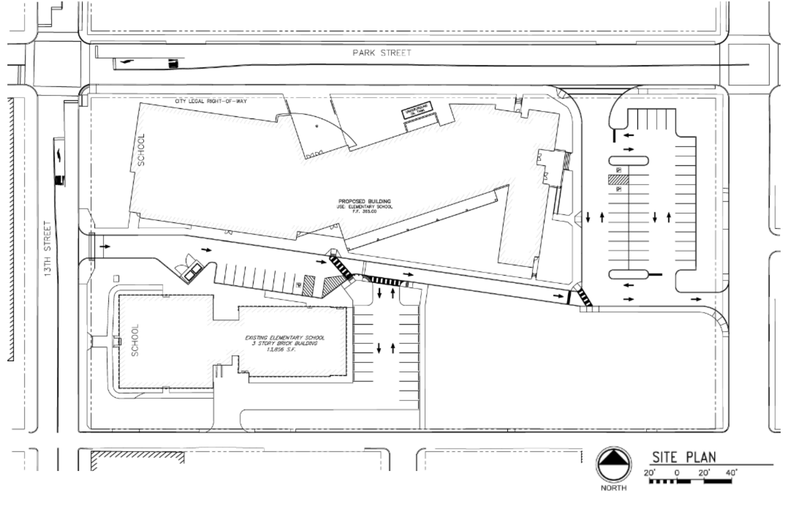
Patrick Allen | Rachel Barrow | Alex Byard | Melanie Fonner | Brad Frederick | Mike Palmer

reading elementary school



Our mission is to develop a design that merges education with the community in a facility that is safe and cost effective while functioning as a learning tool.

project objectives

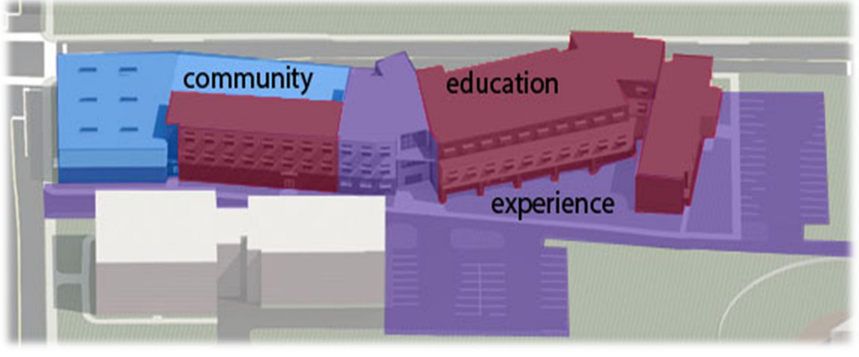
owner goals

- Safety & Security
- Lifecycle & Maintenance
- Cost Effective

nexus goals

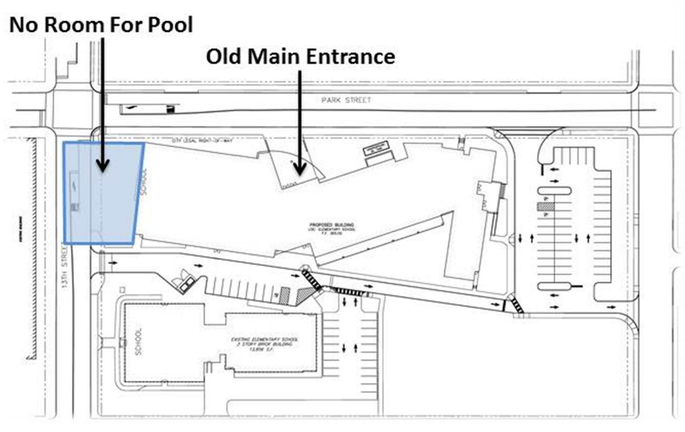
- Integration
- Reduce, Reuse, Recover
- Learning Tool

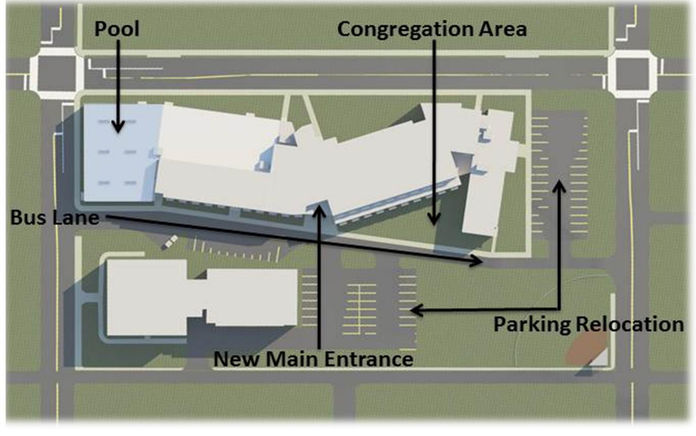
mission



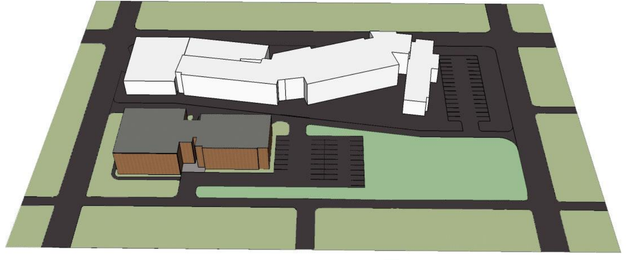
Our mission is to develop a design that merges education with the community in a facility that is safe and cost effective while functioning as a learning tool.

reading elementary school

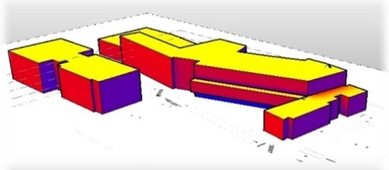


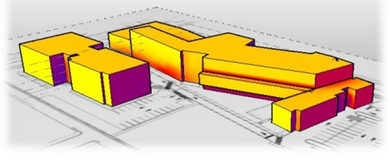


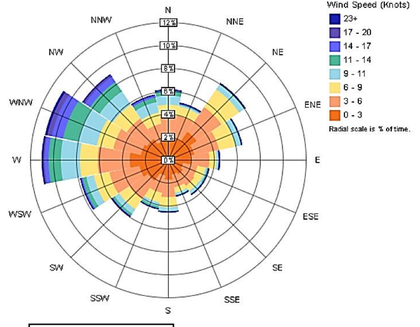
mechanical design process map



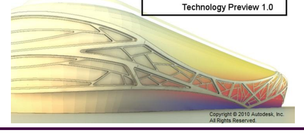
Google SketchUp

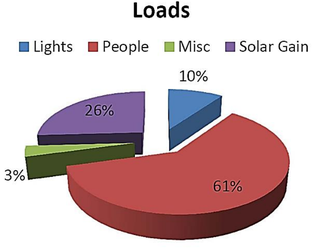






Autodesk® Project Vasari
Technology Preview 1.0

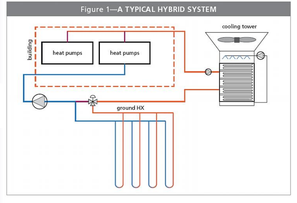




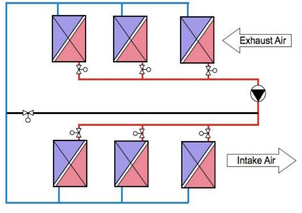
Baseline Building Loads

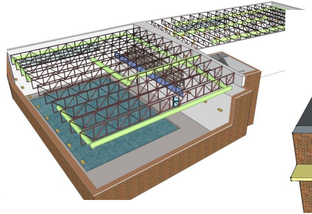
Zone		Cooling Capacity [TONS]	Heating Capacity [TONS]	Airflow [CFM]
1	Academic	165.2	85.3	42,120
2	Community	127.4	48.7	28,735
3	Pool	14.1	36.4	9,100
	TOTAL	306.7	170.4	79,955

