Ray & Joan Kroc Corps Community Center

Mathias Kehoe | Mechanical Option

April 09, 2012

Outline

Introduction
DOAS
GSHP
Electrical Breadth
Summary

Ray & Joan Kroc Corps Community Center

- Owned by Salvation Army
- Located in Salem, Oregon
- 92,000 SF
- $33 Million
- Building Contains: Two Pools, Gymnasium, Fitness Center, 288 Seat Chapel, Rock Wall, Kitchen, Community Rooms, Classrooms

Existing Mechanical System

- 10 RTUs with DX cooling and natural gas furnaces
- 2 AHUs with DX cooling and hot water from boilers
- Three boilers supply hot water to pools and AHUs

Proposed Changes

- Use Dedicated Outdoor Air System to provide ventilation
- Use Ground Source Heat Pumps to provide heating and cooling
- Use Energy Recovery techniques to lower pool heating cost

Goals

- Reduce or Eliminate Natural Gas Usage in the Building
- Reduce Energy Consumption
- Reduce Utility Rates

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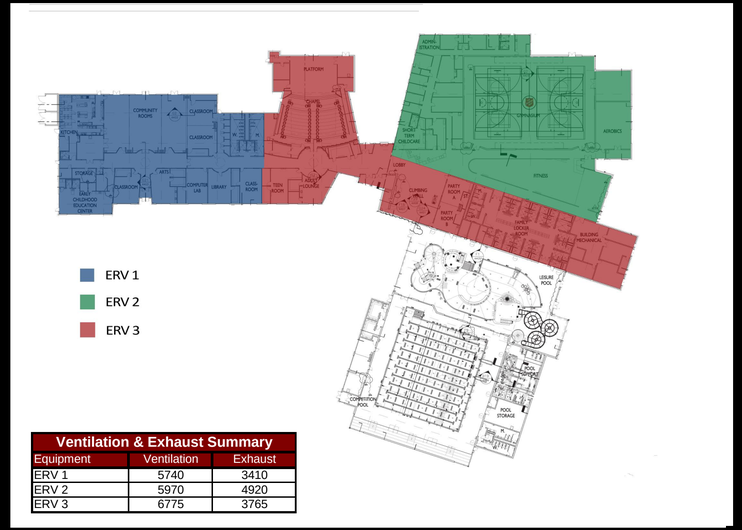
Benefits of DOAS

- Use Energy Recovery Wheel to capture heat from exhaust air
- Supply air at room neutral temperatures to further reduce load
- Provide more accurate ventilation rates for improved air quality

Ventilation

- Existing system is over ventilated, does not provide accurate ventilation to each room.
- Designed to meet ASHRAE Standard 62.1
- Heavily concentrated on north and central parts of the building



Ventilation & Exhaust Summary		
Equipment	Ventilation	Exhaust
ERV 1	5740	3410
ERV 2	5970	4920
ERV 3	6775	3765

Pressurization Exhaust

- Designed to meet ASHRAE Standard 62.1 20-50 CFM per window or door
- Exhausted Gymnasium, Aerobics Room, and Fitness Area to keep negatively pressurized
- Heavily concentrated on south end of building

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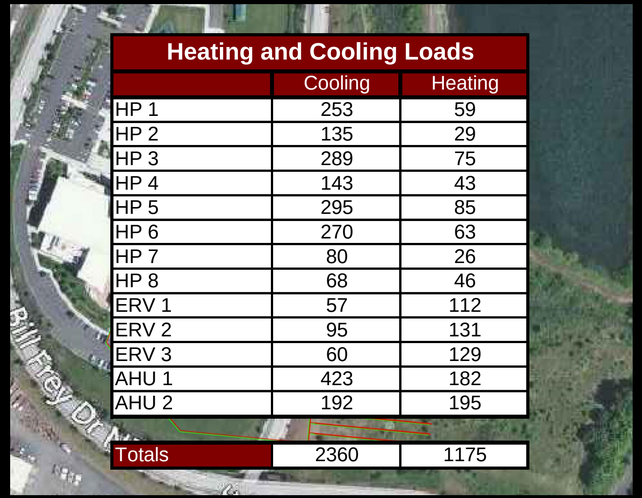
Benefits of GSHP

