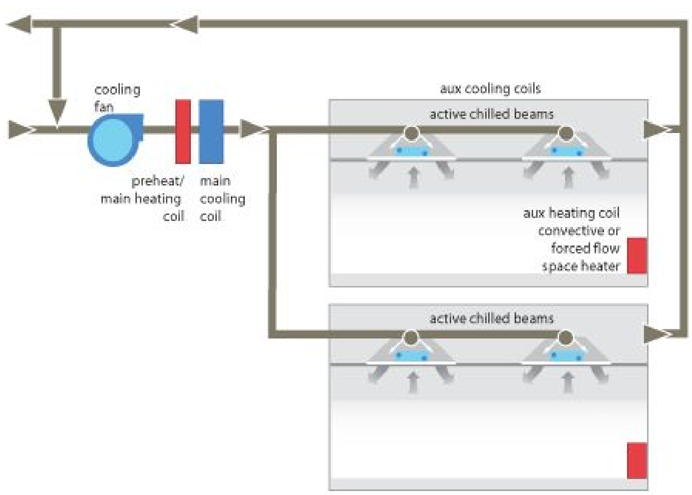

Figure 5: Active Chilled Beam System Schematic

Table 4: Active Chilled Beam Software Results

Active Chilled Beam			
First Cost			
Size	**Cost**	**Number**	**Total**
8'	950	41	$ 38,950
6'	750	49	$ 36,750
4'	650	6	$ 3,900
2'	500	29	$ 14,500
TOTAL		125	**$ 94,100**

Table 5: Energy Use per Year

Total Building Energy per Year (kBtu/yr)	6,680,735.00
Total Source Energy per Year (kBtu/yr)	12,624,769.00

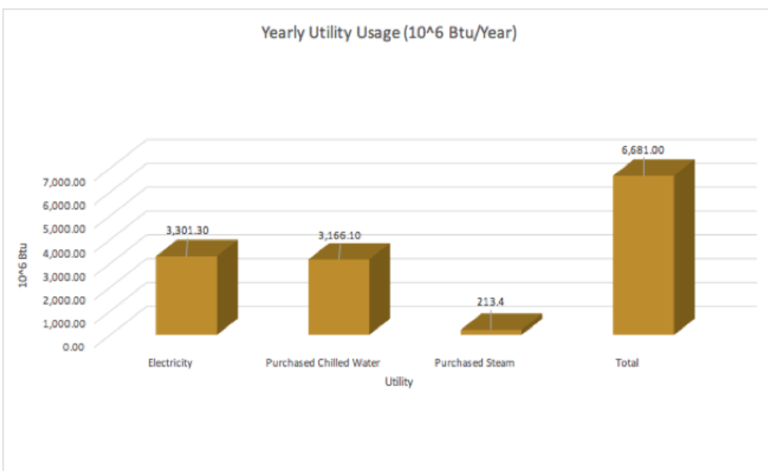

Figure 6: Yearly Utility Use of Active Chilled Beam System

Table 6: Energy and Life Cycle Cost

Energy Cost per Year	$ 96,691.00
Initial Cost	$ 159,100.00
Maintenance Cost per Year	$ 1,417.45

15 Year Life Cycle Cost	$ 1,630,726.75
Savings per Year	$ 5,888.20

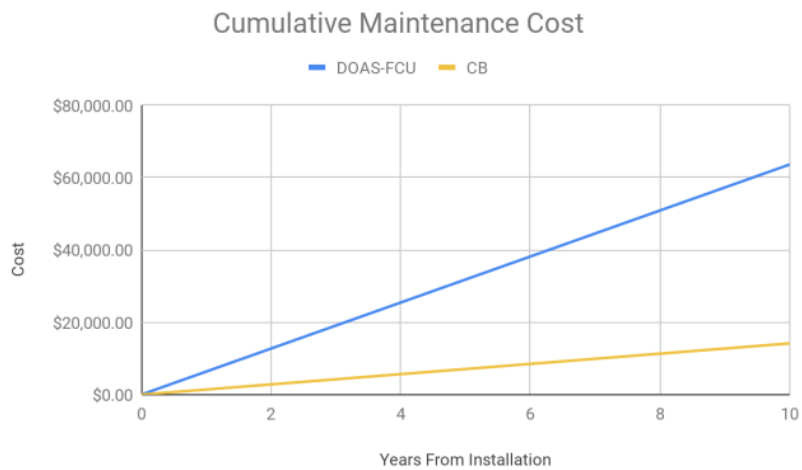

Figure 7: Yearly Progressive Maintenance Cost of Original System versus Active Chilled Beam System