mechanical design process map

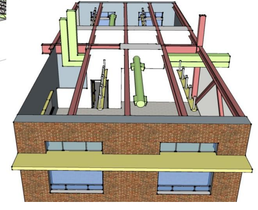


vs

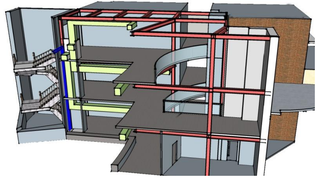




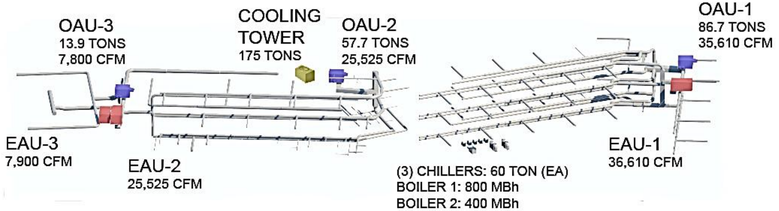
pool / gym



classroom



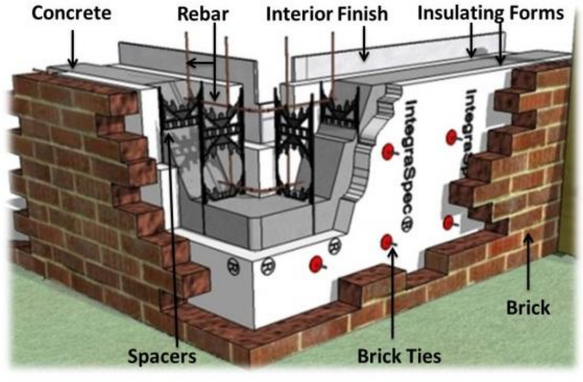
lobby

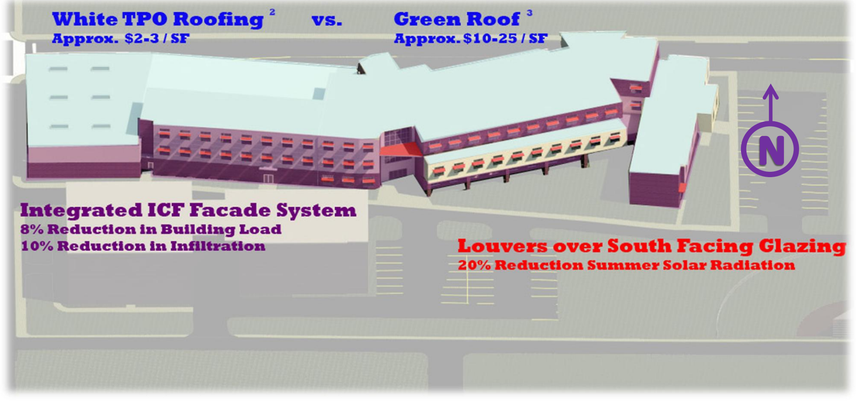


system selection

coordination / layout

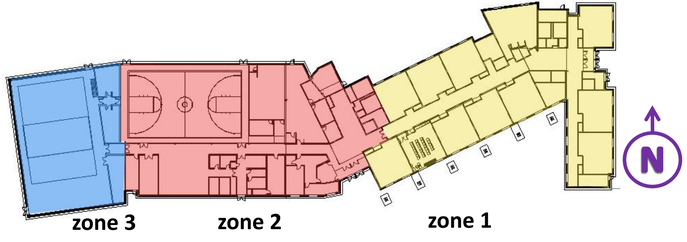
envelope



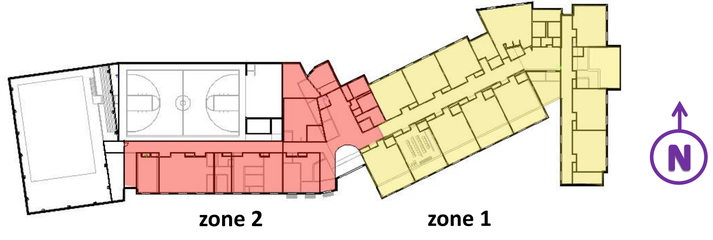


zone breakdown

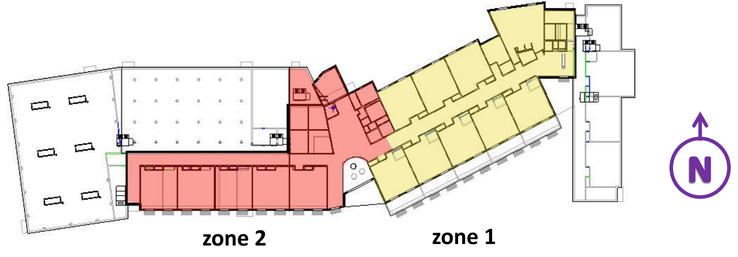
pool **community** **academic**



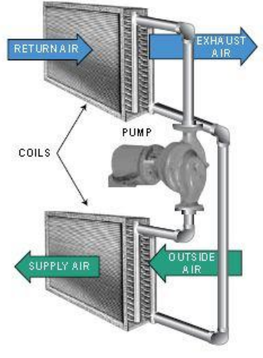
community **academic**

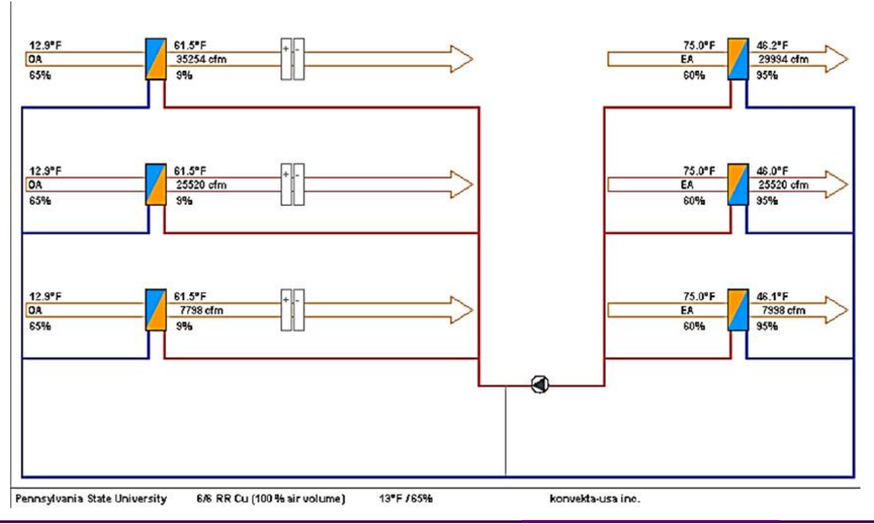


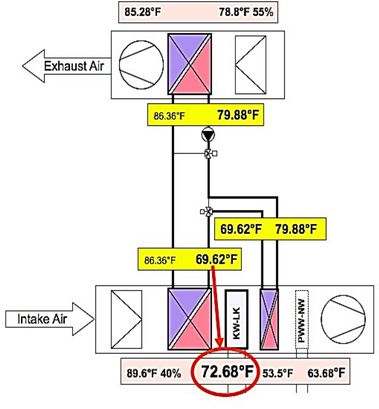
community **academic**



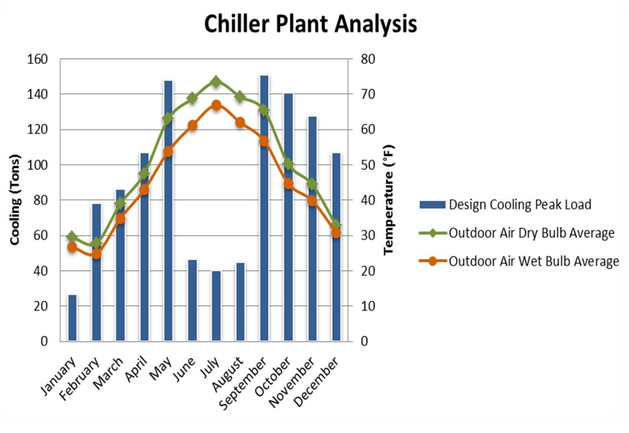
ethylene-glycol







hvac equipment selection



Building Loads

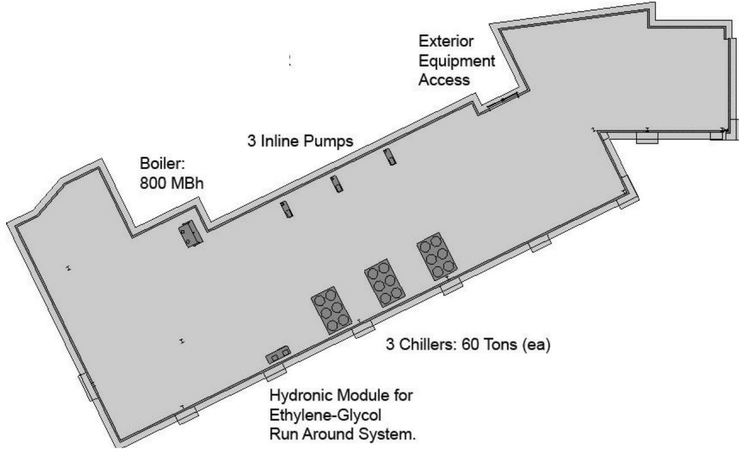
Zone		Cooling Capacity [TONS]	Heating Capacity [TONS]	Airflow [CFM]	kWh/a	sf/ton
1	Academic	86.7	64.2	35,610	321,059	424.23
2	Community	57.7	39.6	25,525	232,429	554.12
3	Pool	13.9	28.3	7,800	70,986	524.34
	TOTAL	158.3	132.1	68,935	624,474	

		AHU 1	AHU 2	AHU 3	EAHU 1	EAHU 2	EAHU 3
Design							
type	(fin spacing - mm)	3.0	3.0	3.0	3.0	3.0	3.0
height	(inch)	49.4	41.5	47.4	45.5	41.5	47.4
length	(inch)	145.7	15.9	70.9	135.8	126.0	70.9
installed depth	(inch)	16.3	15.9	15.9	16.3	15.9	15.9
weight (dry)	(lb)	4498.0	3264.0	1058.0	3880.0	3264.0	1058.0
water capacity	(gal)	128.6	91.0	30.6	111.2	91.0	30.6
corrosion protection		KO31	KO31	KO31	KO31	KO32	KO33
Materials							
tubes		copper	copper	copper	copper	copper	copper
fins		alu (0.0157 inch)	alu (0.0157 inch)	alu (0.0157 inch)	alu (0.4 inch)	alu (0.0157 inch)	alu (0.0157 inch)
collectors		steel	steel	steel	steel	steel	steel
Rating data air side							
Media		AIR	AIR	AIR	AIR	AIR	AIR
volume flow	(cfm)	35254.0	25520.0	7799.0	29994.0	25520.0	7999.0
intake	(°F/%r.h.)	30.0 / 65	30.0 / 65	30.0 / 65	75.0 / 60	75.0 / 61	75.0 / 62
outlet	(°F/%r.h.)	64.9 / 17	64.9 / 17	64.9 / 17	52.5 / 96	52.5 / 97	52.5 / 98
pressure drop	(inch H2O)	0.6	0.6	0.6	0.7	1.7	2.7
Rating data water side							
Media		ETH-GLY 30%w	ETH-GLY 30%w	ETH-GLY 30%w	ETH-GLY 30%w	ETH-GLY 30%w	ETH-GLY 30%w
volume flow	(gpm)	96.2	69.7	21.3	88.4	75.2	23.6
intake / outlet	(°F)	71.6 / 41.6	71.6 / 41.6	71.6 / 41.6	41.4 / 71.5	41.4 / 71.8	41.4 / 71.6
pressure drop	(ft H2O)	97.0	97.0	101.0	92.0	92.0	89.0
Performance	(BTU/h)	1365016.0	988256.0	301739.0	1255404.0	1079422.0	336822.0

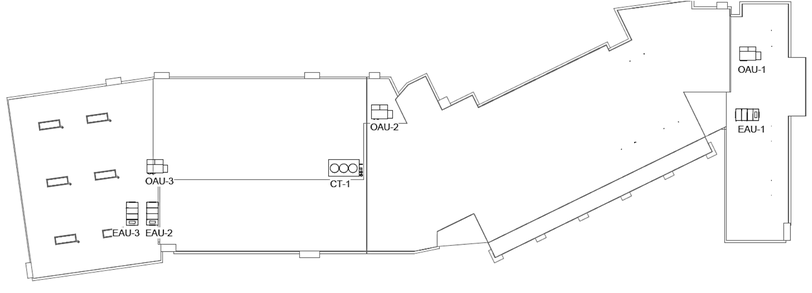
equipment sizing

Equipment Breakdown

Equipment	Description	Capacity
Chiller-1	Rotary-Screw Water Chillers	60 Tons
Chiller-2	Rotary-Screw Water Chillers	60 Tons
Chiller-3	Rotary-Screw Water Chillers	60 Tons
Cooling Tower	Axial Fan, Induced Draft	175 Tons
Boiler-1	Gas-Fired Boiler	800 MBh
Boiler-2	Gas-Fired Boiler	350 MBh
OAU-1	Dedicated Outdoor Air	38,000 CFM
OAU-2	Dedicated Outdoor Air	27,000 CFM
OAU-3	Dedicated Outdoor Air	8,000 CFM
EAU-1	Exhaust Air Unit	34,500 CFM
EAU-2	Exhaust Air Unit	24,500 CFM
EAU-3	Exhaust Air Unit	9,000 CFM
Ethylene-Glycol System	Without Pool	65,000 CFM
Ethylene-Glycol System	With Pool	8,000 CFM
Total	**Without Pool**	
Total	**With Pool**	