- Provide consistent heating and cooling the entire year
- Low cost of operation, no natural gas usage
- Long service life

Load Calculations

- Previous Trace model needed updated
- Using 8 Heat Pumps to provide heating and cooling
- AHUs and Outdoor Air Units are on the ground loop as well



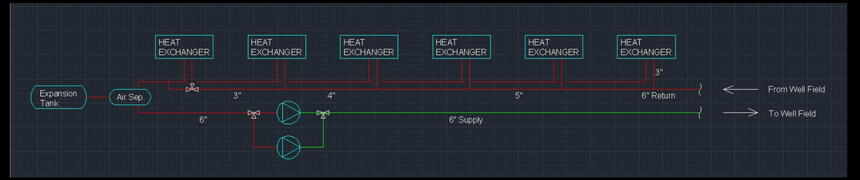
Heating and Cooling Loads		
	Cooling	Heating
HP 1	253	59
HP 2	135	29
HP 3	289	75
HP 4	143	43
HP 5	295	85
HP 6	270	63
HP 7	80	26
HP 8	68	46
ERV 1	57	112
ERV 2	95	131
ERV 3	60	129
AHU 1	423	182
AHU 2	192	195
Totals	2360	1175

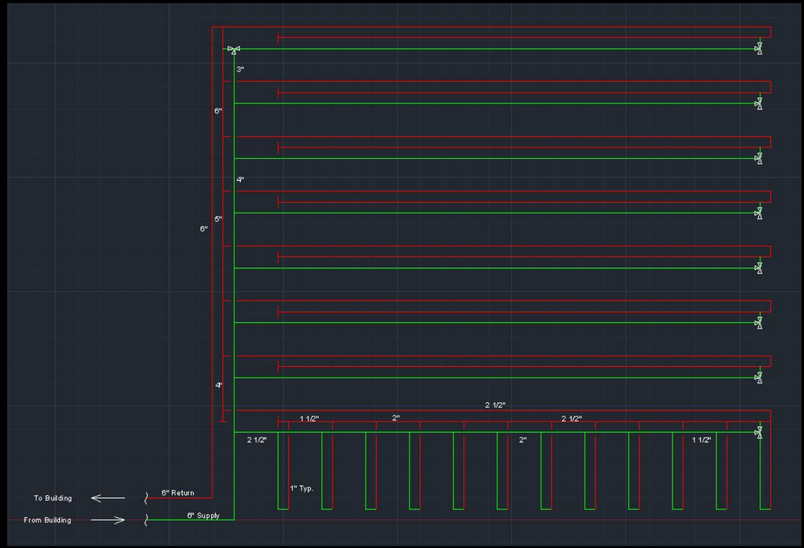
Site Layout

- Calculated well field size using GLHE Pro
- Determined Total Well Length: 27,800 ft.
- Chose 96 – 300 ft wells.

Piping Layout

- Piping size determined using B&G System Syzer Calculator
- Kept Friction Loss between 1 and 4 ft per 100’ of pipe
- Reverse Return