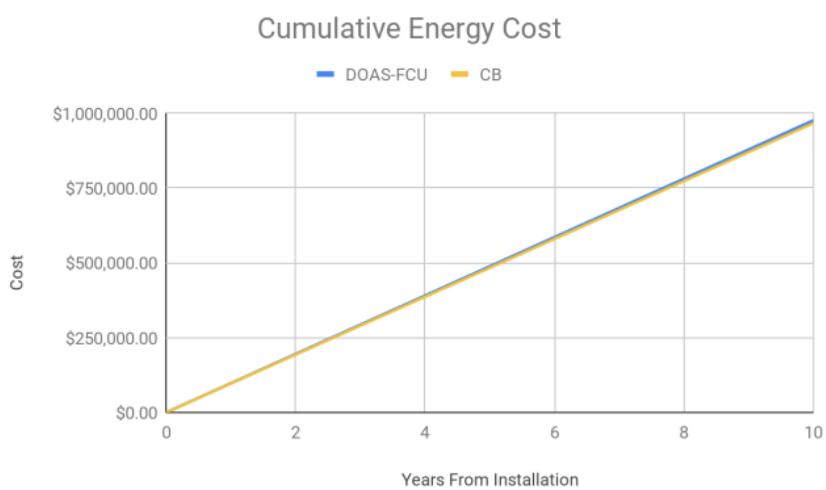

Figure 8: Yearly Progressive Energy Cost of Original System versus Active Chilled Beam System

$$Payback\ Period = \frac{\underline{Initial\ Cost}}{Savings} = \frac{\$159,100}{\$5,888.20} = 27\ years$$

The first mechanical redesign proposal will be an air handling unit changeover-bypass system with variable air volume units. Hot water and chilled water will be provided to the rooftop air handling unit from the Penn State campus steam and chiller plants. Included in the air handling unit will be a desiccant energy wheel, used to help with latent and sensible recovery for both heating and cooling seasons, standard air filters, and fans that supply both necessary ventilation air and enough for heating and cooling. Air will be selectively distributed throughout the building with the use of variable air volume (VAV) units, which controls the volume of supply air to zones based on zone loads. In the occasion that the VAV zones do not require the full amount of air supplied by the air handling unit, then the changeover-bypass system will return the excess air back to the air handling unit.

In order to correctly size the proposed air handling unit, Trane Trace was first used to determine the heating and cooling loads of the building under this new system. The company H.C. Nye Co. was then consulted to assist in choosing a model of the correct size.

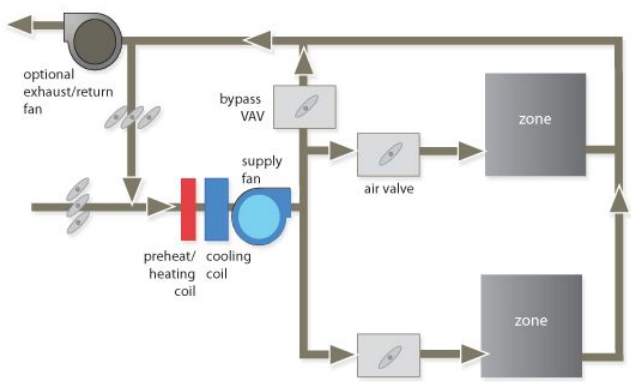

Figure 9: Air Handling Unit with VAV Schematic Diagram

Table 7: Air Handling Unit Specifications

Maximum Air Flow	15,946 CFM
Cooling - Sensible Capacity	474.45 MBH
Cooling - Latent Capacity	204.60 MBH
Heating Capacity	228.7 MBH

Table 8: Energy Use per Year

Total Building Energy per year (kBtu/yr)	5,444,031.00
Total Source Energy per year (kBtu/yr)	11,683,876.00

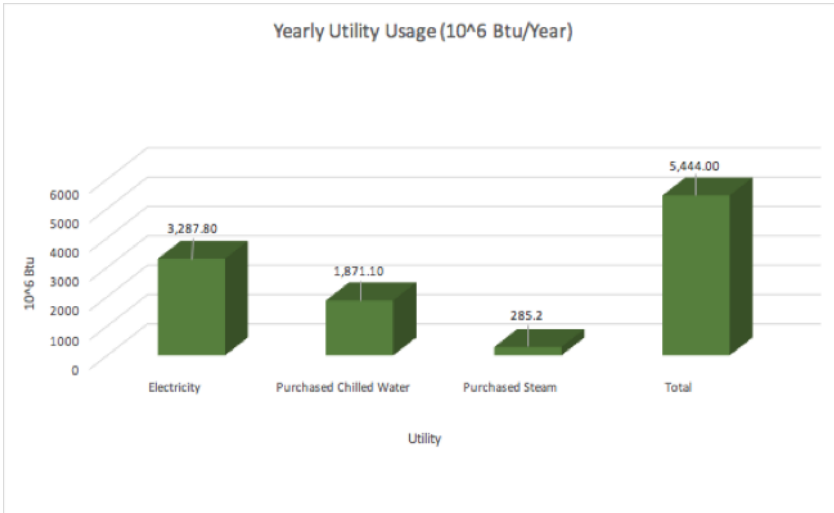

Figure 10: Yearly Utility Use of Air Handling Unit System

Table 9: Energy and Life Cycle Cost

Energy Cost per Year	$ 94,770.00
Initial Cost	$ 114,000.00
Maintenance Cost per Year	$ 548.20
15 Year Life Cycle Cost	$ 1,543,773
Savings per Year	$ 8,678.45

Figure 11: Yearly Progressive Maintenance Cost of Original System versus Air Handling Unit System