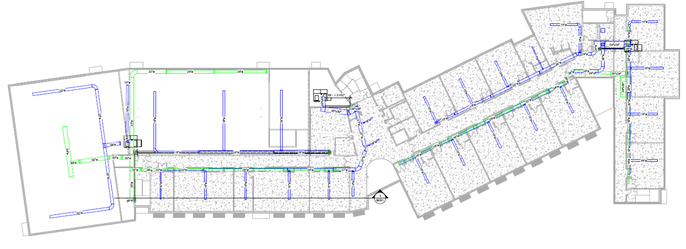
Basement Mechanical Room Layout



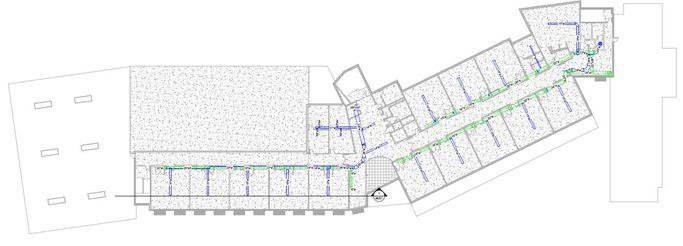
Roof Mechanical Layout

duct layout

first floor duct layout



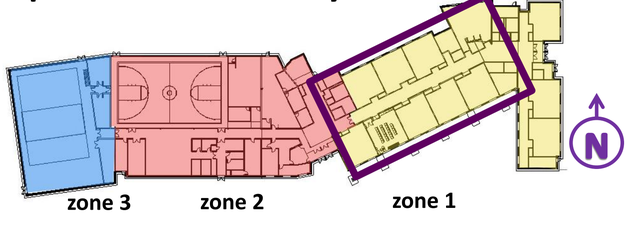
second floor duct layout



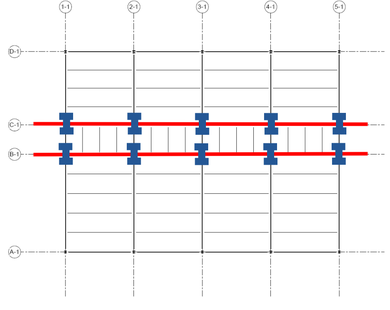
third floor duct layout

academic – classrooms

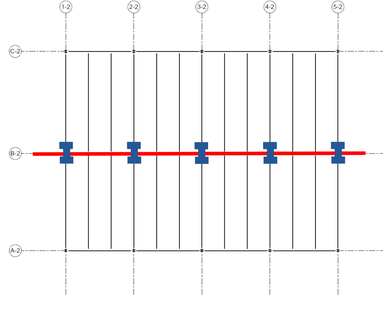
pool community academic

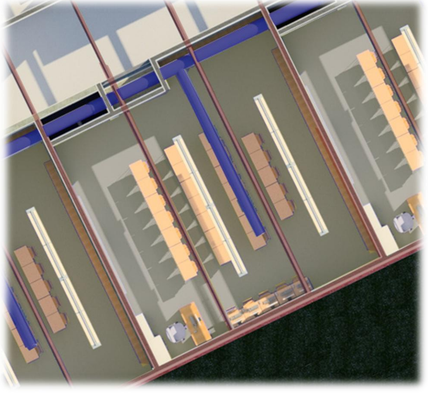


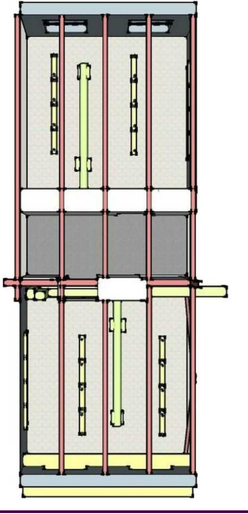
Existing Structural Bay Configuration



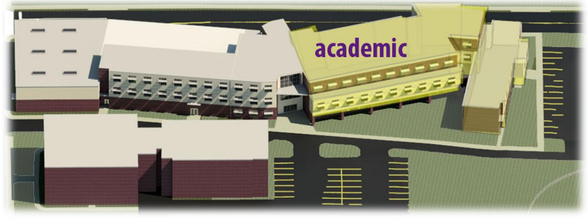
Proposed Structural Redesign



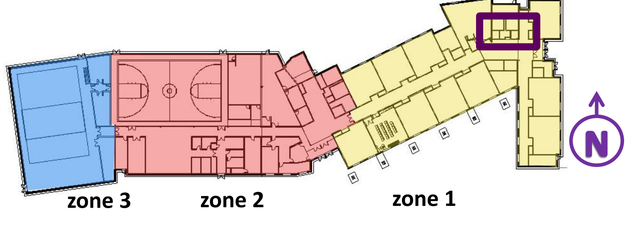


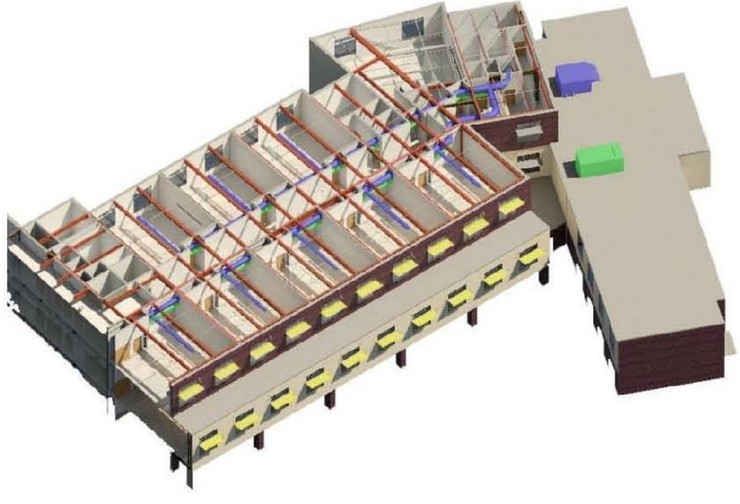


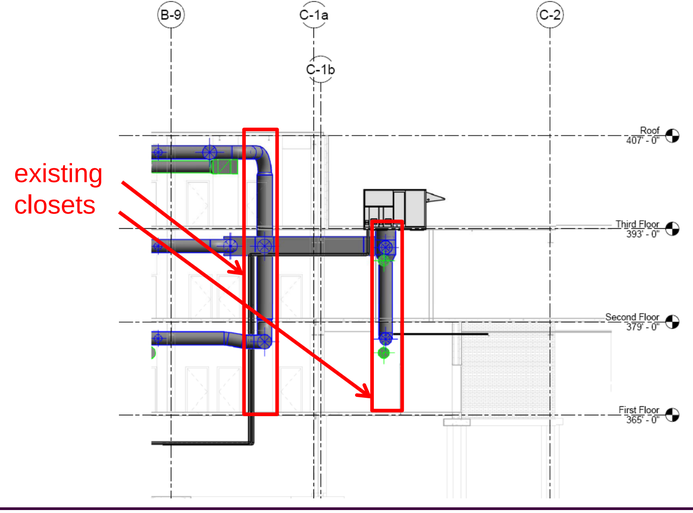
academic – classrooms



pool community academic

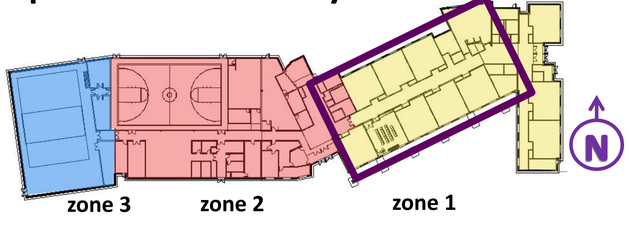


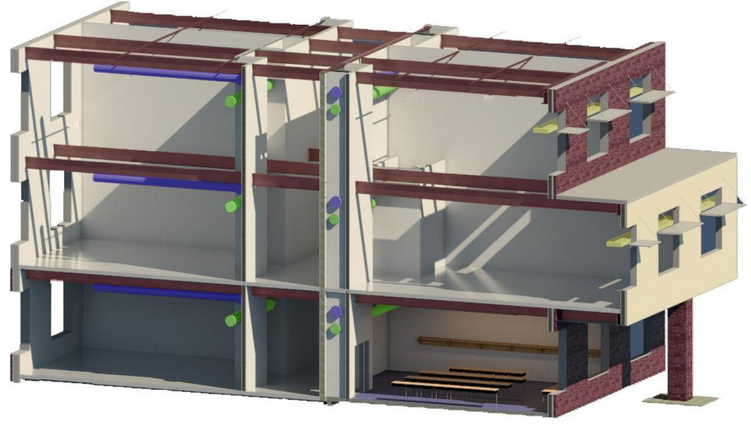




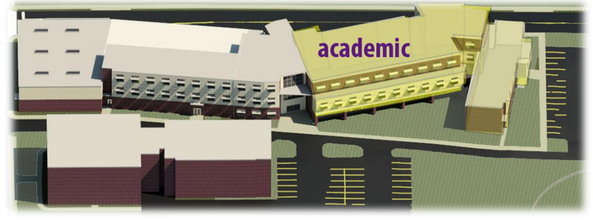
academic – classrooms

pool community academic

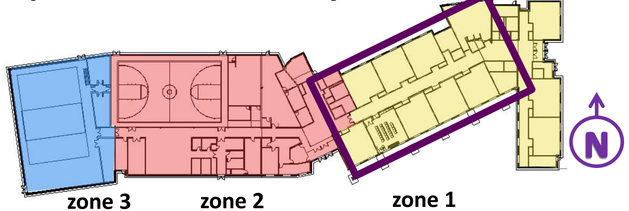




academic – acoustics



pool **community** **academic**



TYPICAL CLASSROOM ACOUSTIC ANALYSIS

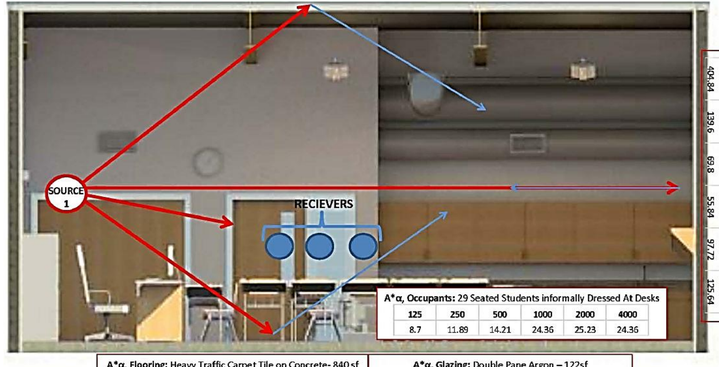
Room Dimensions
Height: 13 ft
Width: 30 ft
Length: 28 ft
Volume: 10,920 cf

$T_{60}(Reverb\ Time) = 0.05V/A$
Recommended Time For Elementary School Classrooms: 0.6-0.8 seconds

Frequency (Hz)	125	250	500	1000	2000	4000
Room T_{60} (s)	0.682551	0.785962	0.48628	0.516361	0.827285	1.085314

A*α, Ceiling: 3VLPA Metal Deck w/Insulation- 840 sf

125	250	500	1000	2000	4000
336	470.4	898.8	655.2	478.8	294



A*α, Walls: 1/2" Thick on 2x4 metal stud 16" O.C. - 1396 sf

125	250	500	1000	2000	4000
418.84	139.6	69.8	55.84	97.72	125.64

A*α, Occupants: 29 Seated Students informally Dressed At Desks

125	250	500	1000	2000	4000
8.7	11.89	14.21	24.36	25.23	24.36

A*α, Flooring: Heavy Traffic Carpet Tile on Concrete- 840 sf

125	250	500	1000	2000	4000
16.8	50.4	117.6	310.8	50.4	54.6

A*α, Glazing: Double Pane Argon – 122sf

125	250	500	1000	2000	4000
33.6	22.4	22.4	11.2	7.8	4.5

VULCRAFT

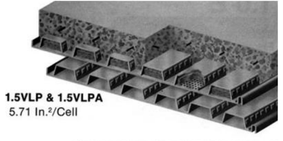
CELLULAR DECK

ROOF

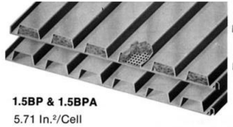
Galvanized Only
For: Electrified Raceways — Canopies — Long Spans
Heavy Forms — Flat Acoustical Ceilings

Vulcraft Cellular Units are approved by U.L. for use as Electrical Raceways.

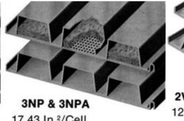
NOTE:
Insulation not installed by Vulcraft.



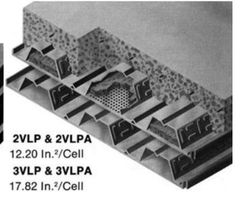
1.5VLP & 1.5VLPA
5.71 In.²/Cell



1.5BP & 1.5BPA
5.71 In.²/Cell



3NP & 3NPA
17.43 In.²/Cell

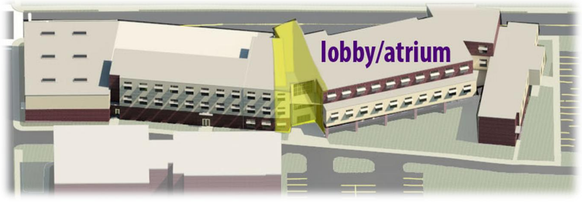


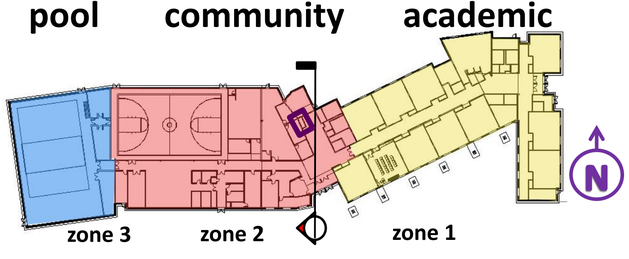
2VLP & 2VLPA
12.20 In.²/Cell
3VLP & 3VLPA
17.82 In.²/Cell