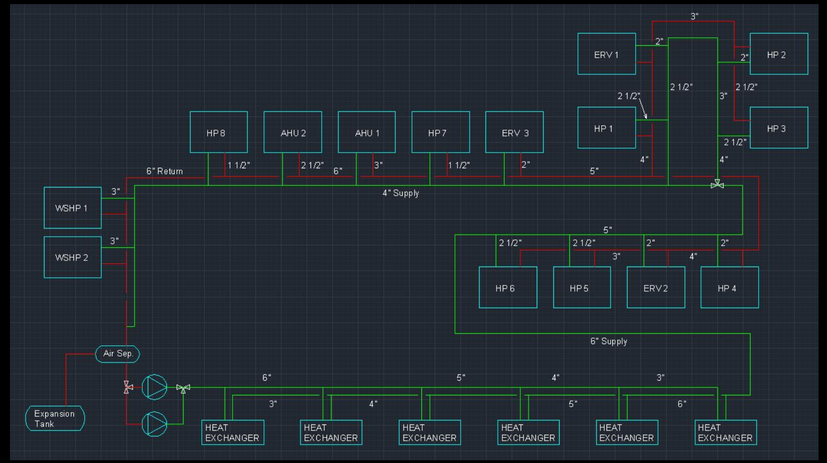




Heat Pump Selections

- Max Rooftop Heat Pump size: 20 tons
- Max Heat Pump size: 25 tons
- Sized based on cooling load

Heat Pump Selection					
	Model	Design Load (MBH)		Selected Load (MBH)	
		Cooling	Heating	Cooling	Heating
HP 1	50RTP20	253	59	264	229
HP 2	50RTP14	135	29	189	168
HP 3	50 VQP300	289	75	345	312
HP 4	50RTP14	143	43	189	168
HP 5	50VQP300	295	85	345	312
HP 6	50RTP20	270	63	264	229
HP 7	50RTP08	80	26	114	98
HP 8	50RTP05	68	46	76	62



Outline

Electrical System Change

Box	Old Demand (A)	New Demand (A)	Difference
HMA	408	300	108
HMB	324	241	83
HMC	322	231	91
HMD	250	365	-115
HAE	393	402	-9
LPD	261	252	9
AHU 1(MDC)	244.5	0	244.5
AHU 2(MDC)	185.2	0	185.2
RTU1 (MDC)	188	0	188
Building Feed	2496	1711	
Total			785

Electrical Breadth

- Determined equipment being removed
- Placement of equipment on location compared to panel capacities
- Calculated new panelboard demand loads to verify compatibility with existing panel boards

Panel Schedule

Panel HMB

Project:	SALEM KROC CENTER	Voltage L-L (V):	480
Job No:	2006129	Voltage L-N (V):	277
Location:	Electrical B115	Type:	3 PHASE, 4 WIRE
Minimum Bus Capacity (A):	600	Short Circuit Rating (A):	See one-line Diagram
Main O.C. Device (A):	None	Mounting:	Surface
Design Capacity (A)"	560	Comments	None

Device Amps	Pole	Lighting (VA)	Rect. (VA)	M/LM/E/A/S (VA)	Description	Ckt. No.	Phase	Ckt. No.	Description	M/LM/E/A/S (VA)	Rect. (VA)	Lighting (VA)	Pole	Device Amps
35	3			6730	SFPB-N1.18 Supply Fan Pwr Box	1	A	2	RTU-R.3 Rooftop Unit	16885			3	70
-	-			6730	-	3	B	4	-	16885			-	-
-	-			6730	-	5	C	6	-	16885			-	-
30	3			5730	SFPB-N1.18 Supply Fan Pwr Box	7	A	8	RTU-R.4 Rooftop Unit	10795			3	50
-	-			5730	-	9	B	10	-	10795			-	-
-	-			5730	-	11	C	12	-	10795			-	-
20	3				SPARE	13	A	14	OHP-1.1 Outdoor Heat Pump	3045			3	15
-	-				-	15	B	16	-	3045			-	-
-	-				-	17	C	18	-	3045			-	-
20	1	3005			Corridor, Teen, Adult LTG	19	A	20	OHP-R.2 Outdoor Heat Pump	3045			3	15
20	1	1789			Chapel, Sto, Offices, Ext LTG	21	B	22	-	3045			-	-
20	1	340			Sto D102, Vest B106, B104	23	C	24	-	3045			-	-
20	1	1675			Site Lighting	25	A	26	SPARE				3	15
20	1				Lobby B105	27	B	28	-				-	-
20	1	1500			Building Sign	29	C	30	-				-	-
20	1				SPARE	31	A	32	BUSSED SPACE					
20	1				SPARE	33	B	34	BUSSED SPACE					
					BUSSED SPACE	35	C	36	BUSSED SPACE					
					BUSSED SPACE	37	A	38	XFMR to Panel "LPB"	39438			3	225
					BUSSED SPACE	39	B	40	-	34248			-	-
-	-				BUSSED SPACE	41	C	42	-	33852			-	-