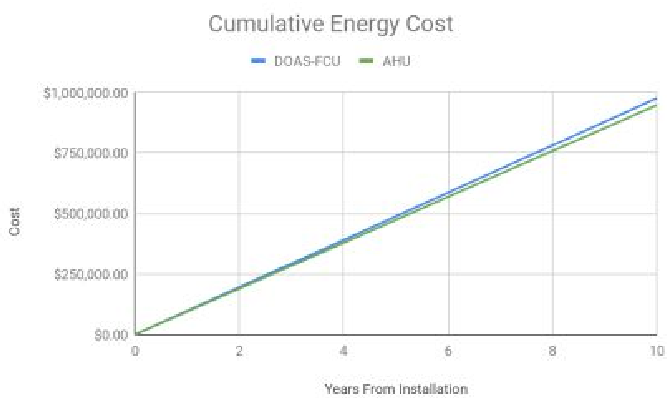

Figure 12: Yearly Progressive Energy Cost of Original System versus Air Handling Unit System

$$Payback\ Period = \frac{Initial\ Cost}{Savings} = \frac{\$114,000}{\$8,678.45} = 13\ years$$

Depth Proposal Comparison

After completing each mechanical redesign analysis, the final system recommendation was chosen to be the proposed air handling unit with VAV units throughout the building. This system was chosen based off of a number of results from the analysis. Not only does this system have the lower payback period of 13 years, but also has a much lower annual energy use and upfront cost.

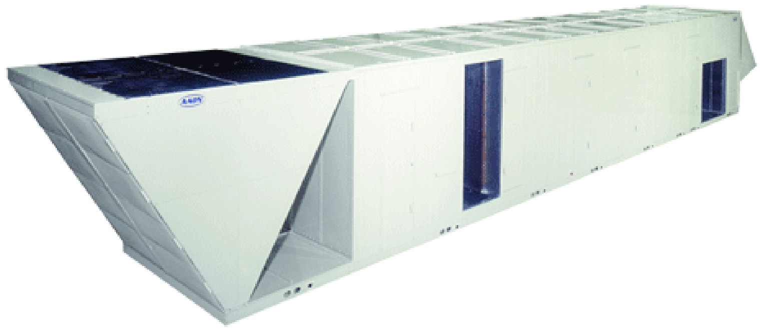

Figure 13: Air Handling Unit

Table 10: Air Handling Unit with VAV Cumulative Analysis Results

Total Building Energy Savings per Year (kBtu/yr)	1,014,081
Total Source Energy Savings per Year (kBtu/yr)	935,289
Initial Cost Savings	$ 101,000.00
Cost Savings per Year	$ 8,678.45
15 Year Cost Savings	$ 231,176.75
25 Year Cost Savings	$ 317,961.25

Structural Breadth

To support the proposed air handling unit on the roof of the existing building, a structural breadth was chosen which consists of resizing the roof support and decking. Curb dimensions and the weight of the proposed air handling unit were supplied by H.C. Nye Co..

Calculating Weight per Square Foot Allowance:
Total Weight = 8,864 lbs
Area = 192.94 SF
8,864 lbs /192.94 SF = 45.94 psf => **Weight per SF Allowance = 75 psf**

The structure of the roof where the equipment will sit consists of girders that are 27’4” center to center, and joists that are 6’ 2.5” center to center.

