Mount Carmel Fitness & Health Center

Lewis Center, Ohio

Tarek Birkdar
Mechanical Option
Dr. Treado

Mount Carmel Fitness & Health Center

Lewis Center, Ohio

7100 Graphics Way
Lewis Center
OH, 43035

129,622
S.F.
3 Stories

$11,000,000

September 2014 –
January 2016

Aquatic Center

Welcome Center

Mount Carmel Fitness & Health Center

Lewis Center, Ohio

Clinical Architect

DAVIS WINCE ltd
ARCHITECTURE

General Contractor

ELFORD
GREAT BUILDERS. GREAT BUILDINGS.

MEP Engineering

Civil Engineering

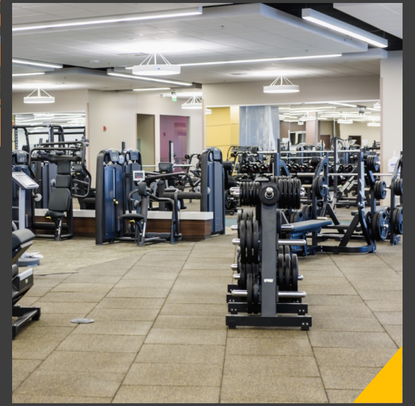
EMH&T

Architects

OHLSON LAVOIE COLLABORATIVE
ARCHITECTURE
INTERIORS
AQUATICS
OLC ARCHITECTURE
www.olcdesigns.com

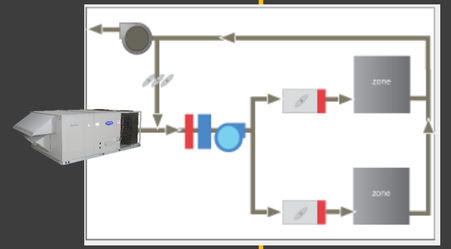
Fitness Center

Child Care



Mount Carmel Fitness & Health Center

Lewis Center, Ohio



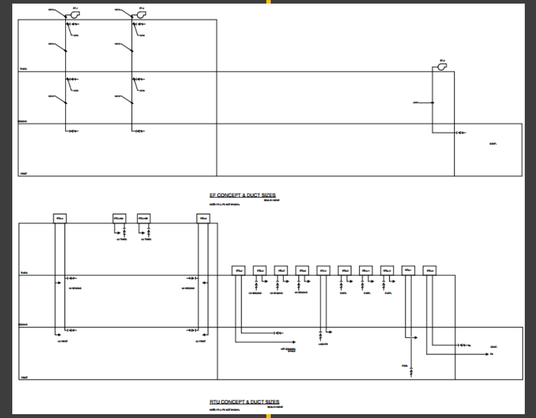
Typical RTU Operation Schematic

Heating/Cooling & Ventilation

[13] Roof Top Units

Each supplying anywhere from 2500 – 15000 CFM

RTU connected to VAV boxes for reheat purposes



Existing System Riser Diagram

Mount Carmel Fitness & Health Center

Lewis Center, Ohio

Roof Top Unit Schedule				Cooling Coil				Heating Section		
		Supply Air (CFM)	Outside Air (%)	Total MBH	Sensible MBH	EAT/LAT (F)	EER	Input MBH	Output MBH	EAT/LAT (F)
System	RTU-1	30000	22.60%	969	555	84/60	-	1062	850	75/101
	RTU-2	12000	40.8%	471	335	83.17/60.82	10.3	750	607	41.4/88.5
	RTU-3	2600	24.2%	88	65	79.85/58.36	12.6	150	120	43/96
	RTU-4	13000	20.0%	449	345	79/55.12	10.4	850	697	56/105
	RTU-5	4000	35.5%	144	101	82.1/60.52	12.1	250	203	45/92
	RTU-6	6400	31.3%	246	188	81.25/56.39	10	400	324	48/95
	RTU-7	6400	31.3%	246	188	81.25/56.39	10	400	324	48/95
	RTU-8	5600	29.6%	200	158	80.93/57.27	11	350	284	49/96
	RTU-9	15000	32.0%	570	432	81.4/55.7	10.6	850	697	47.6/90
	RTU-10A	11200	30.0%	396	306	81/59.24	10.3	600	486	49/89.5
	RTU-11	11200	30.0%	396	306	81/59.24	10.3	600	486	49/89.5
	RTU-12	3200	39.1%	115	88	82.81/59.23	12.5	250	200	43/101
	RTU-13	2400	32.7%	88	66	81.54/57.68	12.6	200	160	47/109

Roof Top Unit Schedule

Air Conditioning Unit Schedule

Tenant Air Conditioning Unit Schedule				Cooling Coil		Configuration
		Supply Air (CFM)	CUA Mark	Total MBH	EAT (F)	
System	ACU-1	425	2	18	80	Wall
	ACU-2	425	4	18	80	Wall
	ACU-3	425	6	18	80	Wall
	ACU-4	425	7	18	80	Wall
	ACU-5	425	8	18	80	Wall
	ACU-6	425	9	18	80	Wall
	ACU-7	425	10	18	80	Wall

Tenant Condensing Unit Schedule			
		Service	MBH
System	CUA-1	ACU-1	18
	CUA-2	ACU-2	18
	CUA-3	ACU-3	18
	CUA-4	ACU-7	18
	CUA-5	ACU-4	18
	CUA-6	ACU-5	18
	CUA-7	ACU-6	18
	CUA-8	CRAC-1	50.4

Cooling Coil:
Entering Air Temp.
79F (DB) - 84F (DB)
Leaving Air Temp.
55F (DB) - 60F (DB)

Heating Coil:
Entering Air Temp.
42F (DB) - 56F (DB)
Leaving Air Temp.
88F (DB) - 95F (DB)

Mechanical Room
Electrical Room
Telecommunication Room
I.T. Room

Cooling Coil:
Entering Air Temp.
80F (DB) - 67F (WB)

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Lewis Center, Ohio

Energy Recovery Ventilator Schedule			Recovery		Outside Air		Exhaust Air	
		Service	Type	Material	CFM	ESP ("WC)	CFM	ESP ("WC)
System	ERV-1	Lockers	Wheel	Aluminum	12000	1.3	14000	1.25
			Summer Conditions			Winter Conditions		
			OA - EAT (DB/WB F)	OA - LAT (DB/WB F)	EA - EAT (DB/WB F)	OA - EAT (DB/WB F)	OA - LAT (DB/WB F)	EA - EAT (DB/WB F)
			95/76	80.4/67.4	75/63	0/-1	51.2/41.4	70/53
			Cooling Coil				Heating Section	
			Total MBH	Sensible MBH	EAT (DB/WB F)	LAT (DB/WB F)	Input (MBH)	Output (MBH)
			592	390	80.4/67.3	50.9/50.9	1000	800
			OA Filters			EA Filters		
			Type	Merv	Depth	Type	Merv	Depth
			Flat	8	2"	Flat	8	2"

Energy Recovery Ventilator Schedule

Summer Conditions
Entering Air Temp. 95F (DB)
Leaving Air Temp. 81F (DB)
EA: Entering Air Temp.
75F (DB)

Winter Conditions
Entering Air Temp. 0F (DB)
Leaving Air Temp. 51F (DB)
EA: Entering Air Temp.
70F (DB)