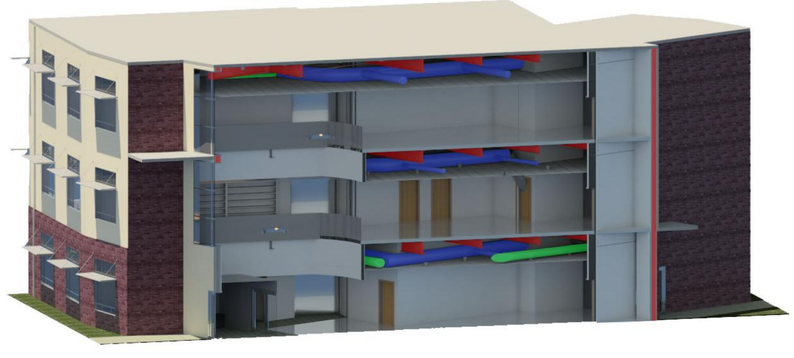
ACOUSTICAL DATA

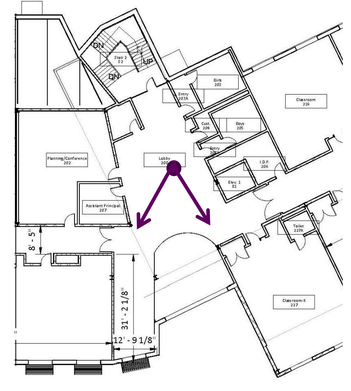
Deck Type	Absorption Coefficients 125	250	500	1000	2000	4000	Noise Reduction Coefficient	RAL™ Test No.
1.5BPA	0.34	0.42	0.36	0.22	017	0.17	0.30 W/O Insulation	A85-154
3NPA	0.40	0.38	0.47	0.19	0.11	0.17	0.30 W/O Insulation	A85-156
1.5VLPA	0.09	0.11	0.25	0.14	0.16	0.28	0.15 W/O Insulation	A86-317
2VLPA	0.12	0.24	0.20	0.14	0.07	0.18	0.15 W/O Insulation	A86-319
3VLPA	0.33	0.31	030	0.14	0.09	0.01	0.20 W/O Insulation	A86-321
1.5BPA	0.38	0.49	0.63	0.98	0.74	0.54	0.70 W/ Insulation	A85-155
3NPA	0.48	0.56	0.98	0.92	0.72	0.58	0.80 W/ Insulation	A85-157
1.5VLPA	0.14	0.21	0.61	0.99	0.69	0.27	0.65 W/ Insulation	A86-318
2VLPA	0.31	0.41	0.94	0.88	0.56	0.44	0.70 W/ Insulation	A86-320
3VLPA	0.40	0.56	1.07	0.78	0.57	0.35	0.75 W/ Insulation	A86-322

community - lobby

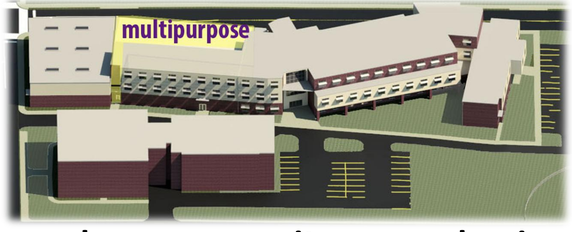


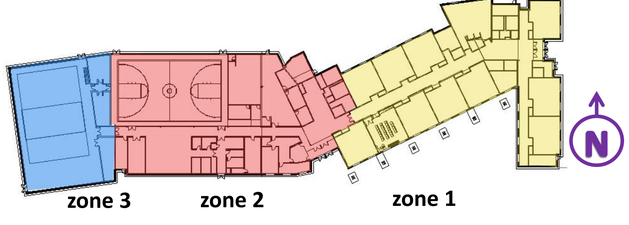


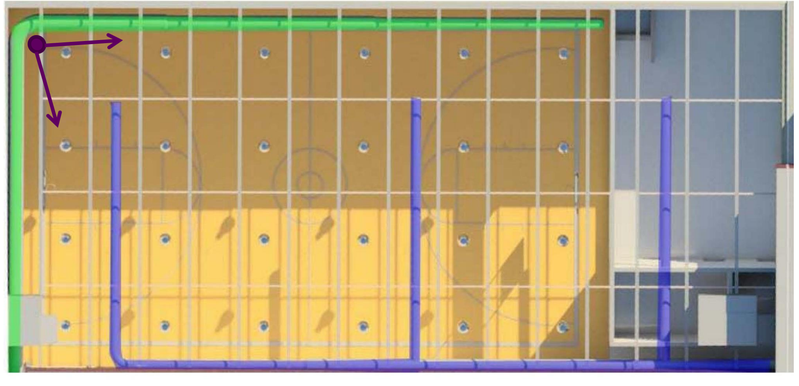




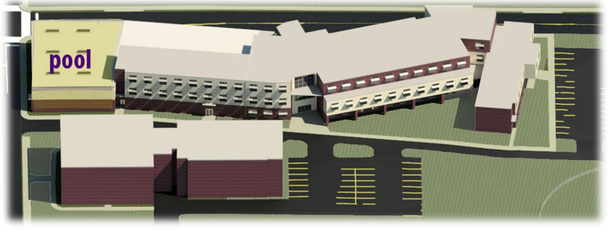
community - multipurpose

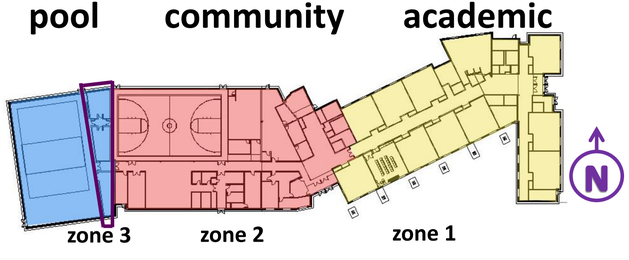


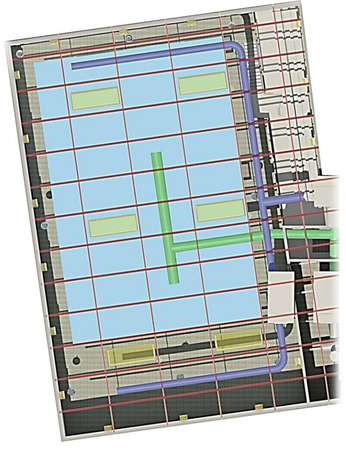


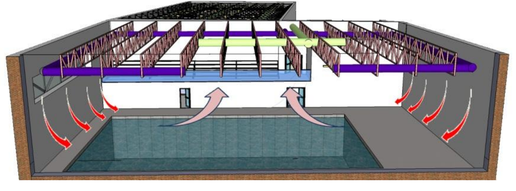


pool

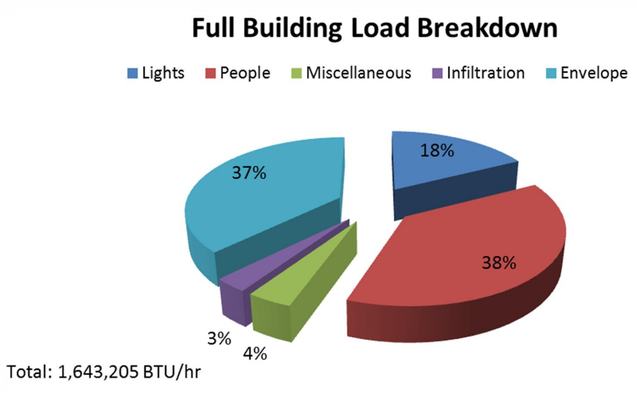








sustainability



Total: 1,643,205 BTU/hr

Baseline Building Loads

Zone		Cooling Capacity [TONS]	Heating Capacity [TONS]	Airflow [CFM]	kWh/a	sf/ton
1	Academic	165.2	85.3	42,120	609,496	291.37
2	Community	127.4	48.7	28,735	441,265	270.53
3	Pool	14.1	36.4	9,100	134,680	368.35
	TOTAL	306.7	170.4	79,955	1,185,560	

vs

Nexus Building Load

Zone		Cooling Capacity [TONS]	Heating Capacity [TONS]	Airflow [CFM]	kWh/a	sf/ton
1	Academic	86.7	64.2	35,610	321,059	424.23
2	Community	57.7	39.6	25,525	232,429	554.12
3	Pool	13.9	28.3	7,800	70,986	524.34
	TOTAL	158.3	132.1	68,935	624,474	

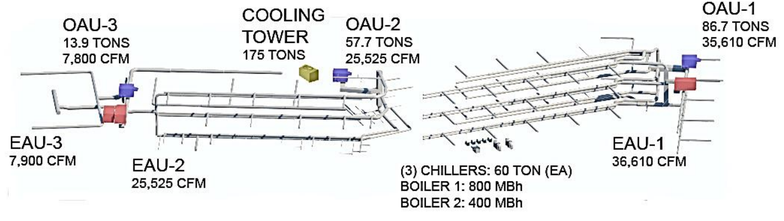
LEED 2009 for Schools	
Sustainable Site	13
Water Efficiency	7
Energy and Atmosphere	14
Materials and Resources	4
Indoor Environmental Quality	15
Innovation and Design Process	2
Regional Priority Credits	0
Total	**55**

conclusion

recover

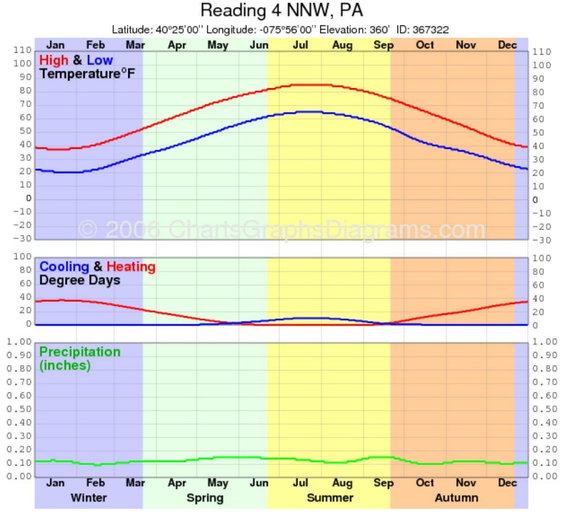
reduce

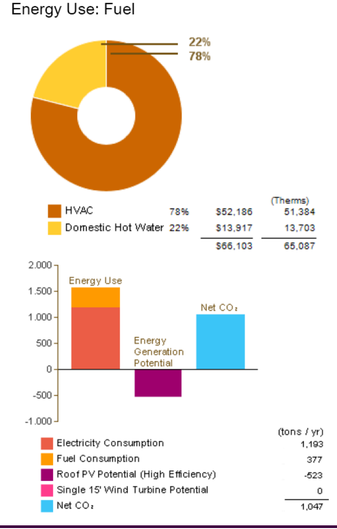
reuse

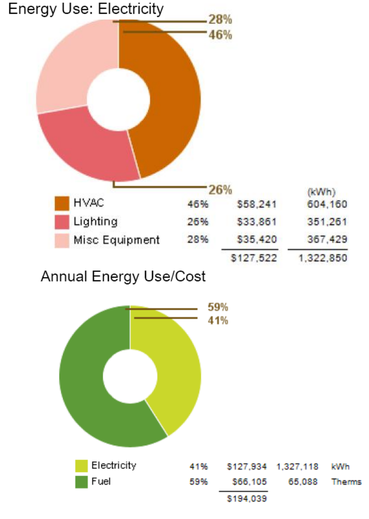


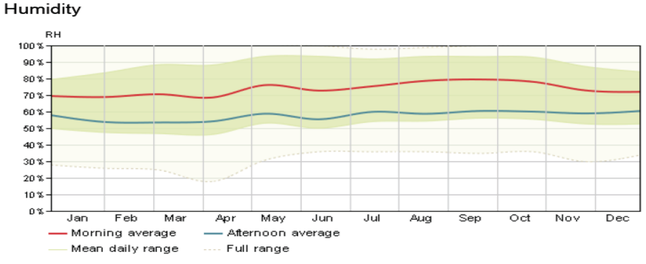
appendix

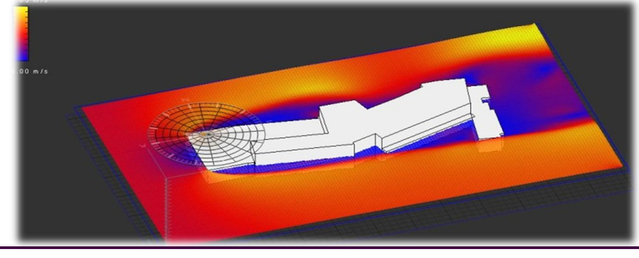
project vasari preliminary energy outputs





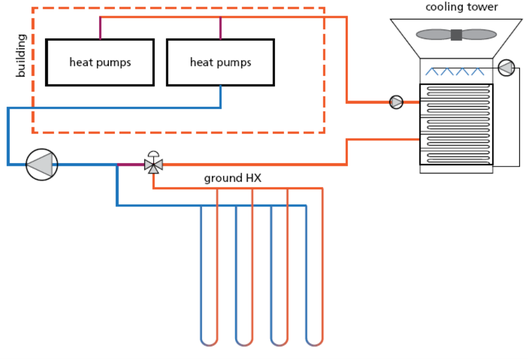






hybrid geothermal analysis

Figure 1—A TYPICAL HYBRID SYSTEM

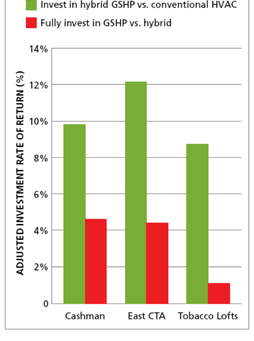


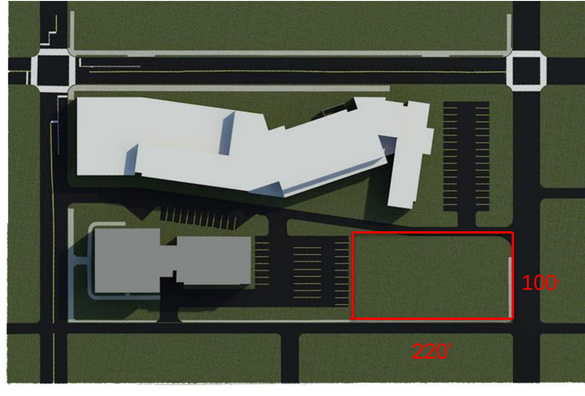
Equipment	Capacity	Unit Price	Quantity	Price
Geothermal Wells	130 Tons	$ 5,000.00	48	$ 240,000.00
WSHP-1	2 Tons	$ 2,345.00	50	$ 117,250.00
WSHP-2	15 Tons	$ 16,650.00	2	$ 33,300.00
Total				**$ 390,550.00**

vs.