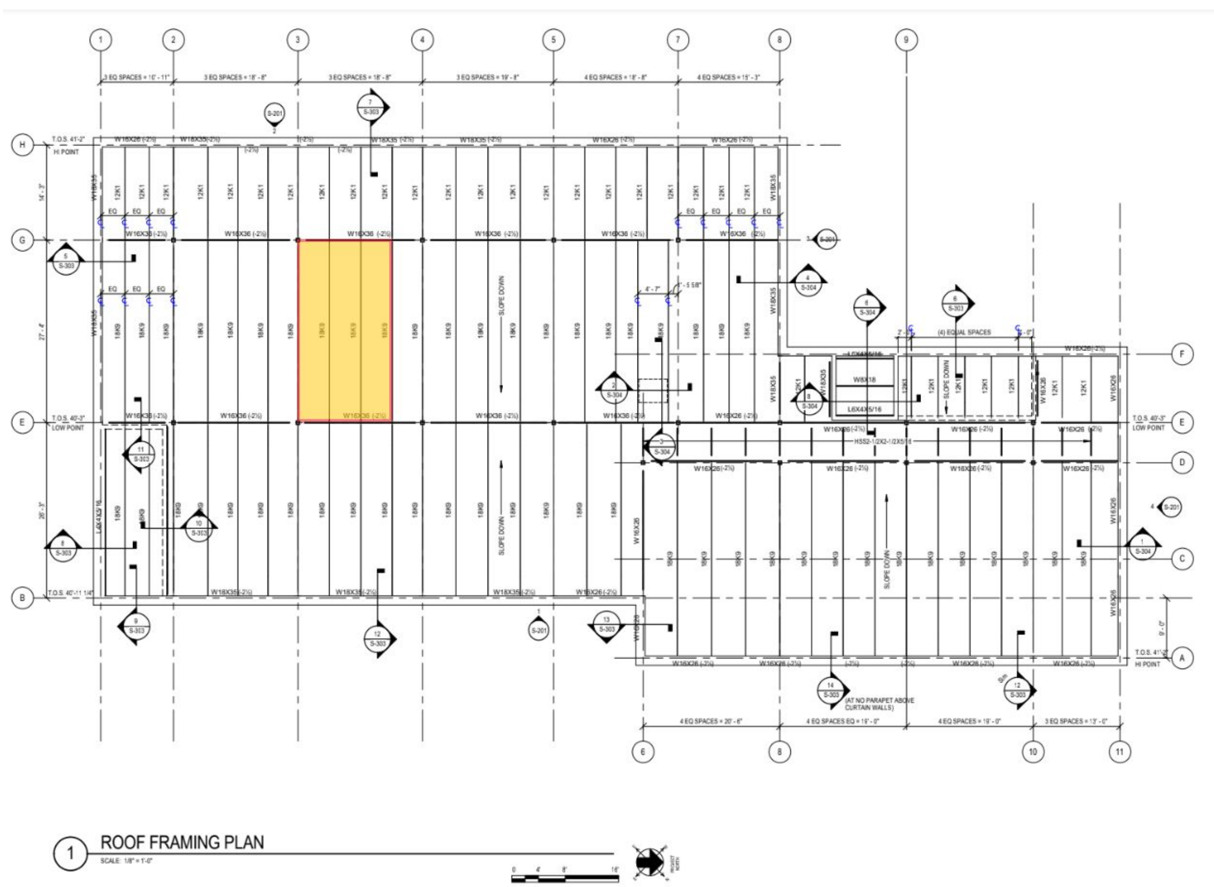

Figure 14: Location of Proposed Air Handling Unit on Roof

Dead Loads:
Membrane = 1.5 psf
Mechanical & Lighting Standard DL = 15 psf

Factored Snow Load:
$P_f = 0.7 * C_e * C_t * C_s * I_s * P_g$
C_e (Exposure Factor) = exposure of type C from drawings, and using Table 7-2 from ASCE 7, factor = **0.9**
C_t (thermal factor) = assumed to be **1**
C_s (slope factor) = assumed to be **1**
I_s (importance factor) = category 2 - factor = **1.0**
P_g (Snow Load) = from State College Ordinance at **40 psf**
$\boldsymbol{P_f = 25.2}$ ***psf***

(1) Size the Decking for Equipment

Using Vulcraft 1.5B Type Steel Roof Decking at 6' span, 3 spans each

Dead Load + Equipment Load + Snow Factored Load
= 16.5 psf + 75 psf + 25.2 psf

Allowable Total Load = 116.7 psf

Using Vulcraft 1.5B Type Steel Roof Decking at 6' span, 3 spans each
Deck Type **B19** (130 psf) is able to support the Allowable Total Load (116.7 psf) and is the most economical and allowable deck.

VERTICAL LOADS FOR TYPE 1.5B

No. of Spans	Deck Type	Max. SDI Const. Span	Allowable T		
			5-0	5-6	6-0
3	B24	5'-10	154 / 120	128 / 90	108 / 69
	B22	6'-11	124 / 167	103 / 126	87 / 97
	B20	7'-9	159 / 209	132 / 157	111 / 121
	B19	8'-5	186 / 250	154 / 188	130 / 145
	B18	9'-1	210 / 289	174 / 217	147 / 167
	B16	10'-3	264 / 369	219 / 277	185 / 214

Figure 15: Vulcraft Sizing Table for 1.5B Steel Roof Deck

(2) Size the Joist for the Equipment
Using Newmill's Economical Load Tables at a 27' joist span

LRFD = $(1.2 L_D + 1.6 L_L) * ft$
$= 1.2(16.5) + 1.6(100.2) = 180.12$ *psf*
180.12(6') = 1080.72 plf

LL(psf) = Equipment Load + Snow Factored Load
*LL(plf) = LL(psf) * ft*
*=100.2 * 6 = 601.2 plf*

Using LRFD = 1080.72 plf and LL = 601.2 plf
And Newmill's Economical Load Tables at a 27' joist span
Joist type **20LH08** was chosen due to the live load having a greater factor then the LRFD and being the most economical

Joist Span (ft)	Total Load (plf)			Live Load (plf)		Joist Designation	Joist Weight (plf)
	Factored		Service				
	LRFD		ASD	1/240	1/360		
27 (cont.)	F	768	512	512	406	22K7	8.5
	F	825	550	550	522	26K7	8.8
	F	849	566	566	406	20LH04	10.9
	F	913	609	609	437	20LH05	11.3
	F	972	648	621	414	18LH05	13.0
	F	1186	791	791	561	20LH06	14.5
	F	1267	845	845	599	20LH07	15.6
	F	1309	873	873	619	20LH08	16.1
	F	1429	953	953	675	20LH09	17.2
	F	1542	1028	1028	724	20LH10	18.0

Figure 16: Newmill Economical Load Table for Sizing Joists

The electrical breadth was chosen in order to support the electrical load of the proposed air handling unit. First, the existing circuit was replaced with the proposed circuit, as the existing system will not be used, and the panel can handle the proposed circuit.
Using the electrical data from the submittal sheets given by H.C. Nye Co., the rating is 460V at 3 phase and the max overcurrent is 50 amps. Therefore I used a 50 amp 3 pole breaker for the circuit.

Sizing the Wires:
To size the wires, the minimum circuit ampacity of 42 amps was used, yielding **THHW (75C) #8 AWG**

Sizing the Groundwire:
To size the ground wire, NEC[1] Table 250-95 was used with a 50 amp overcurrent device, yielding **#8 AWG**

Sizing the Conduit:
To size the conduit, PVC was chosen due to the system being outdoors, and the total wire area will be 0.15 in^2. ¾ inch PVC conduit was chosen because the area of the conduit will be 0.51 in^2, and this will only fill 28.88% of the conduit, which is allowable by NEC of 3 or more current carrying conductors.