Heat Recovery Wheel
OA Filters: Flat Merv 8
EA Filters: Flat Merv 8

Exhaust Air: 14,000 CFM
Outside Air: 12,000 CFM

Mount Carmel Fitness & Health Center

Lewis Center, Ohio

Exhaust Fan Schedule

		Service	Type	CFM	SP ("WC)	OV (FPM)	Tip Speed (FPM)	RPM	Arrangement	Drive
System	EF-1	General	Pre	4,180	1.25	1970	6790	1441	Downblast	Belt
	EF-2	General	Pre	2,000	1.25	1357	5741	1462	Downblast	Direct
	EF-3	General	Pre	2,000	1.25	1357	5741	1462	Downblast	Direct
	EF 4	Kitchen	IC	1270	0.75	713	5249	1671	-	Belt
	EF 5	Vest.	IC	1200	0.45	431	3679	937	-	Direct
	EF 6	Vest.	IC	1200	0.45	431	3679	937	-	Direct
	EF 7	Chemical Storage	IC	1000	0.75	-	-	2825	-	Direct
	EF 9	MRI Emergency Exhaust	UPRE	1200	0.5	774	3866	1094	-	Belt
	EF 10	Medical Elec. Room 1st Floor	IC	500	0.5	200	4466	1706	-	Belt
	EF 11	Wellness Elec. 1st Floor	IC	500	0.5	200	4466	1706	-	Belt
	EF 12	Medical Elec. 2nd Floor	IC	500	0.5	200	4466	1706	-	Belt
	EF 13	Medical Elec. 3rd Floor	IC	500	0.5	200	4466	1706	-	Belt
	EF 14	General	Pre	3400	1.25	1603	6083	1291	Downblast	Belt
	EF 15	Isolation	US	500	1.25	870	7144	1910	-	Belt
	EF 16	Vest.	IC	1200	0.45	431	3679	937	-	Direct
	EF 17	Vest.	IC	600	0.45	736	4390	1677	-	Direct

Down Blast Centrifugal Exhaust Ventilators

Exhausting 500 – 4180 CFM

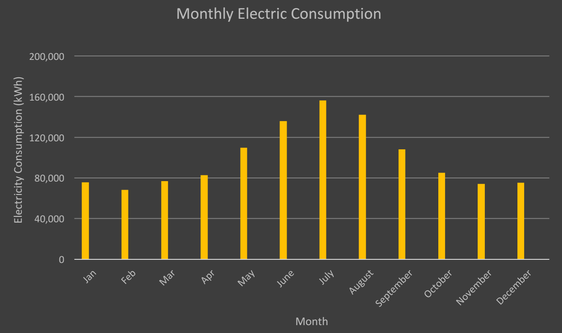
5 Major Exhaust Fans (General Area)

Kitchen
Chemical Storage
MRI Emergency
Electrical Rooms
Vestibule

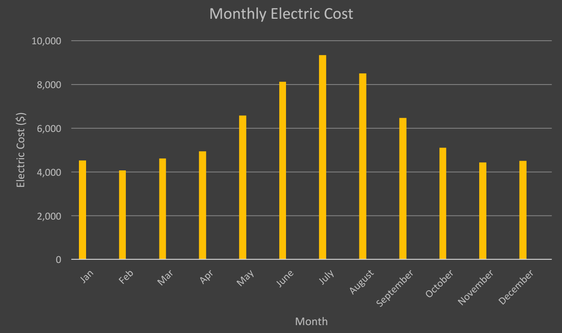
Mount Carmel Fitness & Health Center

Lewis Center, Ohio

Monthly Electric Consumption Existing System



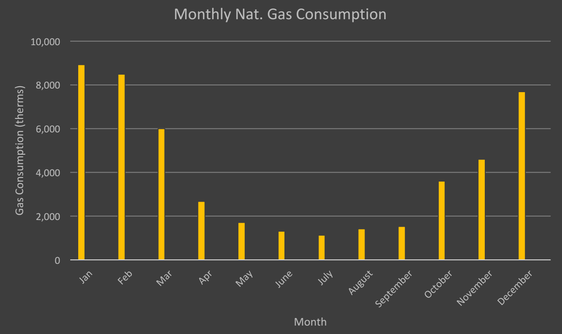
Monthly Electric Cost Existing System



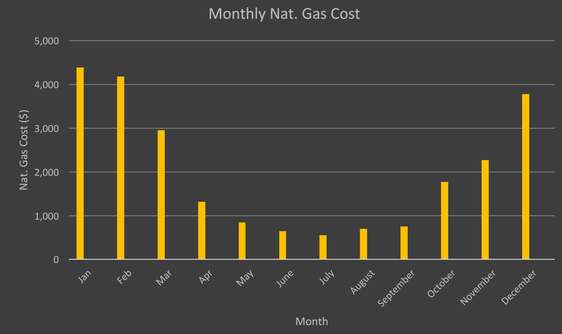
Mount Carmel Fitness & Health Center

Lewis Center, Ohio

Monthly Nat. Gas Consumption Existing System



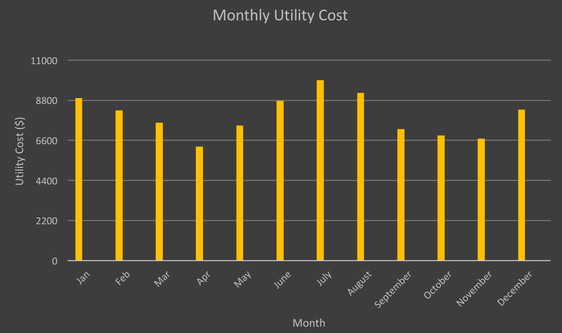
Monthly Nat. Gas Consumption Existing System



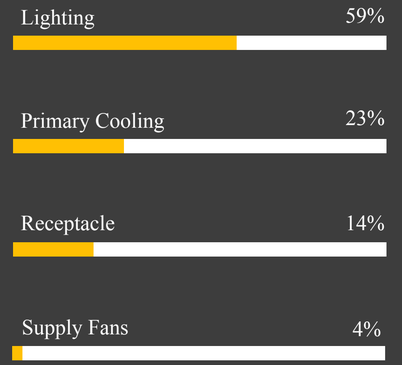
Mount Carmel Fitness & Health Center

Lewis Center, Ohio

Monthly Utility Cost Existing System



Annual Electricity Consumption Existing System



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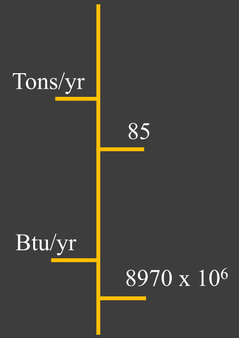
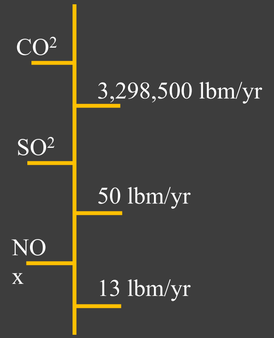
Lewis Center, Ohio

Annual Energy Consumption Existing System



Annual System Emissions Existing System



Mount Carmel Fitness & Health Center

Lewis Center, Ohio

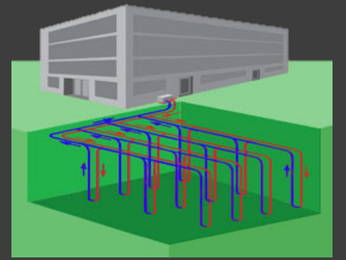
Reducing Energy Consumption

Reducing System Emissions

Reducing Energy Costs

Creating A Central Plant

Proposed Mechanical Depth



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Mount Carmel Fitness & Health Center