Equipment	Capacity	Price
Ethylene-Glycol System	65,000 CFM	**$ 295,000.00**

Figure 2—THE ECONOMICS OF HYBRID SYSTEMS





trace700 zone checksum outputs

academic

Academic Zone

COOLING COIL PEAK — Peaked at Time: Mo/Hr: 7 / 12; Outside Air: OADB/WB/HR: 84 / 70 / 91
CLG SPACE PEAK — Mo/Hr: 9 / 12; OADB: 77

	Space Sens. + Lat. Btu/h	Plenum Sens. + Lat Btu/h	Net Total Btu/h	Percent Of Total (%)	CLG Space Peak Space Sensible Btu/h	Percent Of Total (%)
Envelope Loads						
Skylite Solar	0	0	0	0	0	0
Skylite Cond	0	0	0	0	0	0
Roof Cond	17,197	0	17,197	2	11,571	2
Glass Solar	303,680	0	303,680	29	382,399	51
Glass/Door Cond	8,463	0	8,463	1	-5,648	-1
Wall Cond	6,280	0	6,280	1	2,584	0
Partition/Door	0		0	0	0	0
Floor	0		0	0	0	0
Adjacent Floor	0	0	0	0	0	0
Infiltration	18,847		18,847	2	-1,675	0
Sub Total ==>	354,467	0	354,467	34	389,231	52
Internal Loads						
Lights	148,154	3,315	151,469	15	148,154	20
People	349,800	0	349,800	34	187,890	25
Misc	21,791	0	21,791	2	21,791	3
Sub Total ==>	519,745	3,315	523,060	50	357,835	48
Ceiling Load	0	0	0	0	0	0
Ventilation Load	0	0	126,077	12	0	0
Adj Air Trans Heat	0		0	0	0	0
Dehumid. Ov Sizing			0	0		
Ov/Undr Sizing	944		944	0	944	0
Exhaust Heat		-708	-708	0		
Sup. Fan Heat			36,107	3		
Ret. Fan Heat		0	0	0		
Duct Heat Pkup		0	0	0		
Underflr Sup Ht Pkup			0	0		
Supply Air Leakage		0	0	0		
Grand Total ==>	875,155	2,607	1,039,946	100.00	748,009	100.00

HEATING COIL PEAK — Mo/Hr: Heating Design; OADB: 9

	Space Peak Space Sens Btu/h	Coil Peak Tot Sens Btu/h	Percent Of Total (%)
Envelope Loads			
Skylite Solar	0	0	0.00
Skylite Cond	0	0	0.00
Roof Cond	-26,169	-26,169	4.90
Glass Solar	0	0	0.00
Glass/Door Cond	-94,709	-94,709	17.72
Wall Cond	-32,217	-32,217	6.03
Partition/Door	0	0	0.00
Floor	0	0	0.00
Adjacent Floor	0	0	0.00
Infiltration	-54,679	-54,679	10.23
Sub Total ==>	-207,775	-207,775	38.87
Internal Loads			
Lights	0	0	0.00
People	0	0	0.00
Misc	0	0	0.00
Sub Total ==>	0	0	0.00
Ceiling Load	0	0	0.00
Ventilation Load	0	0	0.00
Adj Air Trans Heat	0	0	0
Ov/Undr Sizing	0	0	0.00
Exhaust Heat		0	0.00
OA Preheat Diff.		-242,377	45.34
RA Preheat Diff.		-84,424	15.79
Additional Reheat		0	0.00
System Plenum Heat		0	0.00
Underflr Sup Ht Pkup		0	0.00
Supply Air Leakage		0	0.00
Grand Total ==>	-207,774	-534,575	100.00

TEMPERATURES

	Cooling	Heating
SADB	54.9	75.6
Ra Plenum	75.0	70.0
Return	75.1	70.0
Ret/OA	76.0	70.0
Fn MtrTD	0.1	0.0
Fn BldTD	0.2	0.0
Fn Frict	0.7	0.0

AIRFLOWS

	Cooling	Heating
Diffuser	33,850	33,850
Terminal	33,850	33,850
Main Fan	33,850	33,850
Sec Fan	0	0
Nom Vent	8,391	0
AHU Vent	8,391	0
Infil	815	815
MinStop/Rh	0	0
Return	34,666	34,666
Exhaust	9,207	815
Rm Exh	0	0
Auxiliary	0	0
Leakage Dwn	0	0
Leakage Ups	0	0

ENGINEERING CKS

	Cooling	Heating
% OA	27.2	0.0
cfm/ft²	0.92	0.92
cfm/ton	390.60	
ft²/ton	424.23	
Btu/hr·ft²	28.29	-20.95
No. People	872	

COOLING COIL SELECTION

	Total Capacity ton	Total Capacity MBh	Sens Cap. MBh	Coil Airflow cfm	Enter DB °F	Enter WB °F	Enter HR gr/lb	Leave DB °F	Leave WB °F	Leave HR gr/lb
Main Clg	86.7	1,040.0	765.6	33,850	76.1	63.1	66.7	54.2	52.5	57.1
Aux Clg	0.0	0.0	0.0	0	0.0	0.0	0.0	0.0	0.0	0.0
Opt Vent	0.0	0.0	0.0	0	0.0	0.0	0.0	0.0	0.0	0.0
Total	86.7	1,040.0								

AREAS

	Gross Total	Glass ft²	Glass (%)
Floor	36,765		
Part	0		
Int Door	0		
ExFlr	0		
Roof	13,000	0	0
Wall	19,551	5,496	28
Ext Door	42	0	0

HEATING COIL SELECTION

	Capacity MBh	Coil Airflow cfm	Ent °F	Lvg °F
Main Htg	-770.4	33,850	54.9	75.6
Aux Htg	0.0	0	0.0	0.0
Preheat	0.0	0	0.0	0.0
Humidif	0.0	0	0.0	0.0
Opt Vent	0.0	0	0.0	0.0
Total	-770.4			

community

Community Zone

COOLING COIL PEAK — Peaked at Time: Mo/Hr: 7 / 15; Outside Air: OADB/WB/HR: 88 / 72 / 94
CLG SPACE PEAK — Mo/Hr: 9 / 14; OADB: 81

	Space Sens. + Lat. Btu/h	Plenum Sens. + Lat Btu/h	Net Total Btu/h	Percent Of Total (%)	CLG Space Peak Space Sensible Btu/h	Percent Of Total (%)
Envelope Loads						
Skylite Solar	0	0	0	0	0	0
Skylite Cond	0	0	0	0	0	0
Roof Cond	21,396	0	21,396	3	14,903	3
Glass Solar	202,257	0	202,257	29	248,940	48
Glass/Door Cond	3,609	0	3,609	1	-8,693	-2
Wall Cond	2,931	0	2,931	0	249	0
Partition/Door	0		0	0	0	0
Floor	0		0	0	0	0
Adjacent Floor	0	0	0	0	0	0
Infiltration	9,821		9,821	1	-3,488	-1
Sub Total ==>	240,014	0	240,014	35	251,910	49
Internal Loads						
Lights	111,632	6,483	118,115	17	111,632	22
People	239,060	0	239,060	35	118,410	23
Misc	32,812	0	32,812	5	32,812	6
Sub Total ==>	383,504	6,483	389,987	56	262,854	51
Ceiling Load	0	0	0	0	0	0
Ventilation Load	0	0	63,290	9	0	0
Adj Air Trans Heat	0		0	0	0	0
Dehumid. Ov Sizing			0	0		
Ov/Undr Sizing	931		931	0	931	0
Exhaust Heat		-1,341	-1,341	0		
Sup. Fan Heat			0	0		
Ret. Fan Heat		0	0	0		
Duct Heat Pkup		0	0	0		
Underflr Sup Ht Pkup			0	0		
Supply Air Leakage		0	0	0		
Grand Total ==>	624,450	5,142	692,882	100.00	515,696	100.00

HEATING COIL PEAK — Mo/Hr: Heating Design; OADB: 9

	Space Peak Space Sens Btu/h	Coil Peak Tot Sens Btu/h	Percent Of Total (%)
Envelope Loads			
Skylite Solar	0	0	0.00
Skylite Cond	0	0	0.00
Roof Cond	-28,504	-28,504	12.75
Glass Solar	0	0	0.00
Glass/Door Cond	-46,259	-46,259	20.69
Wall Cond	-19,029	-19,029	8.51
Partition/Door	0	0	0.00
Floor	0	0	0.00
Adjacent Floor	0	0	0.00
Infiltration	-32,368	-32,368	14.48
Sub Total ==>	-126,161	-126,161	56.42
Internal Loads			
Lights	0	0	0.00
People	0	0	0.00
Misc	0	0	0.00
Sub Total ==>	0	0	0.00
Ceiling Load	0	0	0.00
Ventilation Load	0	0	0.00
Adj Air Trans Heat	0	0	0
Ov/Undr Sizing	1	1	0.00
Exhaust Heat		0	0.00
OA Preheat Diff.		-124,228	55.56
RA Preheat Diff.		26,787	-11.98
Additional Reheat		0	0.00
System Plenum Heat		0	0.00
Underflr Sup Ht Pkup		0	0.00
Supply Air Leakage		0	0.00
Grand Total ==>	-126,159	-223,600	100.00

TEMPERATURES

	Cooling	Heating
SADB	55.0	75.1
Ra Plenum	75.0	70.0
Return	75.3	70.0
Ret/OA	76.5	70.0
Fn MtrTD	0.0	0.0
Fn BldTD	0.0	0.0
Fn Frict	0.0	0.0

AIRFLOWS

	Cooling	Heating
Diffuser	23,398	19,319
Terminal	23,398	19,319
Main Fan	23,398	19,319
Sec Fan	0	0
Nom Vent	5,205	0
AHU Vent	5,205	0
Infil	483	483
MinStop/Rh	0	0
Return	23,768	19,769
Exhaust	5,575	450
Rm Exh	112	32
Auxiliary	0	0
Leakage Dwn	0	0
Leakage Ups	0	0

ENGINEERING CKS

	Cooling	Heating
% OA	22.5	0.0
cfm/ft²	0.73	0.60
cfm/ton	405.23	
ft²/ton	554.12	
Btu/hr·ft²	21.66	-14.85
No. People	451	

COOLING COIL SELECTION

	Total Capacity ton	Total Capacity MBh	Sens Cap. MBh	Coil Airflow cfm	Enter DB °F	Enter WB °F	Enter HR gr/lb	Leave DB °F	Leave WB °F	Leave HR gr/lb
Main Clg	57.7	692.9	522.7	23,398	76.0	62.9	66.1	55.0	52.7	56.7
Aux Clg	0.0	0.0	0.0	0	0.0	0.0	0.0	0.0	0.0	0.0
Opt Vent	0.0	0.0	0.0	0	0.0	0.0	0.0	0.0	0.0	0.0
Total	57.7	692.9								

AREAS

	Gross Total	Glass ft²	Glass (%)
Floor	31,995		
Part	0		
Int Door	0		
ExFlr	0		
Roof	14,160	0	0
Wall	10,941	2,639	24
Ext Door	84	0	0

HEATING COIL SELECTION

	Capacity MBh	Coil Airflow cfm	Ent °F	Lvg °F
Main Htg	-475.2	19,319	53.6	75.9
Aux Htg	0.0	0	0.0	0.0
Preheat	0.0	0	0.0	0.0
Humidif	0.0	0	0.0	0.0
Opt Vent	0.0	0	0.0	0.0
Total	-475.2			

pool

Pool Zone

COOLING COIL PEAK — Peaked at Time: Mo/Hr: 7 / 15; Outside Air: OADB/WB/HR: 88 / 72 / 94
CLG SPACE PEAK — Mo/Hr: 7 / 15; OADB: 88