Sizing the Load on Each Wire:
The load on each wire was found using the minimum circuit ampacity.
460V*38/1000 = 17.48 kVA
Divide by 3 for each wire => **5.8266 kVA per wire**

UNTING: SURFACE | FED FROM: PANEL MDS | NEUTRAL SIZE: 100%
.OSURE: NEMA 1 | LOCATION: | TOTAL POLES: 42

H CIRCUIT		CIRC.	BREAKER		LOAD (KVA)			WIRE		GND.	COND	COND	GND.	WIRE		LOAD (KVA)			BREAKER		CIRC.	FEEDER/BRANCH CIRCUIT		CKT
	AREA	NOTES	AMP	POLES	A	B	C	NO.	SIZE	SIZE	SIZE	SIZE	SIZE	SIZE	NO.	A	B	C	POLES	AMP	NOTES	DESCRIPTION	AREA	NO.
U-104-2	1ST FL		20	3	2.2			4	12	12	3/4	3/4	8	8	4	5.8			3	50		AHU-M301	PENTHOUSE	2
	MACH SHOP					2.2											5.8							4
							2.2											5.8						6
	PENTHOUSE		70	3	1.0			4	4	8	1-1/4					0						SPACE - PFFB		8
						1.0											0							10
							1.0											0						12
			70	3												0						SPACE - PFFB		14
																	0							16
																		0						18
			20	3												0						SPACE - PFFB		20
																	0					SPACE - PFFB		22
																		0				SPACE - PFFB		24
			70	3												0						SPACE - PFFB		26
																	0					SPACE - PFFB		28
																		0				SPACE - PFFB		30
					0											0						SPACE - PFFB		32
						0											0					SPACE - PFFB		34
							0											0				SPACE - PFFB		36
			30	3				4	10	10	3/4					0						SPACE - PFFB		38
																	0					SPACE - PFFB		40
																		0				SPACE - PFFB		42
		SIDE CONNECTED KVA			3	3	3				PANEL CONNECTED KVA	27				5.8	5.8	5.8	SIDE CONNECTED KVA					
											PANEL DEMAND KVA											DERATING FACTOR (80%)		
											PANEL DEMAND FACTOR											DEMAND LOAD SIZE:		AMPS

Figure 17: Proposed Panel Schedule

[1] National Electric Code

Final Remarks

Acknowledgments

Dr. William Bahnfleth

Thesis Advisor - PSU AE Department

Mr. Moses Ling

Professor - PSU AE Department

Mr. Daniel Scott

Construction Services - PSU OPP

Mr. Paul Moser

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Mechanical Engineer - MG Engineering

Mr. Buck Nye

President - H.C. Nye Company, Inc.

Michael Connor

Student - Penn State Architectural Engineering Student

Emily Blessner

Student - Penn State Architectural Engineering Student

ABET Accreditation

PSU AE - ABET 2.3

In order to meet ABET accreditation, the proposed systems met the following criteria. First, there was no change to the architectural design of the building. Both redesign solutions were designed with the goal of allowing the original architect's design to remain, and have very little visual impact on the building. In addition to this, one of the main needs of a building is to keep the occupants comfortable. By providing heating and cooling, both redesign proposals satisfy this need.

PSU AE - ABET 2.4

The proposed design solutions for this building meet the criteria of environmental, economic, and sustainability factors. Both redesign options in this project have a lower overall energy use, which is a benefit to the environment. In using less energy, the building will also have lower maintenance and upfront cost, and therefore have a lower total cost over time. Another benefit to the reduced energy use is that this yields a more sustainable and overall environmentally friendly building and building operation.

Appendix

I. Existing Conditions

Monthly & Annual Totals of Energy Use
Annual Total Energy Consumption: 205,178 Btu/(SF*year)
Annual Electric Energy Consumption: 977,097 kWh
Annual Steam Energy Consumption: 2,075 therms
Annual Chilled Water Energy Consumption: 28,724 therms

Heating Loads
Total: 780 MBH

Cooling Loads
Total: 68.3 Tons

EUI of Building: 205 kBtu/(SF*year)

Annual Energy Costs
Total Annual Electric Consumption: $82,402
Total Annual Chilled Water: $52,711
Total Annual Steam: $3,646

Utility Cost per Area: $4.58 per SF
Total Annual Utility Cost: $143,175

II. Air Handling Unit with VAV

Figure 1: Air Handling Unit Specifications

AAON®

Unit Rating

2425 South Yukon Ave - Tulsa, Oklahoma 74107-2728 - Ph. (918) 583-2266 Fax (918) 583-6094
AAONEcat32 Ver. 4.281 (SN: 5728272-)

1A 1B 1C 1D 2 3 4 5A 5B 5C 6A 6B 6C 7 8 9 10 11 12 13 14A 14B 15 16 17 18 19 20 21 22 23

RL-045-3-0-NW0N-EHJ:ZGED-D00-KAW-000-D00AD00-00-00000000B

Tag: RTU# 1

Job Information

Job Name:	*Mitchell Setzer PSU*
Job Number:	*Job #100008739*
Site Altitude:	*0 ft*