Connected VA Phase A:	85668	Demanded VA Phase A:	89889
Connected VA Phase B:	80478	Demanded VA Phase B:	84699
Connected VA Phase C:	80082	Demanded VA Phase C:	84303

	Connected	D.F.	Demand		
Lighting Load:	8309	1.25	10386	Demand Load (A) =	324
Receptacle (First 10 KVA):	0	1.00	0	Spare Capacity (A) =	176
Receptacle (Remainder):	0	0.30	0		
Largest Motor:	50655	1.25	63319		
Remaining Motors:	88035	1.00	88035		
Appliances:	0	0.65	0		
Equipment:	0	1.00	0		
Sub Fed Panl:	107538	1.00	107538		
Total:	254537		269278		
Load (Amps):	306.2		323.9		

Panel Schedule

Panel HMB

Project:	SALEM KROC CENTER	Voltage L-L (V):	480
Job No:	2006129	Voltage L-N (V):	277
Location:	Electrical B115	Type:	3 PHASE, 4 WIRE
Minimum Bus Capacity (A):	400	Short Circuit Rating (A):	See one-line Diagram
Main O.C. Device (A):	None	Mounting:	Surface
Design Capacity (A)"	400	Comments	None

Device Amps	Pole	Lighting (VA)	Rect. (VA)	M/LM/E/A/S (VA)	Description	Ckt. No.	Phase	Ckt. No.	Description	M/LM/E/A/S (VA)	Rect. (VA)	Lighting (VA)	Pole	Device Amps
70	3			13080	HP 3	1	A	2	ERV 3	11002			3	60
-	-			13080	-	3	B	4	-	11002			-	-
-	-			13080	-	5	C	6	-	11002			-	-
20	3				SPARE	7	A	8	SPARE				3	20
-	-				-	9	B	10	-				-	-
-	-				-	11	C	12	-				-	-
20	3				SPARE	13	A	14	SPARE				3	15
-	-				-	15	B	16	-				-	-
-	-				-	17	C	18	-				-	-
20	1	3005			Corridor, Teen, Adult LTG	19	A	20	SPARE				3	15
20	1	1789			Chapel, Sto, Offices, Ext LTG	21	B	22	-				-	-
20	1	340			Sto D102, Vest B106, B104	23	C	24	-				-	-
20	1	1675			Site Lighting	25	A	26	SPARE				3	15
20	1				Lobby B105	27	B	28	-				-	-
20	1	1500			Building Sign	29	C	30	-				-	-
20	1				SPARE	31	A	32	BUSSED SPACE					
20	1				SPARE	33	B	34	BUSSED SPACE					
					BUSSED SPACE	35	C	36	BUSSED SPACE					
					BUSSED SPACE	37	A	38	XFMR to Panel "LPB"	39438			3	225
					BUSSED SPACE	39	B	40	-	34248			-	-
-	-				BUSSED SPACE	41	C	42	-	33852			-	-

Connected VA Phase A:	63520	Demanded VA Phase A:	66790
Connected VA Phase B:	58330	Demanded VA Phase B:	61600
Connected VA Phase C:	57934	Demanded VA Phase C:	61204

	Connected	D.F.	Demand		
Lighting Load:	8309	1.25	10386	Demand Load (A) =	241
Receptacle (First 10 KVA):	0	1.00	0	Spare Capacity (A) =	159
Receptacle (Remainder):	0	0.30	0		
Largest Motor:	39240	1.25	49051		
Remaining Motors:	33006	1.00	33006		
Appliances:	0	0.65	0		
Equipment:	0	1.00	0		
Sub Fed Panl:	107538	1.00	107538		
Total:	188093		199981		
Load (Amps):	226.2		240.5		