	Space Sens. + Lat. Btu/h	Plenum Sens. + Lat Btu/h	Net Total Btu/h	Percent Of Total (%)	CLG Space Peak Space Sensible Btu/h	Percent Of Total (%)
Envelope Loads						
Skylite Solar	34,519	0	34,519	21	34,519	30
Skylite Cond	355	0	355	0	355	0
Roof Cond	9,527	0	9,527	6	9,527	8
Glass Solar	3,143	0	3,143	2	3,143	3
Glass/Door Cond	227	0	227	0	227	0
Wall Cond	1,691	0	1,691	1	1,691	1
Partition/Door	0		0	0	0	0
Floor	0		0	0	0	0
Adjacent Floor	0	0	0	0	0	0
Infiltration	21,258		21,258	13	10,170	9
Sub Total ==>	70,721	0	70,721	42	59,633	52
Internal Loads						
Lights	28,387	426	28,813	17	28,387	25
People	35,250	0	35,250	21	16,650	14
Misc	11,118	0	11,118	7	11,118	10
Sub Total ==>	74,754	426	75,180	45	56,154	48
Ceiling Load	0	0	0	0	0	0
Ventilation Load	0	0	14,745	9	0	0
Adj Air Trans Heat	0		0	0	0	0
Dehumid. Ov Sizing			0	0		
Ov/Undr Sizing	0		0	0	0	0
Exhaust Heat		0	0	0		
Sup. Fan Heat			6,307	4		
Ret. Fan Heat		0	0	0		
Duct Heat Pkup		0	0	0		
Underflr Sup Ht Pkup			0	0		
Supply Air Leakage		0	0	0		
Grand Total ==>	145,475	426	166,953	100.00	115,788	100.00

HEATING COIL PEAK — Mo/Hr: Heating Design; OADB: 9

	Space Peak Space Sens Btu/h	Coil Peak Tot Sens Btu/h	Percent Of Total (%)
Envelope Loads			
Skylite Solar	0	0	0.00
Skylite Cond	-6,153	-6,153	3.50
Roof Cond	-14,972	-14,972	8.52
Glass Solar	0	0	0.00
Glass/Door Cond	-3,938	-3,938	2.24
Wall Cond	-17,826	-17,826	10.15
Partition/Door	0	0	0.00
Floor	0	0	0.00
Adjacent Floor	0	0	0.00
Infiltration	-122,658	-122,658	69.83
Sub Total ==>	-165,547	-165,547	94.24
Internal Loads			
Lights	0	0	0.00
People	0	0	0.00
Misc	0	0	0.00
Sub Total ==>	0	0	0.00
Ceiling Load	0	0	0.00
Ventilation Load	0	0	0.00
Adj Air Trans Heat	0	0	0
Ov/Undr Sizing	0	0	0.00
Exhaust Heat		1,269	-0.72
OA Preheat Diff.		0	0.00
RA Preheat Diff.		0	0.00
Additional Reheat		-11,384	6.48
System Plenum Heat		0	0.00
Underflr Sup Ht Pkup		0	0.00
Supply Air Leakage		0	0.00
Grand Total ==>	-165,547	-175,661	100.00

TEMPERATURES

	Cooling	Heating
SADB	63.6	106.7
Ra Plenum	75.0	70.0
Return	81.8	81.2
Ret/OA	82.4	81.2
Fn MtrTD	0.1	0.0
Fn BldTD	0.2	0.0
Fn Frict	0.7	0.0

AIRFLOWS

	Cooling	Heating
Diffuser	5,913	5,913
Terminal	5,913	5,913
Main Fan	5,913	5,913
Sec Fan	0	0
Nom Vent	1,378	0
AHU Vent	1,378	0
Infil	1,530	1,530
MinStop/Rh	5,913	5,913
Return	7,275	7,433
Exhaust	2,740	1,520
Rm Exh	168	10
Auxiliary	0	0
Leakage Dwn	0	0
Leakage Ups	0	0

ENGINEERING CKS

	Cooling	Heating
% OA	23.3	0.0
cfm/ft²	0.81	0.81
cfm/ton	424.98	
ft²/ton	524.34	
Btu/hr·ft²	22.89	-64.10
No. People	54	

COOLING COIL SELECTION

	Total Capacity ton	Total Capacity MBh	Sens Cap. MBh	Coil Airflow cfm	Enter DB °F	Enter WB °F	Enter HR gr/lb	Leave DB °F	Leave WB °F	Leave HR gr/lb
Main Clg	13.9	167.0	128.2	5,913	82.7	68.8	84.8	63.0	60.4	75.5
Aux Clg	0.0	0.0	0.0	0	0.0	0.0	0.0	0.0	0.0	0.0
Opt Vent	0.0	0.0	0.0	0	0.0	0.0	0.0	0.0	0.0	0.0
Total	13.9	167.0								

AREAS

	Gross Total	Glass ft²	Glass (%)
Floor	7,295		
Part	0		
Int Door	0		
ExFlr	0		
Roof	6,515	300	5
Wall	6,734	192	3
Ext Door	0	0	0

HEATING COIL SELECTION

	Capacity MBh	Coil Airflow cfm	Ent °F	Lvg °F
Main Htg	-340.4	5,913	54.4	106.7
Aux Htg	0.0	0	0.0	0.0
Preheat	0.0	0	0.0	0.0
Reheat	-176.1	5,913	54.4	81.4
Humidif	-127.2	6,122	1.8	31.8
Opt Vent	0.0	0	0.0	0.0
Total	-467.6			

ventilation calculations

Reading Elementary School - Reading, PA
ASHRAE 62.1 2007 Minimum Ventilation Calculations

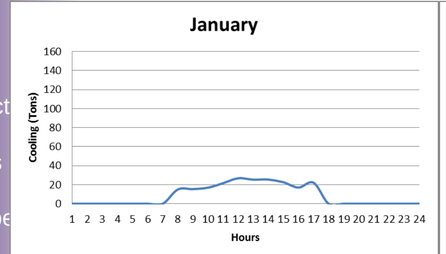
AHU	Capacity cfm	Percent OA	OA cfm
RTU-1	35310	100.0%	35310

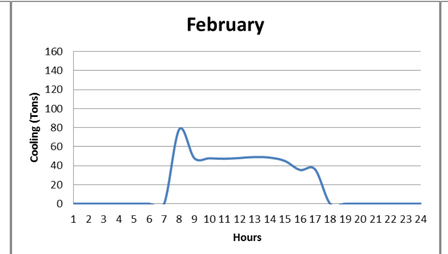
System Population, Ps	871
Zone Population, Pz	700
Occupant Diversity, D = (Pz-Ps)/Pz	80%

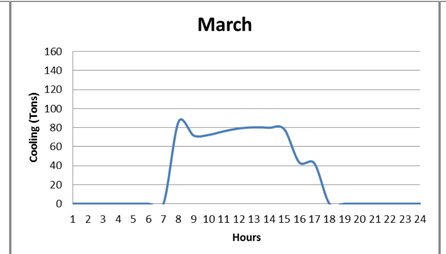
b a =a/b

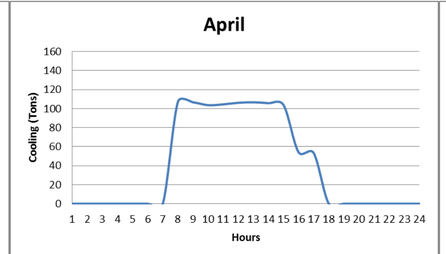
Room Name	Room Number	Occupancy Category	Area (SF)	People# O.A. Rate (cfm/person)	Area O.A. Rate (cfm/SF)	# of Occupants Furniture	Occupant Density	Breathing Zone O.A. Flow Required Vbz	Table 6-2 Zone Air Dist. Eff.	Zone outdoor airflow	Primary O.A. fraction	Table 6-3 System Vent. Eff.	Uncorrected O.A. Intake	Design O.A. Intake	Zone Primary Air Flow Set Point (cfm)	Percent OA	Actual O.A. Flow	% Above Min OA	Meets Standard?	Meets LEED 30%?
			Az	Rp	Ra	Pz,f		Vbz = Rp*Pz + Ra*Az	Ez	Voz = Vbz / Ez	Zp = Voz / Vpz	Ev	Vou = D*(ΣRp*Pz) + Σ(Ra*Az)	Vot = Vou / Ev	Vpz		OA = % * Vpz	=(OA/Vot) -1		
RTU-1										**12702.9**	**0.36**	**0.7**	**11432**	**15753**	**35310**	**100.0%**	**35210**	**124%**	**Yes**	**Yes**
Classroom	134	Classroom	815	10	0.12	26	31.90	357.8	1.0	357.8	0.45	0.7	306.8	438.2	800		800.0	83%	Yes	Yes
Classroom	135	Classroom	815	10	0.12	26	31.90	357.8	1.0	357.8	0.45	0.7	306.8	438.2	800		800.0	83%	Yes	Yes
Classroom	136	Classroom	815	10	0.12	26	31.90	357.8	1.0	357.8	0.45	0.7	306.8	438.2	800		800.0	83%	Yes	Yes
Instructor Storage	137	Storage	245	0	0.12	0	0.00	29.4	0.8	36.8	0.27	0.7	29.4	42.0	135		135.0	221%	Yes	Yes
Special Education	140	Classroom	970	10	0.12	18	18.56	296.4	1.0	296.4	0.38	0.7	261.1	372.9	785		785.0	110%	Yes	Yes
Classroom	141	Classroom	790	10	0.12	26	32.91	354.8	1.0	354.8	0.35	0.7	303.8	433.9	1000		1000.0	130%	Yes	Yes
Classroom	142	Classroom	790	10	0.12	26	32.91	354.8	1.0	354.8	0.35	0.7	303.8	433.9	1000		1000.0	130%	Yes	Yes
Classroom	143	Classroom	790	10	0.12	26	32.91	354.8	1.0	354.8	0.35	0.7	303.8	433.9	1000		1000.0	130%	Yes	Yes
Classroom	144	Classroom	790	10	0.12	26	32.91	354.8	1.0	354.8	0.35	0.7	303.8	433.9	1000		1000.0	130%	Yes	Yes
Classroom	145	Classroom	790	10	0.12	26	32.91	354.8	1.0	354.8	0.35	0.7	303.8	433.9	1000		1000.0	130%	Yes	Yes
Custodial	147	Storage	55	0	0.12	0	0.00	6.6	1.0	6.6	0.33	0.7	6.6	9.4	20		20.0	112%	Yes	Yes
Corridor	149/150	Corridor	1670	0	0.06	0	0.00	100.2	1.0	100.2	0.40	0.7	100.2	143.1	250		250.0	75%	Yes	Yes
Conference	151	Conference	220	10	0.12	8	36.36	106.4	1.0	106.4	0.27	0.7	90.7	129.6	400		400.0	209%	Yes	Yes
Security	152	Office	65	5	0.06	1	15.38	8.9	1.0	8.9	0.30	0.7	7.9	11.3	30		30.0	165%	Yes	Yes
Corridor	153/154	Corridor	1085	0	0.06	0	0.00	65.1	1.0	65.1	0.33	0.7	65.1	93.0	200		200.0	115%	Yes	Yes
Classroom	155	Classroom	780	10	0.12	26	33.33	353.6	1.0	353.6	0.35	0.7	302.6	432.2	1000		1000.0	131%	Yes	Yes
Vestibule	156	Vestibule	100	0	0.06	0	0.00	6.0	1.0	6.0	0.01	0.7	6.0	8.6	760		760.0	8767%	Yes	Yes
Maintenance	157/158	Storage	275	0	0.12	0	0.00	33.0	1.0	33.0	0.33	0.7	33.0	47.1	100		100.0	112%	Yes	Yes
Classroom	159	Classroom	780	10	0.12	26	33.33	353.6	1.0	353.6	0.35	0.7	302.6	432.2	1000		1000.0	131%	Yes	Yes
Classroom	160	Classroom	780	10	0.12	26	33.33	353.6	1.0	353.6	0.35	0.7	302.6	432.2	1000		1000.0	131%	Yes	Yes
Conference	161	Conference	85	5	0.06	2	23.53	15.1	1.0	15.1	0.30	0.7	13.1	18.8	50		50.0	166%	Yes	Yes
Corridor	214/215	Corridor	1670	0	0.06	0	0.00	100.2	1.0	100.2	0.40	0.7	100.2	143.1	250		250.0	75%	Yes	Yes
Classroom	216	Classroom	815	10	0.12	26	31.90	357.8	1.0	357.8	0.45	0.7	306.8	438.2	800		800.0	83%	Yes	Yes
Classroom	217	Classroom	815	10	0.12	26	31.90	357.8	1.0	357.8	0.45	0.7	306.8	438.2	800		800.0	83%	Yes	Yes
Classroom	218	Classroom	815	10	0.12	26	31.90	357.8	1.0	357.8	0.45	0.7	306.8	438.2	800		800.0	83%	Yes	Yes
Instructor Storage	320	Storage	245	0	0.12	0	0.00	29.4	1.0	29.4	0.22	0.8	29.4	36.8	135		135.0	267%	Yes	Yes
Special Education	324	Classroom	970	10	0.12	18	18.56	296.4	1.0	296.4	0.38	0.8	296.4	370.5	785		785.0	112%	Yes	Yes
Classroom	325	Classroom	750	10	0.12	26	34.67	350.0	1.0	350.0	0.35	0.8	350.0	437.5	1000		1000.0	129%	Yes	Yes
Classroom	326	Classroom	750	10	0.12	26	34.67	350.0	1.0	350.0	0.35	0.8	350.0	437.5	1000		1000.0	129%	Yes	Yes
Classroom	327	Classroom	750	10	0.12	26	34.67	350.0	1.0	350.0	0.35	0.8	350.0	437.5	1000		1000.0	129%	Yes	Yes
Classroom	328	Classroom	750	10	0.12	26	34.67	350.0	1.0	350.0	0.35	0.8	350.0	437.5	1000		1000.0	129%	Yes	Yes
Classroom	329	Classroom	750	10	0.12	26	34.67	350.0	1.0	350.0	0.35	0.8	350.0	437.5	1000		1000.0	129%	Yes	Yes