Unit Information

Approx. Op./Ship Weights:	*8864 / 8687 lbs. (±5%)*
Supply CFM/ESP:	*15946 / 0.75 in. wg.*
Pre-Filter FV / Qty:	*318.92 fpm / 18*
Return CFM/ESP/TSP:	*15946 / 0.75 / 1.10 in. wg.*
Outside CFM:	*3127*
Ambient Temperature:	*86 °F DB / 74 °F WB*
Return Temperature:	*79.3 °F DB / 65 °F WB*

Static Pressure

External:	*0.75 in. wg.*	Economizer:	*0.15 in. wg.*
Coil:	*0.60 in. wg.*	Heating:	*1.07 in. wg.*
Filters Clean:	*0.12 in. wg.*	Cabinet:	*0.30 in. wg.*
Dirt Allowance	*0.35 in. wg.*	Total:	*3.34 in. wg.*

Cooling Section

	Gross	Net
Total Capacity:	*679.05*	*644.91 MBH*
Sensible Capacity:	*474.45*	*440.31 MBH*
Latent Capacity:	*204.60 MBH*	
Mixed Air Temp:	*80.61 °F DB*	*66.91 °F WB*
Entering Air Temp:	*80.61 °F DB*	*66.91 °F WB*
Lv Air Temp (Coil):	*52.45 °F DB*	*52.19 °F WB*
Lv Air Temp (Unit)	*54.42 °F DB*	*53.02 °F WB*
Supply Air Fan:	*DT - 2 x 270 @ 6.15 BHP Ea.*	
SA Fan RPM / Width:	*1268 / 6.069"*	
Return Air Fan:	*2 x 270 @ 2.14 BHP Ea.*	
RA Fan RPM / Width:	*922 / 6.130"*	
CW Coil:	*36.7 ft² / 6 Rows / 10 FPI*	
CW Face Velocity:	*434.8 fpm*	

Heating Section

PreHeat Type:	*Std (No Preheat)*
Heating Type:	*Hot Water Heat*
Heating CFM:	*7000*
Total Capacity:	*228.7 MBH*
OA Temp:	*2.0 DB / 1.0°F WB*
RA Temp:	*80.0 °F DB / 62.0 °F WB*
Entering Air Temp:	*64.7 °F DB / 53.9 °F WB*
Leaving Air Temp:	*94.7 °F DB / 64.6 °F WB*
Entering Water:	*140.0 °F*
Leaving Water:	*122.8 °F*
GPM / Head:	*27 / 2.8 ft*
Water Velocity:	*2.75 fps*
FA / RD / FPI / FV:	*10.63 ft² / 2 / 10 / 658.8*

Chilled Water Coils:

GPM / Water PD (HXC only):	*108 / 9.96 ft*
Ent. / Lv. Water Temp:	*43 / 55.6 °F*
Water Velocity:	*3.27 fps*

Electrical Data

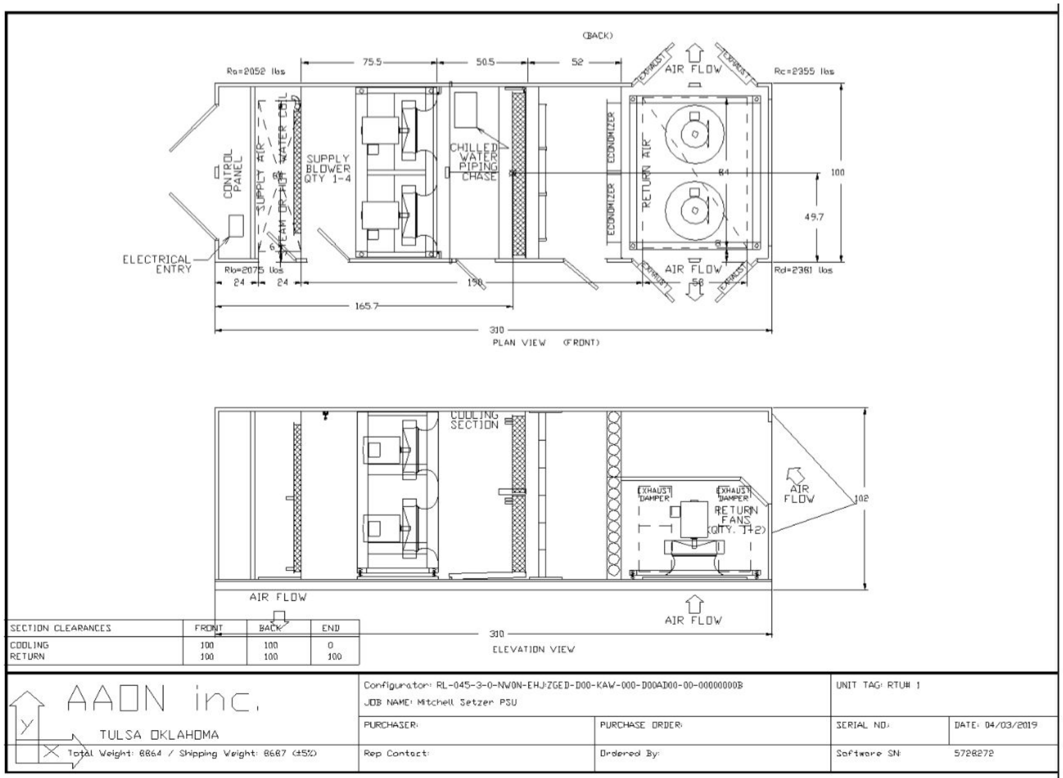
Rating:	*460/3/60*	Minimum Circuit Amp:	*42*
Unit FLA:	*38*	Maximum Overcurrent:	*50*