Panel HMC Wire Cost Changes					
Wire Size	Subtractions	Additions	Difference	Price/Lin. Ft.	Price Change
#14			0	0.24	$ -
#12	1950		-1950	0.37	$ (716.76)
#10	305	155	-150	0.57	$ (85.20)
#8		620	620	0.87	$ 541.94
#6	225		-225	1.34	$ (302.59)
#4	240		-240	2.16	$ (517.80)
#3	550		-550	2.67	$ (1,470.69)
#2			0	3.35	$ -
#1			0	4.40	$ -
#1/0		275	275	5.33	$ 1,466.05
#2/0			0	6.68	$ -
#3/0	2200		-2200	8.38	$ (18,443.85)
#4/0			0	10.53	$ -
250			0	12.49	$ -
300		1100	1100	14.90	$ 16,388.16
350			0	17.44	$ -
400			0	19.85	$ -
500			0	24.02	$ -
			Total		$ (3,140.75)

Wire Savings	
Box	Price Difference
HMA	$ (30,940.88)
HMB	$ (10,959.59)
HMC	$ (3,140.75)
HMD	$ 50.32
HAE	$ 20.28
LPD	$ (55.14)
AHU 1(MDC)	$ (10,625.73)
AHU 2(MDC)	$ (4,239.29)
RTU1 (MDC)	$ (17,713.96)
Building Feed	$ (8,762.07)
Total	$ (86,366.81)

Wire Savings Calculation

- Old Equipment wire sizes were listed in construction documents
- New Equipment wire sizes were determined using NEC 2008

Additional Costs

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System Cost Summary		
Unit	Cost	
Mechanical	$	(6,685.00)
Plumbing	$	191,786.00
Electrical	$	(86,367.00)
Structural	$	94.00
Well Field	$	432,000.00
Total	$	530,828.00

Outline

Simple Payback
Energy Savings

Energy Costs by Month and Type						
	EC (kwh)	ED (kw)	Gas (therms)	EC ($)	ED ($)	Gas ($)
January	91045	158	0	$ 4,569	$ 660	$ -
February	83161	159	0	$ 4,203	$ 666	$ -
March	90291	156	0	$ 4,534	$ 648	$ -
April	86814	156	0	$ 4,372	$ 648	$ -
May	87493	163	0	$ 4,404	$ 690	$ -
June	84823	170	0	$ 4,280	$ 733	$ -
July	90464	178	0	$ 4,542	$ 782	$ -
August	89637	179	0	$ 4,503	$ 788	$ -
September	84044	169	0	$ 4,244	$ 727	$ -
October	86880	153	0	$ 4,376	$ 629	$ -
November	88553	159	0	$ 4,453	$ 666	$ -
December	93232	159	0	$ 4,670	$ 666	$ -
			Individual Costs:	$ 53,150	$ 8,303	$ -
			Total Energy Cost:	$ 61,454		

Mechanical System Summary

- Dedicated Outdoor Air System
- Ground Source Heat Pumps
- Pool Energy Recovery

Annual Utility Cost			
	Building	Pool	Total
Existing System	$ 124,281.00	$ 17,123.00	$ 141,404.00
New System	$ 61,454.00	$ 8,490.00	$ 69,944.00
		Total Savings	$ 71,460.00

Goals

- Reduce or Eliminate Natural Gas Usage in the Building
- Reduce Energy Consumption
- Reduce Utility Rates

Results

- Natural Gas consumption dropped from 48,000 therms to under 6,600 therms. An 86% reduction
- Electricity consumption dropped 12.6%, and peak demand dropped from 549kW to 179kW
- Utility rates were lowered by $71,460, a fifty-one percent reduction

- All three goals were accomplished. Results were better then expected.
- The proposed changes are an excellent option at an affordable price

Acknowledgements

- Major Donna Ames & Salvation Army
- Keith Hayes & BRS Architecture
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  - Sam Snyder
  - Jarod Stanton
- Faculty and Staff
- Friends and Family

Questions and Comments