Lewis Center, Ohio

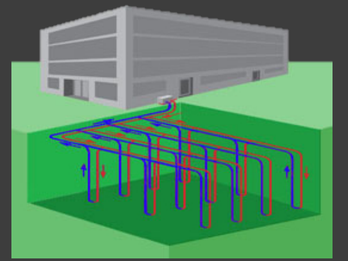
Reducing Energy Consumption

Reducing System Emissions

Reducing Energy Costs

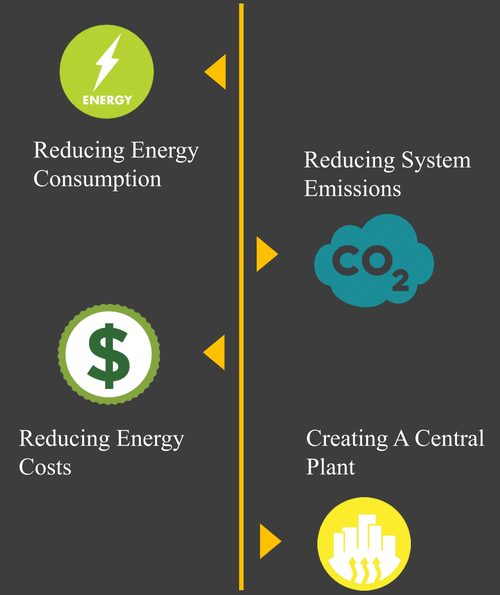
Creating A Central Plant

Proposed Mechanical Depth



Mount Carmel Fitness & Health Center

Lewis Center, Ohio



Proposed Acoustical Breadth

Mount Carmel Fitness & Health Center

Lewis Center, Ohio

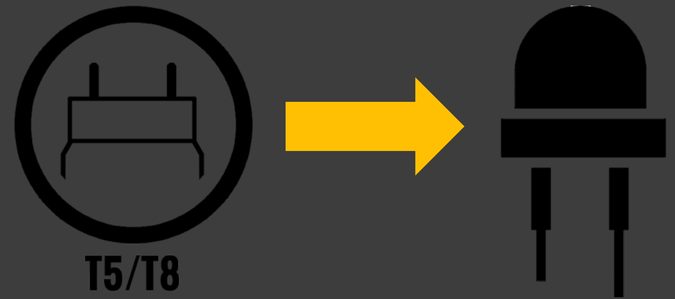
Reducing Energy Consumption

Reducing System Emissions

Reducing Energy Costs

Creating A Central Plant

Proposed Lighting Breadth



Mount Carmel Fitness & Health Center

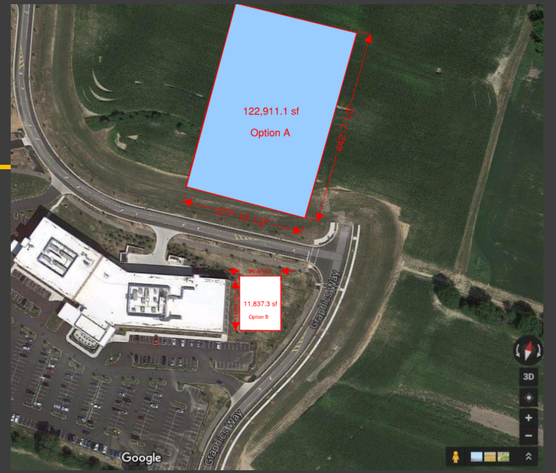
Lewis Center, Ohio

Cooling & Heating Bore Length Design			
Input		Heating	Cooling
Short-Circuit Factor	(Fsc)	1.04	1.04
Part-Load Factor	(PLFm)	1	1
Average Heat Transfer to Ground (Btu/hr)	(qa)	696000	696000
Block Loads (Btu/hr)	(qlh and qlc)	5292000	4596000
Resistance of Ground, Annual pulse	(Rga)	0.217	0.217
Resistance of Ground, Daily pulse	(Rgd)	0.128	0.128
Resistance of Ground, Monthly pulse	(Rgm)	0.207	0.207
Resistance of Bore	(Rb)	0.09	0.09
Undisturbed Ground Temperature (Degrees F)	(tg)	56	56
Temperature Penalty for Bore Spacing (Degrees F)	(tp)	18	18
Heat Pump Inlet Temperature (Degrees F)	(twi)	41	81
Heat Pump Outlet Temperature (Degrees F)	(two)	36	86
System Power Input (Watts)	(Wc and Wh)	69059.2	59976
Required Bore Length	(Lc and Lh)	148149	69621

Well-Field Bore Length Design

Geothermal System Layout Options

Amount of Vertical Bores Required		
Well Depth	Bore Length Required (ft)	Amount of Wells
100	148148.9	1481
200	148148.9	741
300	148148.9	494
400	148148.9	370
500	148148.9	296
550	148148.9	269



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Lewis Center, Ohio

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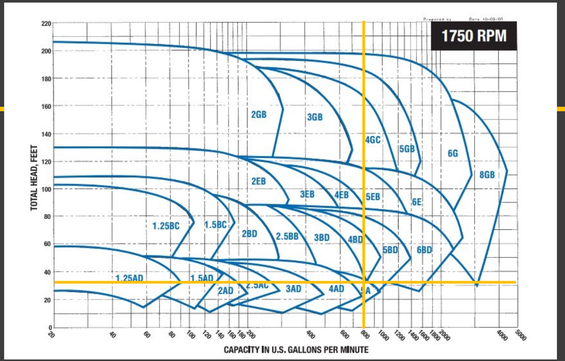
Mount Carmel Fitness & Health Center

Lewis Center, Ohio

Calculating Pressure Loss - Equivalent Pipe Length Method							
Pipe Size (inches)	Flow (gal/min)	Pressure Loss (ft/100 ft)	System Components	Equivalent Length of Component (ft)	Number of Components	Equivalent Length (ft)	Section Pressure Loss (ft H2O)
3	807	128.87	90 deg Elbows	27	6	162	-
-			Straight Pipe	1	10	10	
			-	-		-	
Total	807	128.87				262	33.764

Pump Head Loss Calculation

Geothermal System Equipment Selection



Bell & Gossett 1750 RPM Pumps

Mount Carmel Fitness & Health Center

Lewis Center, Ohio

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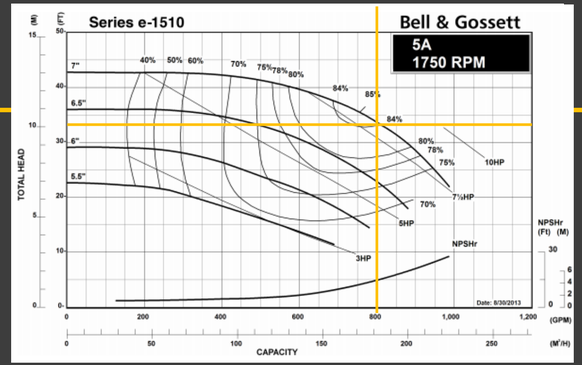
Pump Head Loss Calculation

Geothermal System Equipment Selection



Main Pump Selection – Series E1510

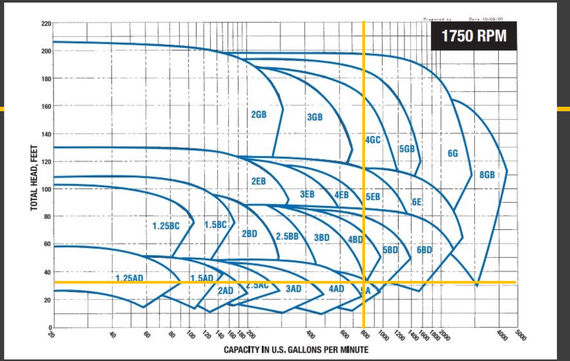
Mount Carmel Fitness & Health Center

Lewis Center, Ohio

Calculating Pressure Loss - Equivalent Pipe Length Method							
Pipe Size (inches)	Flow (gal/min)	Pressure Loss (ft/100 ft)	System Components	Equivalent Length of Component (ft)	Number of Components	Equivalent Length (ft)	Section Pressure Loss (ftH2O)
3	807	128.87	90 deg Elbows	27	5	135	-
-			Straight Pipe	1	7	7	
			45 deg Elbow	13	2	26	
Total	807	128.87				231	29.769

Pump Head Loss Calculation

Geothermal System Equipment Selection



Bell & Gossett 1750 RPM Pumps

Mount Carmel Fitness & Health Center

Lewis Center, Ohio

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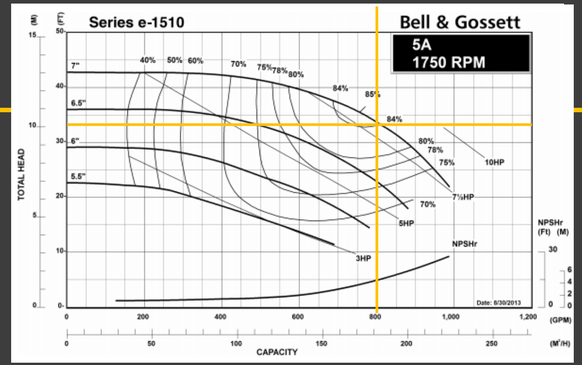
-			Straight Pipe	1	7	7	
			45 deg Elbow	13	2	26	
Total	807	128.87				231	29.769