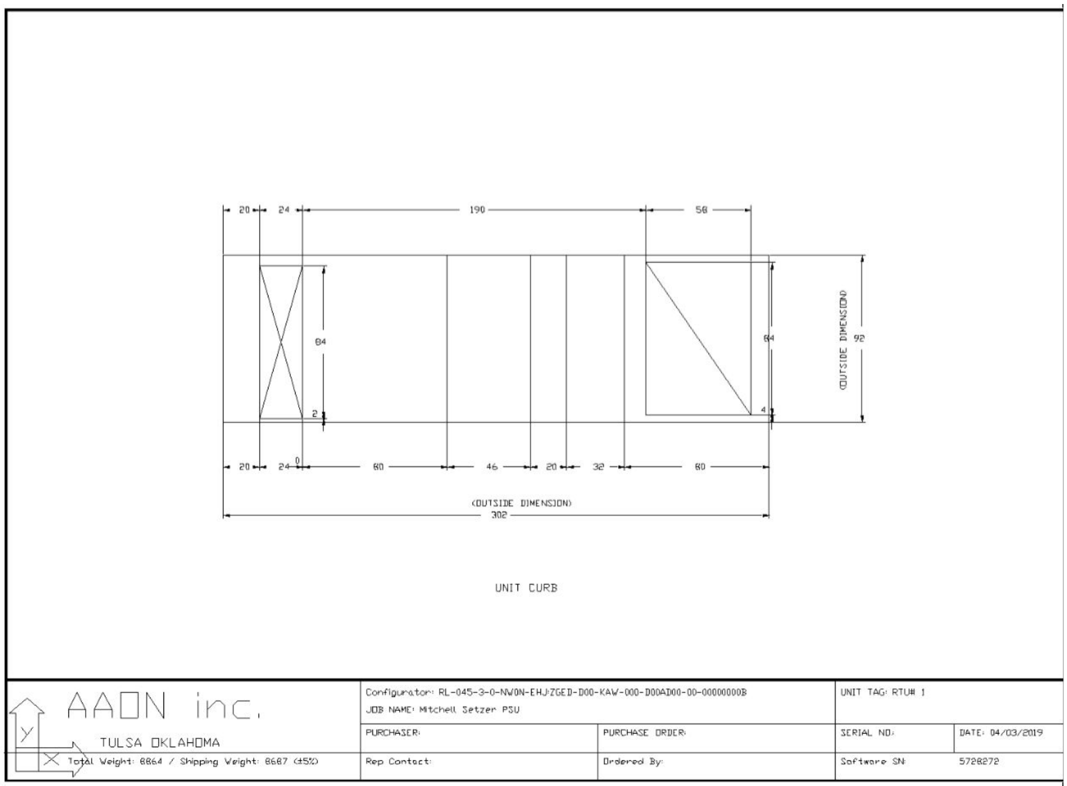
	Qty	HP	VAC	Phase	RPM	FLA	RLA
Supply Fan:	2	10.00	460	3	1760	14.0	
Return Fan:	2	3.00	460	3	1170	4.8	
Control Circuit:	1		120	1		2.9	

*Cabinet Sound Power Levels**

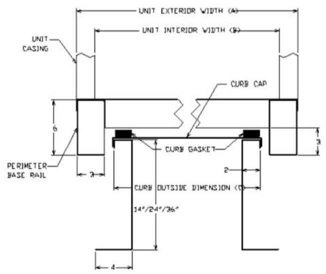
Octave Bands:	63	125	250	500	1000	2000	4000	8000
Discharge LW(dB):	92	90	91	90	86	84	81	78
Return LW(dB):	87	87	82	78	81	77	75	74

**Sound power levels are given for informational purposes only. The sound levels are not guaranteed.*

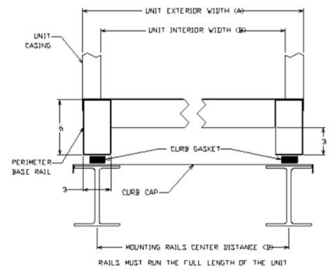

(BACK)
Rs=2052 lbs
75.5
50.5
52
AIR FLOW
EXHAUST
Rc=2355 lbs
CONTROL PANEL
SUPPLY AIR
SUPPLY BLOWER QTY 1-4
CHILLED WATER PIPING CHASE
ECONOMIZER
RETURN AIR
84
100
49.7
ELECTRICAL ENTRY
Rb=2075 lbs
24
24
150
58
Rd=2381 lbs
165.7
310
PLAN VIEW (FRONT)
COOLING SECTION
EXHAUST DAMPER
RETURN FANS (QTY. 1+2)
AIR FLOW
102
AIR FLOW
AIR FLOW
310
ELEVATION VIEW
SECTION CLEARANCES
FRONT
BACK
END
COOLING
100
100
0
RETURN
100
100
100
AAON inc.
TULSA OKLAHOMA
Total Weight: 8864 / Shipping Weight: 8687 (±5%)
Configurator: RL-045-3-0-NW0N-EHJ:ZGED-D00-KAW-000-D00AD00-00-00000000B
JOB NAME: Mitchell Setzer PSU
UNIT TAG: RTU# 1
PURCHASER:
PURCHASE ORDER:
SERIAL NO:
DATE: 04/03/2019
Rep Contact:
Ordered By:
Software SN:
5728272