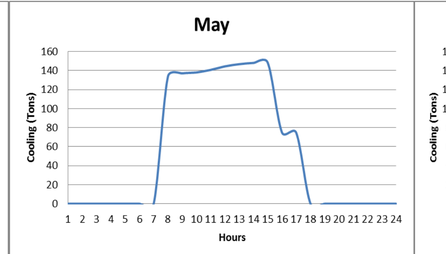
chiller cooling load profiles

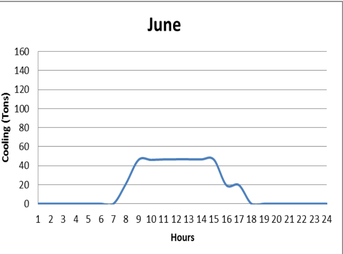


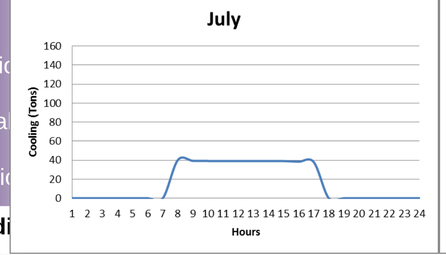


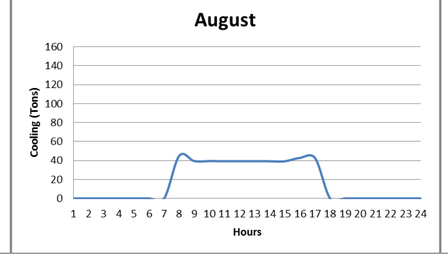


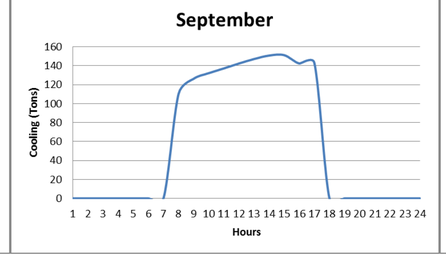


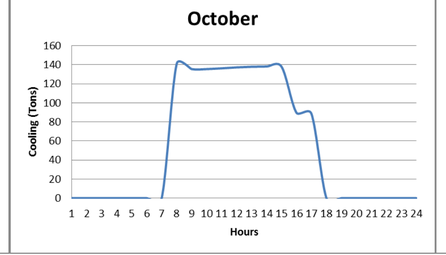


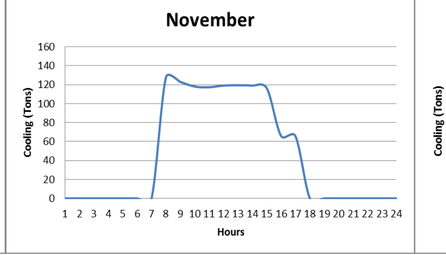


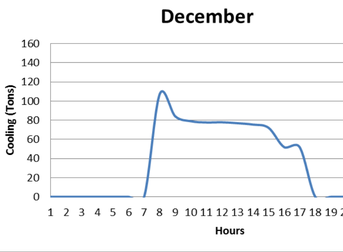












ethylene-glycol system efficiency & msds report

Energy/Financial Comparison: Pennsylvania State AEI

OAU-1/2, EAHU-1/2

		Without E Recovery	Konvekta System
SUMMARY			
Winter			
Heating Energy Requirement	**kWh/a**	856,050	402,000
Effectiveness Heating			0.53
Summer			
Cooling Energy Requirement	**kWh/a**	194,610	178,410
Effectiveness Cooling/Reheat			0.08
Year			
Heating Energy	kWh/a	856,050	402,000
Cooling Energy	kWh/a	194,610	178,410
Electricity (Δ Fans, Pumps)	kWh/a	0	14,503
Total Energy Consumption	**kWh/a**	1,050,660	594,913
Effectiveness			43%
Peak Demand			
Cooling	**kW**	1,525	1,355
	tons	433	385
Heat	**kW**	1,340	535
	MBTU/h	4,572	1,825

Energy/Financial Comparison: Pennsylvania State AEI

OAU-1/2/3, EAHU-1/2/3

		Without E Recovery	Konvekta System
SUMMARY			
Winter			
Heating Energy Requirement	**kWh/a**	965,900	407,500
Effectiveness Heating			0.58
Summer			
Cooling Energy Requirement	**kWh/a**	219,660	200,460
Effectiveness Cooling/Reheat			0.09
Year			
Heating Energy	kWh/a	965,900	407,500
Cooling Energy	kWh/a	219,660	200,460
Electricity (Δ Fans, Pumps)	kWh/a	0	16,514
Total Energy Consumption	**kWh/a**	1,185,560	624,474
Effectiveness			47%
Peak Demand			
Cooling	**kW**	1,722	1,522
	tons	489	432
Heat	**kW**	1,512	411
	MBTU/h	5,159	1,402

ScienceLab.com
Chemicals & Laboratory Equipment

Material Safety Data Sheet
Ethylene glycol MSDS

Section 1: Chemical Product and Company Identification

Product Name: Ethylene glycol

Catalog Codes: SLE1072

CAS#: 107-21-1

RTECS: KW2975000

TSCA: TSCA 8(b) inventory: Ethylene glycol

CI#: Not available.

Synonym: 1,2-Dihydroxyethane; 1,2-Ethanediol; 1,2-Ethandiol; Ethylene dihydrate; Glycol alcohol; Monoethylene glycol; Tescol

Chemical Name: Ethylene Glycol

Chemical Formula: HOCH2CH2OH

Contact Information:

Sciencelab.com, Inc.
14025 Smith Rd.
Houston, Texas 77396

US Sales: **1-800-901-7247**
International Sales: **1-281-441-4400**

Order Online: ScienceLab.com

CHEMTREC (24HR Emergency Telephone), call: 1-800-424-9300

International CHEMTREC, call: 1-703-527-3887

For non-emergency assistance, call: 1-281-441-4400

Section 2: Composition and Information on Ingredients

Composition:

Name	CAS #	% by Weight
Ethylene glycol	107-21-1	100

Toxicological Data on Ingredients: Ethylene glycol: ORAL (LD50): Acute: 4700 mg/kg [Rat]. 5500 mg/kg [Mouse]. 6610 mg/kg [Guinea pig]. VAPOR (LC50): Acute: >200 mg/m 4 hours [Rat].

Section 3: Hazards Identification

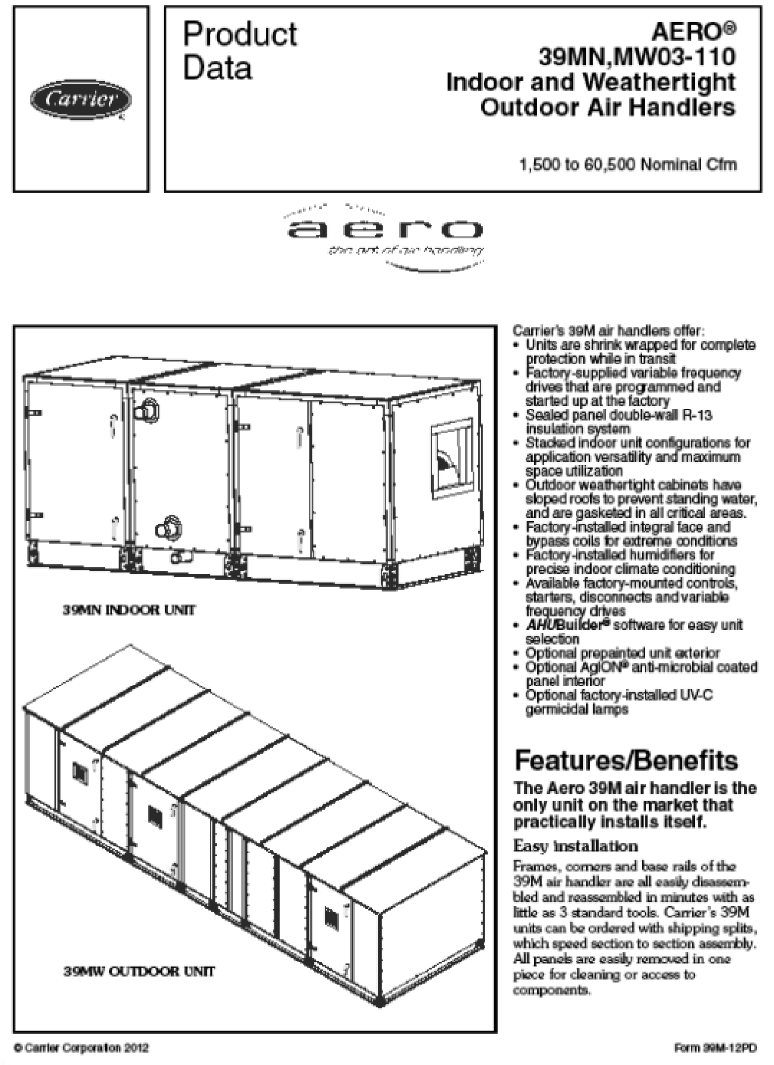
Potential Acute Health Effects:
Hazardous in case of ingestion. Slightly hazardous in case of skin contact (irritant, permeator), of eye contact (irritant), of inhalation. Severe over-exposure can result in death.