Pump Head Loss Calculation

Geothermal System Equipment Selection



Distributor Pump Selection – Series E1510

Mount Carmel Fitness & Health Center

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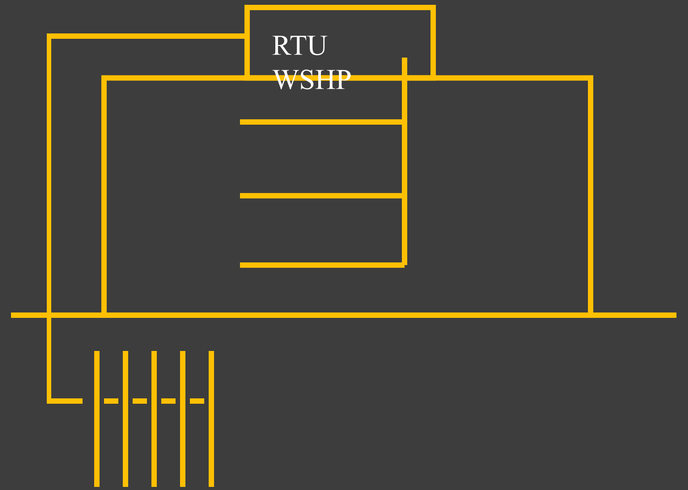
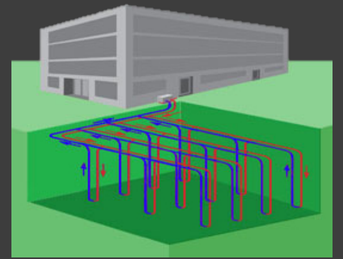


Alternative 1:
Roof Top Unit
WSHP



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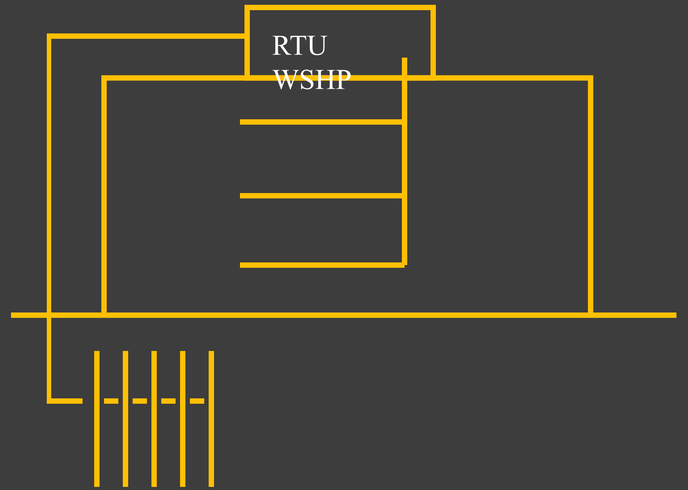

Energy Efficient Cooling & Heating by Reversing Refrigerant Flow

Eliminating the Need of Individual Heat Pumps

Combine Energy Savings from VAV & WSHP Configuration

[3] RN – 140
[1] RN – 30
Units Allow for 100% OA

Mount Carmel Fitness & Health Center

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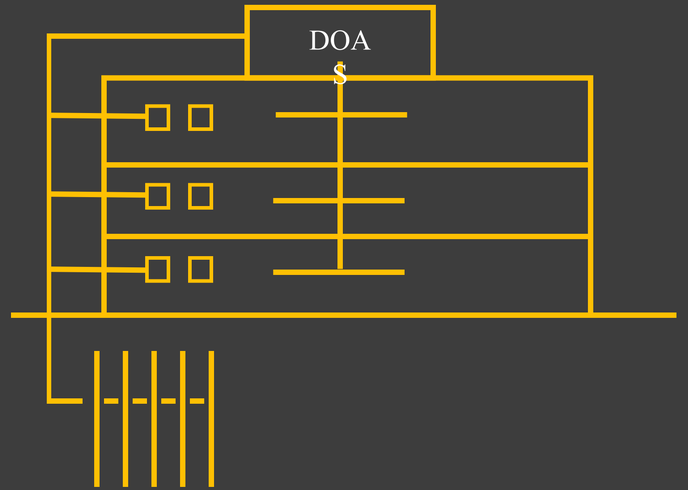
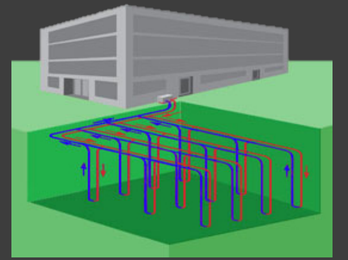


Alternative 2: DOAS + Heat Pumps



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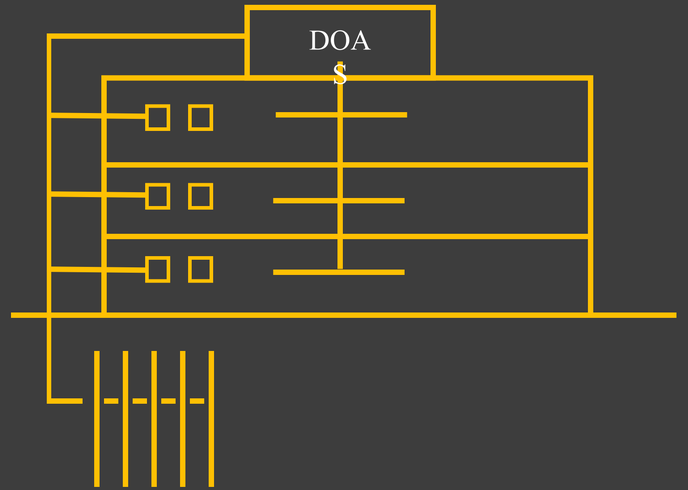


Placement of Heat Pumps Will Be Based On Occupancy Type

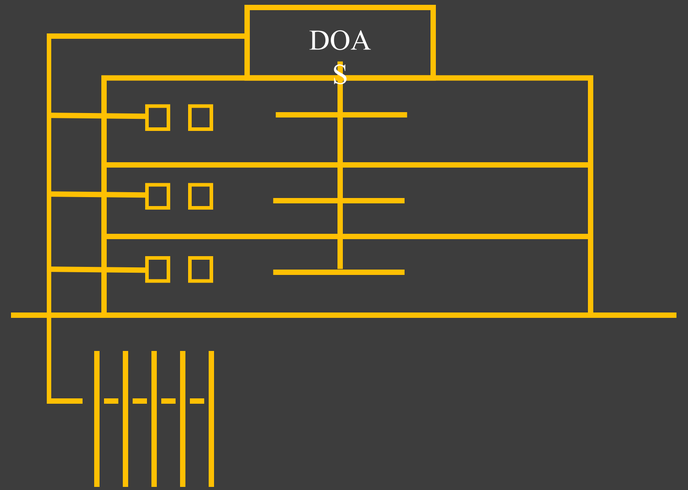
DOAS Preconditioning OA

DOAS Mainly To Supply 100% OA

DOAS Will Dehumidify The Air Lowering DB

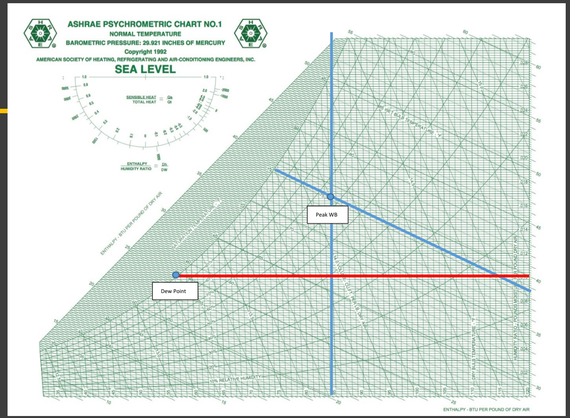
Mount Carmel Fitness & Health Center

Lewis Center, Ohio



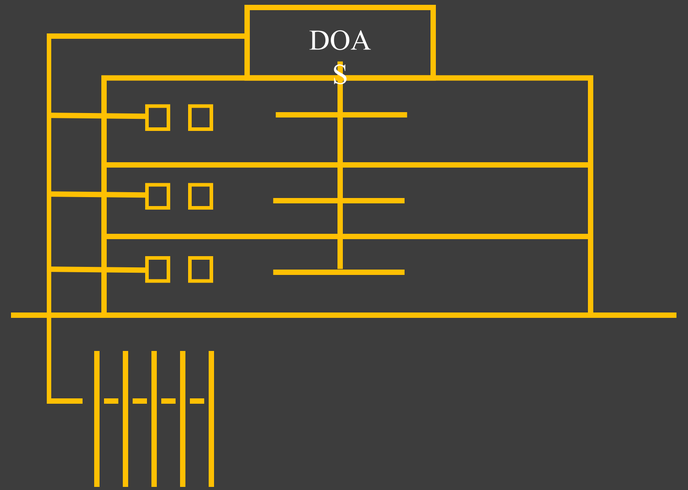
DOAS Equipment Sizing

Design Conditions	
Peak DB	88.3 deg F DB
	73.1deg F WB
Peak WB	84.3 deg F DB
	75.4 deg F WB
Peak DP	80.5 deg F DB
	72.5 deg F WB