20
24
190
58
84
2
84
4
(OUTSIDE DIMENSION)
92
20
24
80
46
20
32
80
(OUTSIDE DIMENSION)
302
UNIT CURB
AAON inc.
TULSA OKLAHOMA
Total Weight: 8864 / Shipping Weight: 8687 (±5%)
Configurator: RL-045-3-0-NW0N-EHJ:ZGED-D00-KAW-000-D00AD00-00-00000000B
JOB NAME: Mitchell Setzer PSU
UNIT TAG: RTU# 1
PURCHASER:
PURCHASE ORDER:
SERIAL NO:
DATE: 04/03/2019
Rep Contact:
Ordered By:
Software SN:
5728272

CABINET	A	B	C	D
NARROW	100	96	92	97
WIDE	142	138	134	139



CURB MOUNTING



STEEL MOUNTING

NOTES: 1) CURB CAP REQUIRED ON LL AND BL UNITS TO PREVENT ANY WATER LEAKS FROM ENTERING A FINISHED SPACE.
2) PERIMETER BASE RAIL IS NOT WATER TIGHT. DO NOT DEPEND ON PERIMETER BASE RAIL FOR WATER SEAL.
3) SEE SMACNA ARCHITECTURAL SHEET METAL MANUAL AND HVAC DUCT CONSTRUCTION STANDARDS FOR CURB INSTALLATION DETAILS

NOTE: SEE SMACNA ARCHITECTURAL SHEET METAL MANUAL AND HVAC DUCT CONSTRUCTION STANDARDS FOR CURB INSTALLATION DETAILS

AAON inc. TULSA OKLAHOMA	Configurator: RL-045-3-0-NW0N-EHJ:ZGED-D00-KAW-000-D00AD00-00-00000000B JOB NAME: Mitchell Setzer PSU		UNIT TAG: RTU# 1	
	PURCHASER:	PURCHASE ORDER:	SERIAL NO:	DATE: 04/03/2019
Total Weight: 8864 / Shipping Weight: 8687 (±5%)	Rep Contact:	Ordered By:	Software SN:	5728272

III. Electrical Breadth

Figure 2: Proposed Panel Board

LIGHTING AND APPLIANCE PANEL SCHEDULE

PANEL DESIGNATION:	PANEL HM3	BUS AMPS:	250	MIN. A.I.C.:	42 KA	MAIN BREAKER:	MLO
LOCATION:	PENTHOSE	PHASE:	3	WIRE:	4	VOLTAGE:	480Y/277
MOUNTING:	SURFACE	FED FROM:	PANEL MDS			NEUTRAL SIZE:	100%
ENCLOSURE:	NEMA 1	LOCATION:				TOTAL POLES:	42

NOTES: PENTHOUSE MECHANICAL PANEL

CKT	FEEDER/BRANCH CIRCUIT		CIRC.	BREAKER		LOAD (KVA)			WIRE		GND.	COND	COND	GND.	WIRE		LOAD (KVA)			BREAKER		CIRC.	FEEDER/BRANCH CIRCUIT		CKT
NO.	DESCRIPTION	AREA	NOTES	AMP	POLES	A	B	C	NO.	SIZE	SIZE	SIZE	SIZE	SIZE	SIZE	NO.	A	B	C	POLES	AMP	NOTES	DESCRIPTION	AREA	NO.
1	BCU-104-1, BCU-104-2	1ST FL		20	3	2.2			4	12	12	3/4	3/4	8	8	4	5.8			3	50		AHU-M301	PENTHOUSE	2
3		MACH SHOP					2.2											5.8							4
5								2.2											5.8						6
7	EFHZ-M301	PENTHOUSE		70	3	1.0			4	4	8	1-1/4					0						SPACE - PFFB		8
9							1.0											0							10
11								1.0											0						12
13	SPARE			70	3												0						SPACE - PFFB		14
15																		0							16
17																			0						18
19	SPARE			20	3												0						SPACE - PFFB		20
21																		0					SPACE - PFFB		22
23																			0				SPACE - PFFB		24
25	SPARE			70	3												0						SPACE - PFFB		26
27																		0					SPACE - PFFB		28
29																			0				SPACE - PFFB		30
31	SPACE - PFFB					0											0						SPACE - PFFB		32
33	SPACE - PFFB						0											0					SPACE - PFFB		34
35	SPACE - PFFB							0											0				SPACE - PFFB		36
37	SPD			30	3				4	10	10	3/4					0						SPACE - PFFB		38
39																		0					SPACE - PFFB		40
41																			0				SPACE - PFFB		42
			SIDE CONNECTED KVA			3	3	3		PANEL CONNECTED KVA			27				5.8	5.8	5.8	SIDE CONNECTED KVA					
										PANEL DEMAND KVA													DERATING FACTOR (80%)		
										PANEL DEMAND FACTOR													DEMAND LOAD SIZE:		AMPS