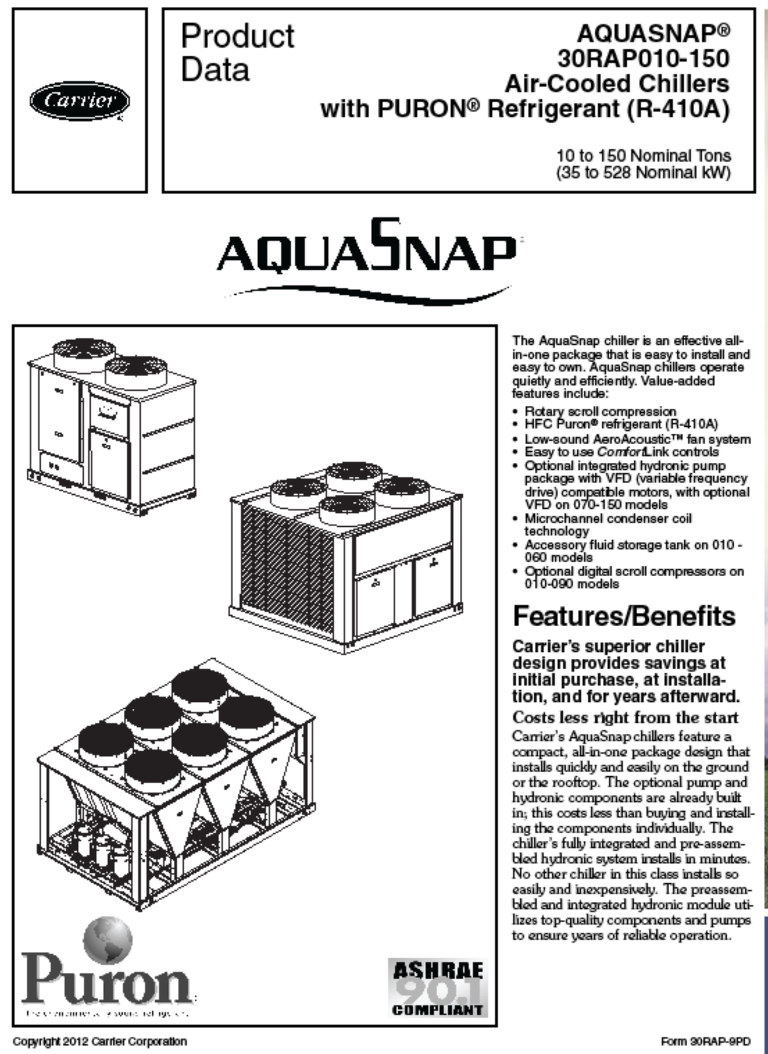
Potential Chronic Health Effects:
CARCINOGENIC EFFECTS: A4 (Not classifiable for human or animal.) by ACGIH. MUTAGENIC EFFECTS: Mutagenic for mammalian somatic cells. Non-mutagenic for bacteria and/or yeast. TERATOGENIC EFFECTS: Not available. DEVELOPMENTAL TOXICITY: Not available. The substance may be toxic to kidneys, liver, central nervous system (CNS). Repeated or prolonged exposure to the substance can produce target organs damage. Repeated exposure to a highly toxic material may produce general deterioration of health by an accumulation in one or many human organs.

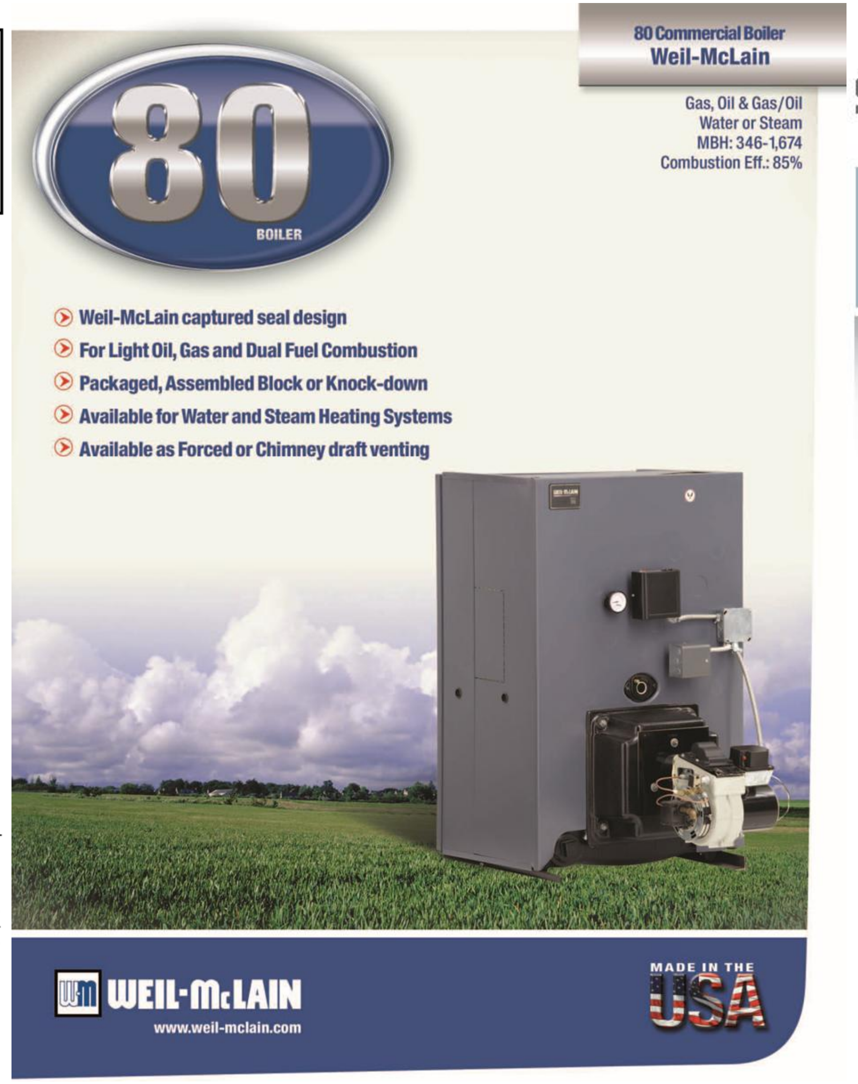
Section 4: First Aid Measures

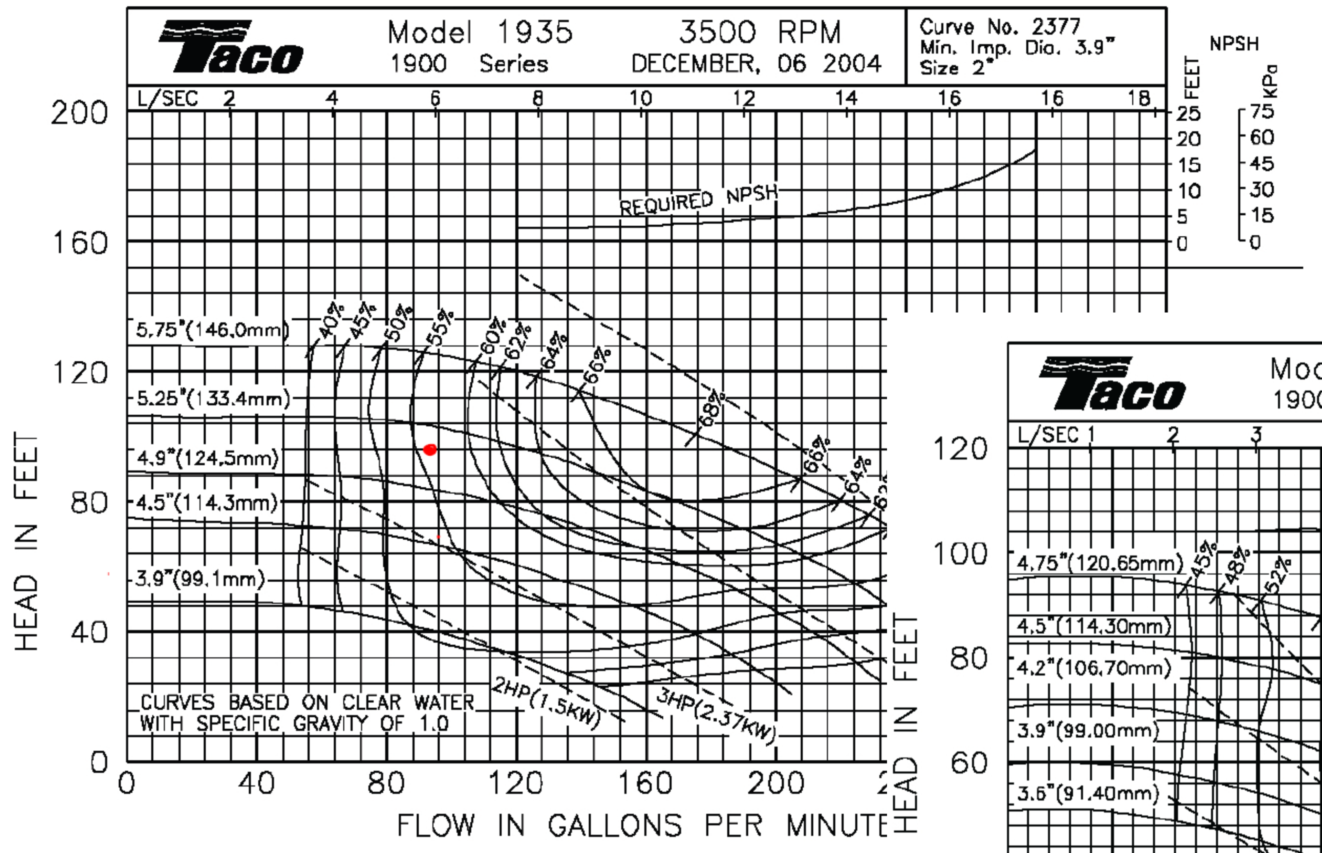
equipment selection

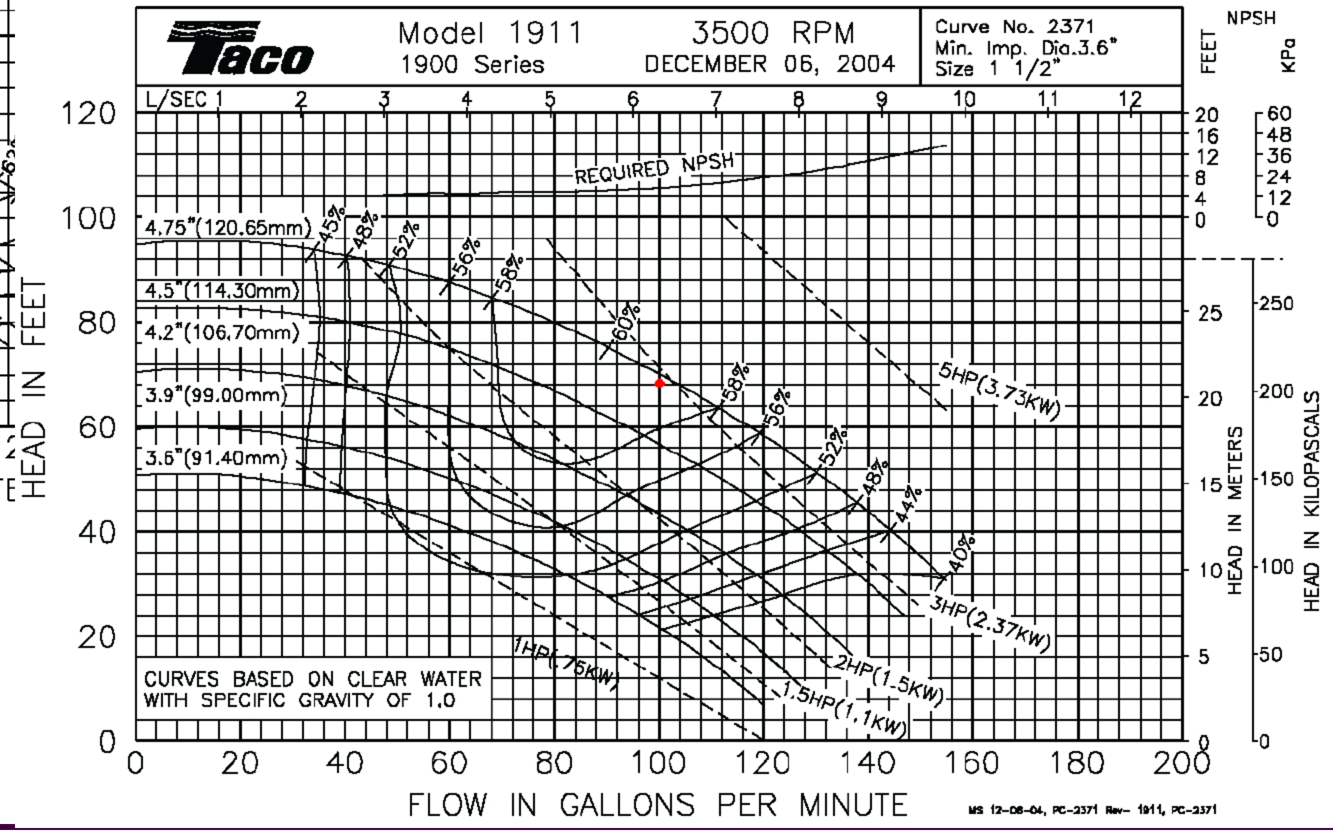
nexus
introduction
process map
envelope
hvac
integration
sustainability
conclusion
appendix











conclusion

recover

reduce

reuse