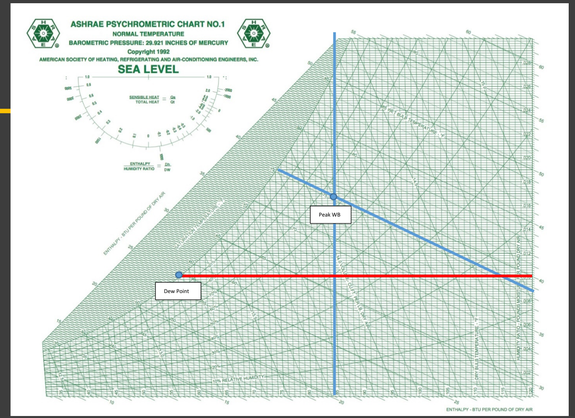
Mount Carmel Fitness & Health Center

Lewis Center, Ohio



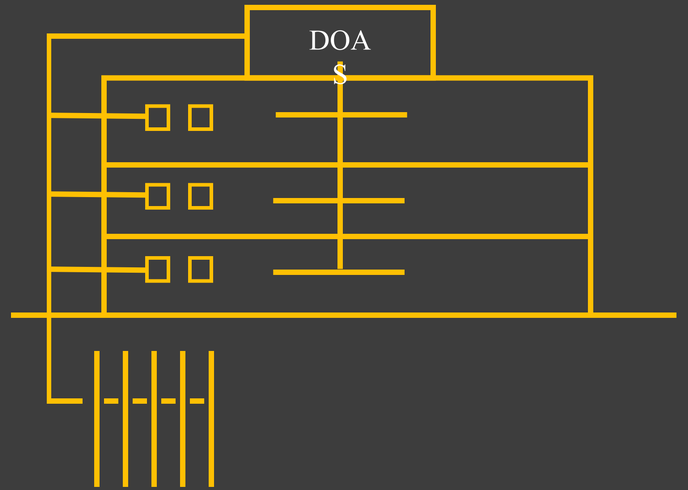
DOAS Equipment Sizing

Zone Latent Load		
Zone	Total Area (ft2)	Latent Load (Btu/hr)
Health Center / Aerobic Rooms	30,340	864,000



Mount Carmel Fitness & Health Center

Lewis Center, Ohio



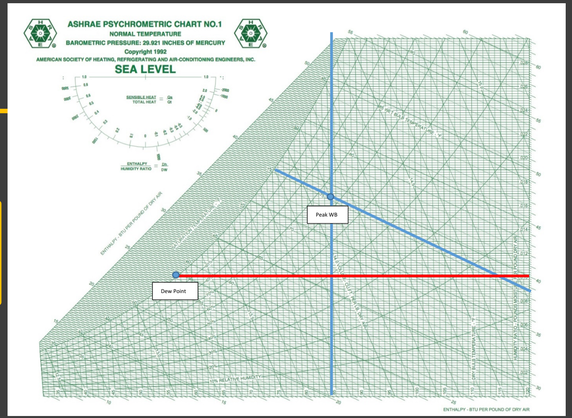
DOAS Equipment Sizing

$Q_T = 4.5(CFM\ Required)(H_{sp}-H_{ca})$

$Q_T = 4.5(25821)(38.7 - 24.9)$

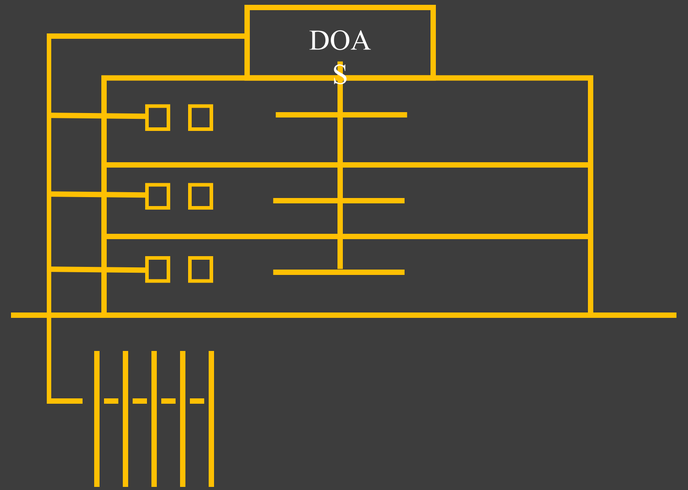
$Q_T = 1603484.1$ Btu/hr = **133.6** Tons

133.6 Tons



Mount Carmel Fitness & Health Center

Lewis Center, Ohio



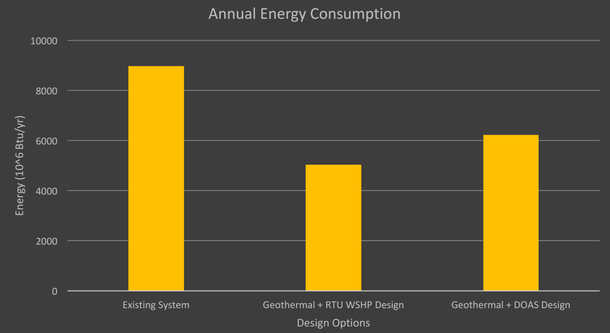
Heat Pump Schedule

Heat Pump Schedule			
Occupancy Type	Location	Capacity Required (tons)	Specified Heat Pumps
Operating Rooms	1st Floor West	27.45	(1) 20 ton (1) 10 ton
Examination Rooms	1st Floor West	23	(1) 20 ton (1) 5 ton
	2nd Floor West	117	(6) 20 ton
Nurse Station	1st Floor West	10	(1) 10 ton
Treatment Rooms	1st Floor West	25	(1) 20 ton (1) 5 ton
Shared Waiting Room	2nd Floor West	9	(1) 10 ton
Conference	1st Floor Center	8	(2) 5 ton
Retail	1st Floor Center	6.6	(1) 10 ton
Dining	1st Floor Center	18	(2) 10 ton
Offices	1st Floor Center	2	(1) 5 ton
Laundry/Storage	1st Floor Center	10	(1) 10 ton
Pools	1st Floor East	60	(3) 20 ton
Lockers/Bathrooms (Male)	1st Floor East	6	(3) 2 ton
Lockers/Bathrooms (Female)	1st Floor East	7.5	(1) 10 ton
Lockers (Kids)	1st Floor East	6	(1) 5 ton (1) 2 ton
Equipment Room	1st Floor East	5	(1) 5 ton
Health Center/ Aerobic Rooms	2nd Floor Center	60	(6) 10 ton
	2nf Floor East	94	(2) 20 ton (5) 10 ton (1) 5 ton

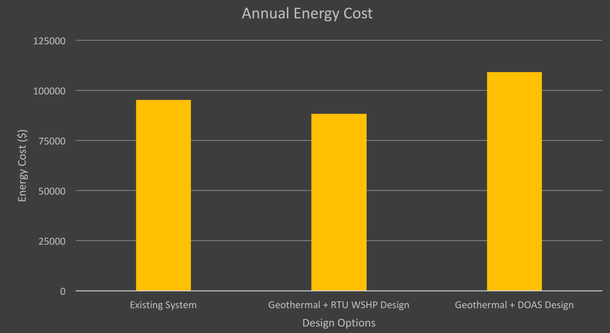
Mount Carmel Fitness & Health Center

Lewis Center, Ohio

Annual Energy Consumption Comparison



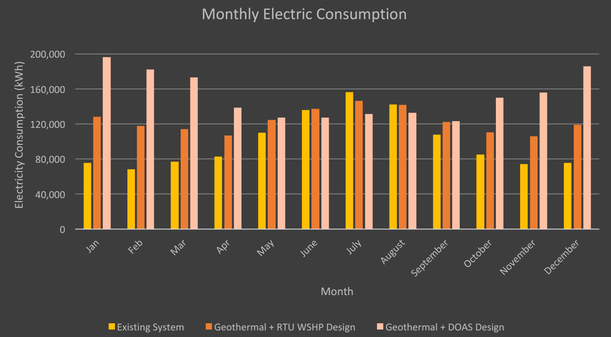
Annual Energy Cost Comparison



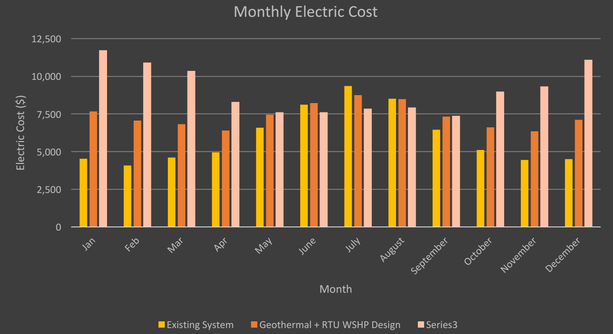
Mount Carmel Fitness & Health Center

Lewis Center, Ohio

Monthly Electric Consumption Comparison



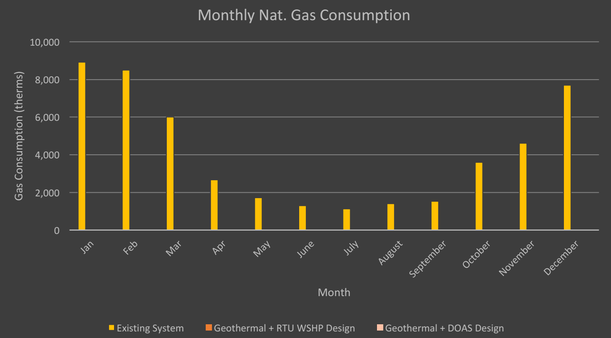
Monthly Electric Cost Comparison



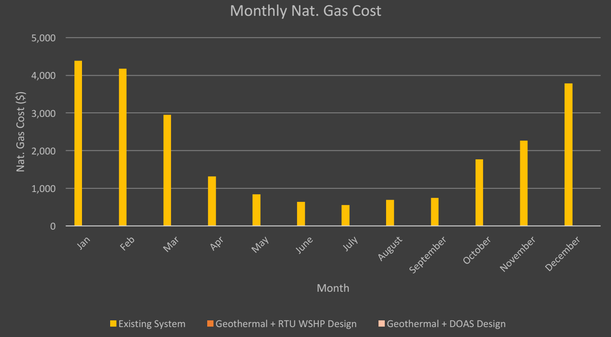
Mount Carmel Fitness & Health Center

Lewis Center, Ohio

Monthly Nat. Gas Consumption Comparison



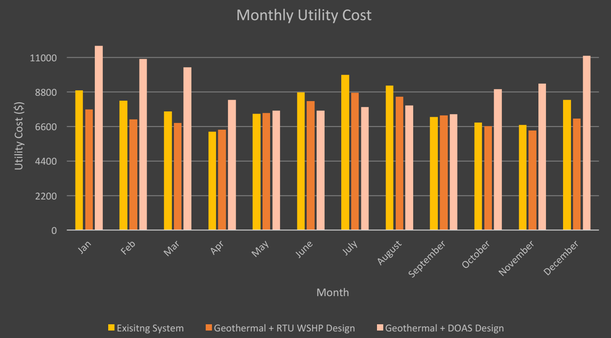
Monthly Nat. Gas Cost Comparison



Mount Carmel Fitness & Health Center

Lewis Center, Ohio

Monthly Utility Cost Comparison

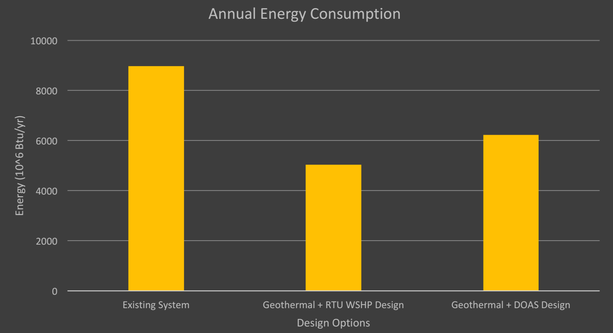


SAVINGS ?

Mount Carmel Fitness & Health Center

Lewis Center, Ohio

Annual Energy Consumption Comparison



Existing System

8970 x 10^6 Btu/yr

Alternative 1

5038 x 10^6 Btu/yr

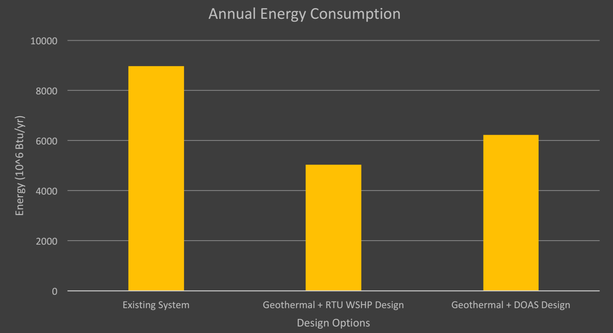
Alternative 2

6228 x 10^6 Btu/yr

Mount Carmel Fitness & Health Center

Lewis Center, Ohio

Annual Energy Consumption Comparison



Existing System

Base Value

Alternative 1

3932 x 10^6 Btu/yr

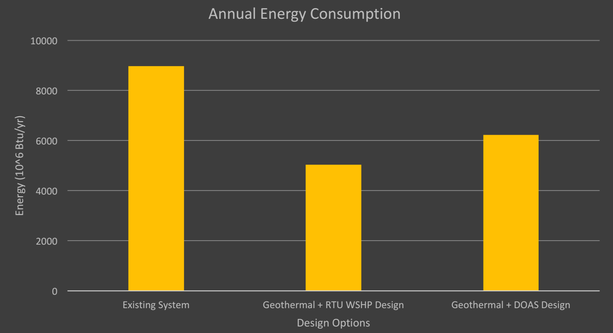
Alternative 2

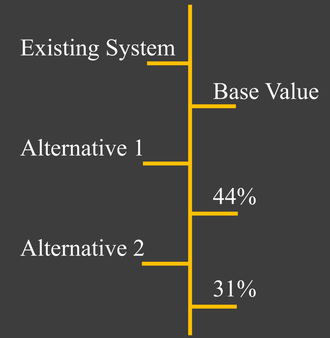
2742 x 10^6 Btu/yr

Mount Carmel Fitness & Health Center

Lewis Center, Ohio

Annual Energy Consumption Comparison

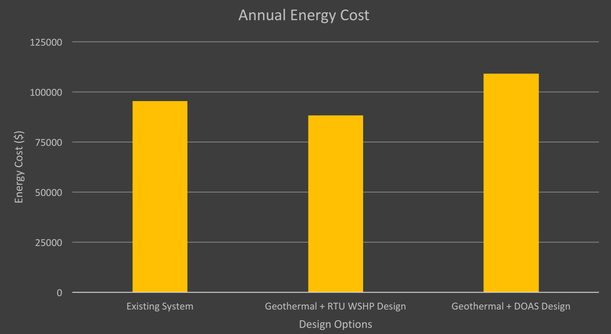




Mount Carmel Fitness & Health Center

Lewis Center, Ohio

Annual Energy Cost Comparison



Existing System
$95,343

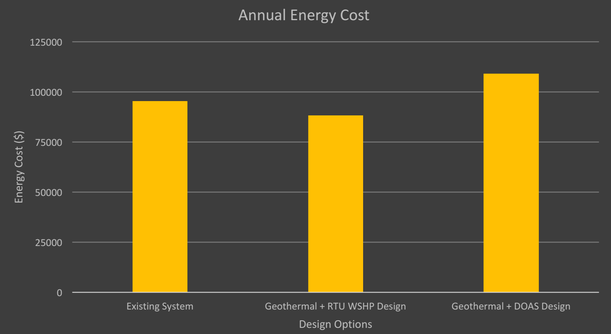
Alternative 1
$88,273

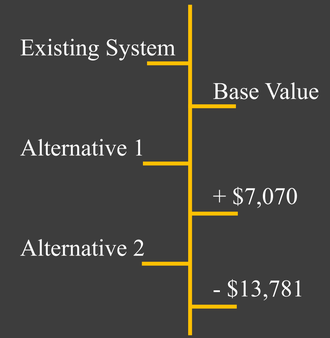
Alternative 2
$109,124

Mount Carmel Fitness & Health Center

Lewis Center, Ohio

Annual Energy Cost Comparison

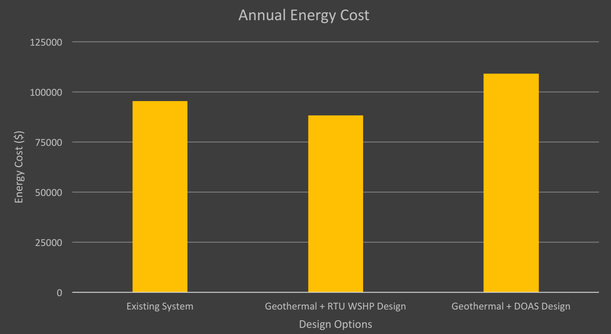


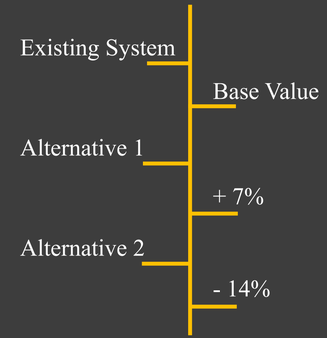


Mount Carmel Fitness & Health Center

Lewis Center, Ohio

Annual Energy Cost Comparison

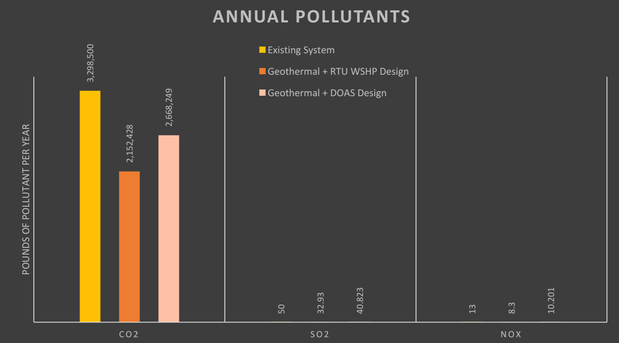




Mount Carmel Fitness & Health Center

Lewis Center, Ohio

Annual Emissions Comparison



Difference in Total Annual Emissions				
System	Pollutant	Total Emissions (lb/yr)	Percent Decrease	(%)
Existing System	CO2	3298500		
	SO2	50		
	NOX	13		
Geothermal + RTU WSHP Design	CO2	2152428		35
	SO2	33		34
	NOX	8.3		36
Geothermal + DOAS Design	CO2	2668249		19
	SO2	40.8		18
	NOX	10.2		22

Difference in Total Annual Emissions

Mount Carmel Fitness & Health Center

Lewis Center, Ohio

Systems Cost Analysis

Existing System				
Unit	Takeoff Quantity		Total Cost/Unit ($)	Total Amount
RTU - 1	15000	CFM	4.38	$ 65,700.00
RTU - 2	13000	CFM		$ 56,940.00
RTU - 3	15000	CFM		$ 65,700.00
RTU - 4	11200	CFM		$ 49,056.00
RTU - 5	11200	CFM		$ 49,056.00
RTU - 6	25000	CFM		$ 109,500.00
RTU - 7	33000	CFM		$ 144,540.00
RTU - 8	35000	CFM		$ 153,300.00
Ductwork, Insulation, and air devices	122016	SF	4.12	$ 502,705.92
Ductless Split System @ Elevators	2	Each	14222	$ 28,444.00
Air Curtains	4	Each	10122	$ 40,488.00
Exhaust Fans	5	Each	6112	$ 30,560.00
Temperature Controls	122016	SF	4.63	$ 564,934.08
Natural Gas Piping	122016	SF	0.85	$ 103,713.60
HVAC Total				$ 1,964,637.60

Existing System 1st Cost

Alternative 1 Geothermal + RTU WSHP Design Cost				
Unit	Takeoff Quantity		Total Cost/Unit ($)	Total Amount
RTU - 1	26000	CFM	2.98	$ 77,480.00
RTU - 2	26000	CFM		$ 77,480.00
RTU - 3	26000	CFM		$ 77,480.00
RTU - 4	8500	CFM		$ 25,330.00
Ductwork, Insulation, and air devices	122016	SF	196	$ 239,151.36
Geothermal Cost + Installation	122016	SF	12.88	$ 1571566.08
E-1510 5A Water Pumps	2	Each	2894	$ 5,788.00
Exhaust Fans	2	Each	4285	$ 8,570.00
HVAC Total				$ 2,082,845.44

Alternative 1 1st Cost

Mount Carmel Fitness & Health Center

Lewis Center, Ohio

Systems Cost Analysis

Existing System				
Unit	Takeoff Quantity		Total Cost/Unit ($)	Total Amount
RTU - 1	15000	CFM	4.38	$ 65,700.00
RTU - 2	13000	CFM		$ 56,940.00
RTU - 3	15000	CFM		$ 65,700.00
RTU - 4	11200	CFM		$ 49,056.00
RTU - 5	11200	CFM		$ 49,056.00
RTU - 6	25000	CFM		$ 109,500.00
RTU - 7	33000	CFM		$ 144,540.00
RTU - 8	35000	CFM		$ 153,300.00
Ductwork, Insulation, and air devices	122016	SF	4.12	$ 502,705.92
Ductless Split System @ Elevators	2	Each	14222	$ 28,444.00
Air Curtains	4	Each	10122	$ 40,488.00
Exhaust Fans	5	Each	6112	$ 30,560.00
Temperature Controls	122016	SF	4.63	$ 564,934.08
Natural Gas Piping	122016	SF	0.85	$ 103,713.60
HVAC Total				$ 1,964,637.60

Existing System 1st Cost

Alternative 2: Geothermal + DOAS Design Cost				
Unit	Takeoff Quantity		Total Cost/Unit ($)	Total Amount
DOAS- 1	15000	CFM	2.13	$ 31950.00
DOAS- 2	15000	CFM		$ 31950.00
WSHP (5 ton)	8	Each	2490	$ 19,920.00
WSHP (10 ton)	19	Each	3652	$ 69,388.00
WSHP (20 ton)	14	Each	6588	$ 92,232.00
Ductwork, Insulation, and air devices	122016	SF	196	$ 239,15136
Geothermal Cost + Installation	122016	SF	12.88	$ 1571566.08
E-150 5A Water Pumps	2	Each	2894	$ 5,788.00
Exhaust Fans	3	Each	4285	$ 12,855.00
HVAC Total				$ 2,074,800.44

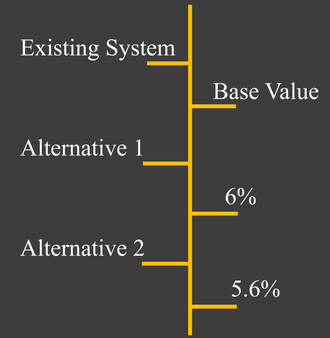
Alternative 2 1st Cost

Mount Carmel Fitness & Health Center

Lewis Center, Ohio

Systems Cost Comparison

Cost Comparison			
Existing System	$ 1964,638	Cost Difference	$ 118,208
Alternative 1	$ 2,082,845		
Alternative 2	$ 2,074,800		$ 110,163



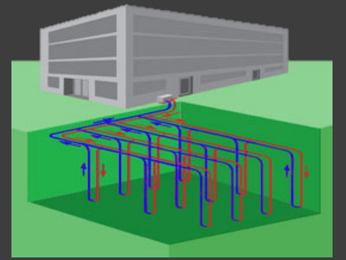
Mount Carmel Fitness & Health Center

Lewis Center, Ohio

Systems Payback Period

System Payback Period			
System	1st Cost	Annual Operation Cost	Payback Period
Exisiting System	$ 1964,637.60	$ 95,343.00	17
Alternative 1	$ 2,082,845.44	$ 88,273.00	

Alternative 1: Roof Top Unit WSHP



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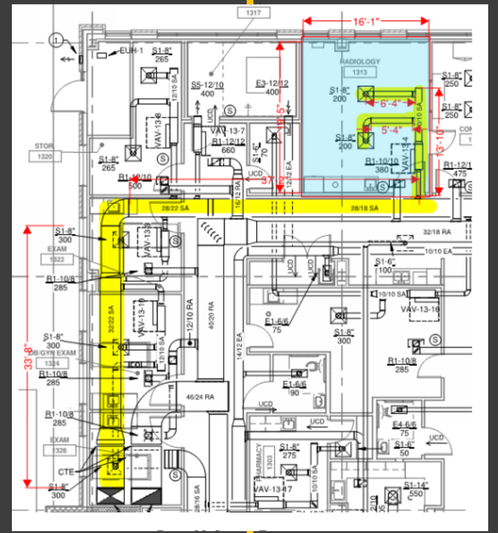
Mount Carmel Fitness & Health Center

Lewis Center, Ohio



Noise Background Level Study

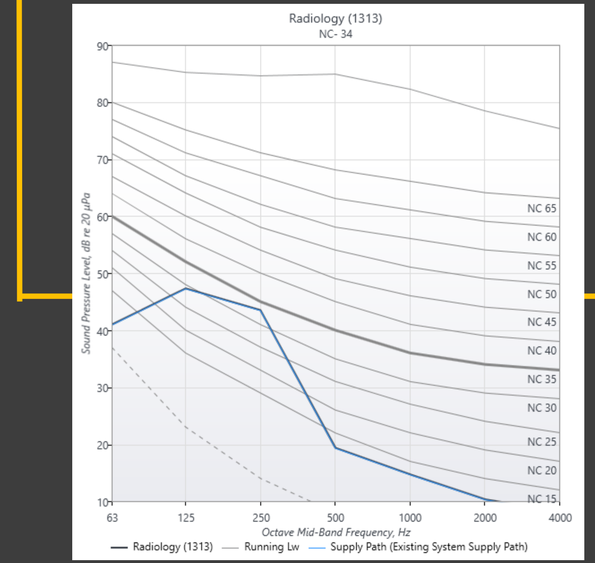
Equipment Sound Pressure Levels

Equipment Sound Pressure Levels							
Equipment Type	63	125	250	500	1000	2000	4000
Existing System RTU - 13	87	85	85	85	82	78	75
RTU WSHP	88	84	83	86	83	77	76
DOAS- 1	85	82	82	81	79	71	70
Heat Pump - 3	77	69	66	68	57	53	51

Mount Carmel Fitness & Health Center

Lewis Center, Ohio

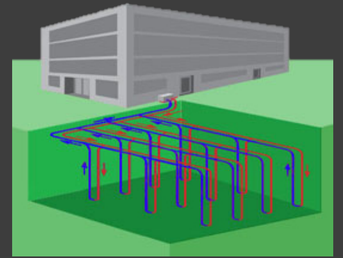
Existing System RTU - 13



Mount Carmel Fitness & Health Center

Lewis Center, Ohio

Alternative 1:
Roof Top Unit
WSHP



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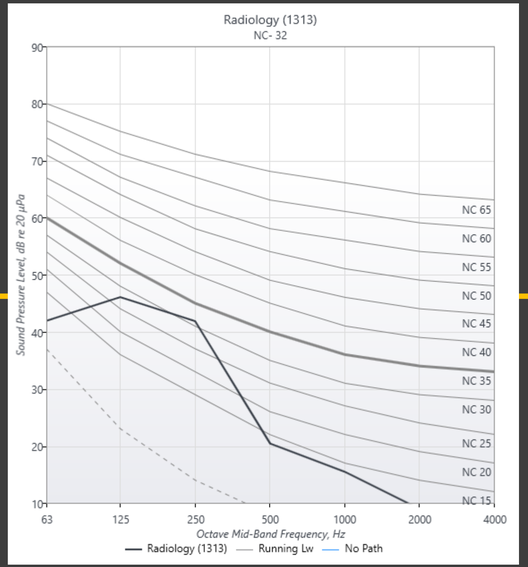
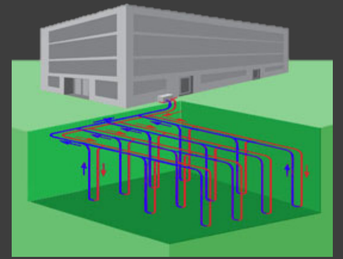


Mount Carmel Fitness & Health Center

Lewis Center, Ohio

Alternative 2: DOAS + Heat Pumps



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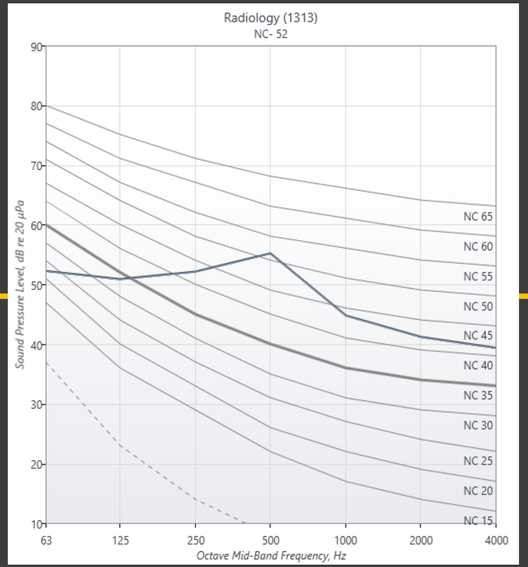
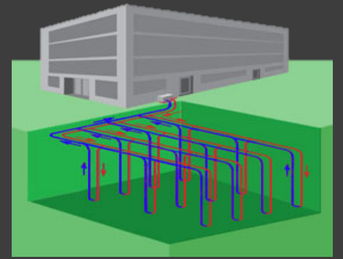
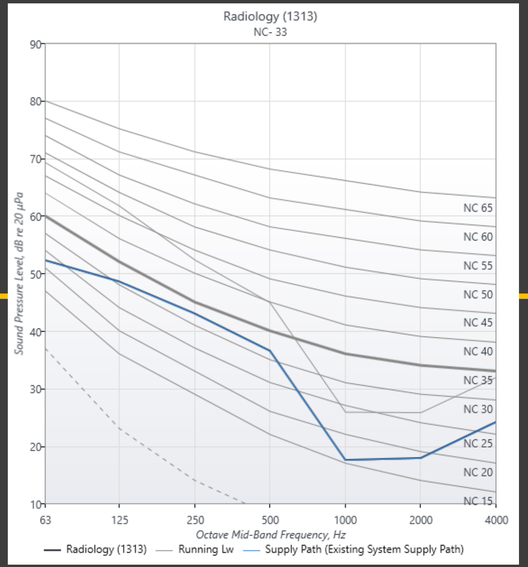


Mount Carmel Fitness & Health Center

Lewis Center, Ohio

Alternative 2: DOAS + Heat Pumps





Mount Carmel Fitness & Health Center

Lewis Center, Ohio

Conclusion

Mount Carmel Fitness & Health Center
Lewis Center, Ohio

Moses D. F. Ling
Dr. James D. Freihaut
Dr. Stephen Treado

Frank A. Eisenhower
(Vice President of
Karpinski Engineering)

Friends

Family

Acknowledgements