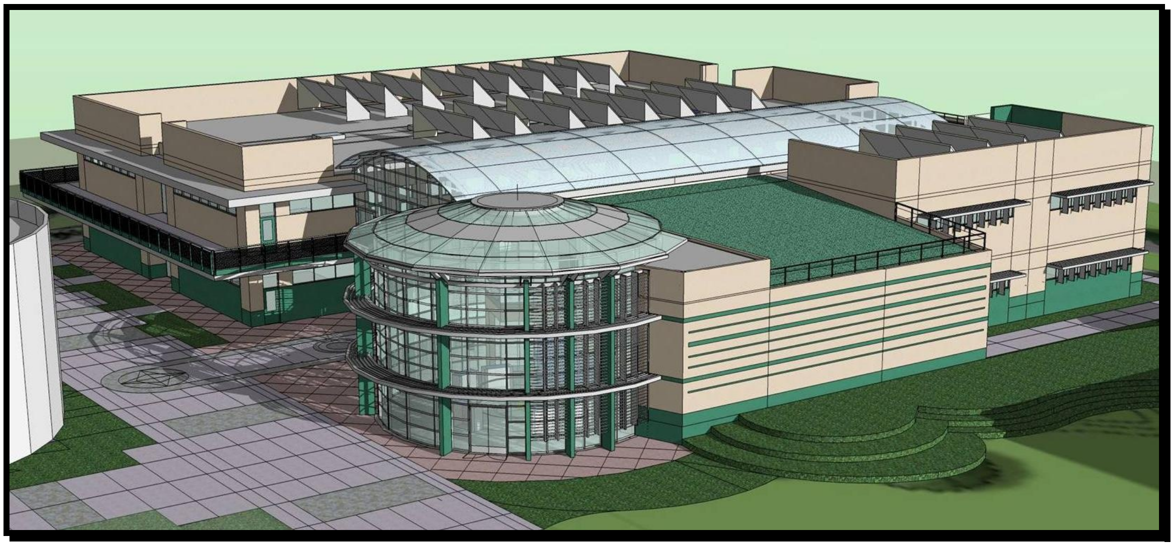
Technical Assignment #3

Mechanical Systems Existing Conditions Report



The Harker School - Science and Technology Building
San Jose, CA

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Mechanical Option

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December 13, 2007

Table of Contents

Executive Summary

The Harker School Science and Technology Building is a two story, 50,000 square foot building located in the heart of Silicon Valley, San Jose, CA. After analyzing the mechanical system being put into the building, it's seems that there is a lot of potential for it to be a big success, but there is also a chance that it won't fulfill all the expectations.

The system chosen for the building is a new direct/indirect evaporative cooling system that is currently only installed in 3-4 buildings in the San Francisco Bay Area. Potentially it could save quite a bit in the operation cost when compared to a more traditional system.

Getting LEED Certification was also a goal for this project. An official LEED review hasn't taken place yet, but it is most likely that enough points will be accumulated to not only achieve certification, but also to pull within a few points of a Silver rating. It remains to be seen if they decide if it is feasible or not to spend more money to ensure those few points.

Aside from the slight uncertainty of using a fairly new and rarely used system, there is also a problem with the ventilation requirements. It falls short of the required outdoor air flow rate as specified by ASHRAE 62.1.

Building Design and System Overview

The Harker School Science and Technology Building is located in San Jose, California on the school's upper campus (high school). It is a two story 50,000 square foot building which has a variety of offices, classrooms, and laboratories located in an East and a West wing. The two wings are separated by a double height open forum which is heated by a radiant floor system. Along with the previously mentioned spaces, the West wing also has a 192 seat lecture room, and a rotunda which has a large glass façade and roof.

Access to the East wing of the building is located all around the perimeter on the ground level as well as the second level via a cantilevered walkway that encompasses the whole wing including inside the rotunda. Sandwiched in between the classrooms and offices of both floors of the East wing are prep offices for the biology, technology, chemistry, and biology departments.

LEED Certification was a primary goal in the design process. Pending a formal review, there are enough points to achieve this. The Silver rating is possibly only a couple points away, however it is unknown at this time whether or not a higher rating will be pursued. There are also plans for a solar power system, but no timetable is currently set for its implementation.

Another goal was to minimize energy use and save on operation costs as much as possible. That is why a new cutting edge direct/indirect evaporative cooling system was selected for use in this project. There are only a few systems of its kind currently in use in the greater San Francisco Bay Area. It has the potential to cut operating costs down to a fraction of what more traditional systems costs are.

The building is conditioned by three 100% OA air handling units which feed VAV boxes throughout the building. As previously mentioned, the forum connecting the two wings is heated by a radiant flooring system. Two gravity ventilators are used to cool the space as it is not conditioned by any of the AHUs.

The radiant flooring system is served by a single boiler which also serves the heating coils and reheat coils in the AHUs and VAV boxes respectively. Two pumps circulate the hot water through the system. One moves it throughout the building, and a second one moves it though the radiant flooring system.

Ventilation Requirements

As was reported in the first technical report, the calculated design airflow came up short of the required amount for all three AHUs. Table 1 has the final data from that report.

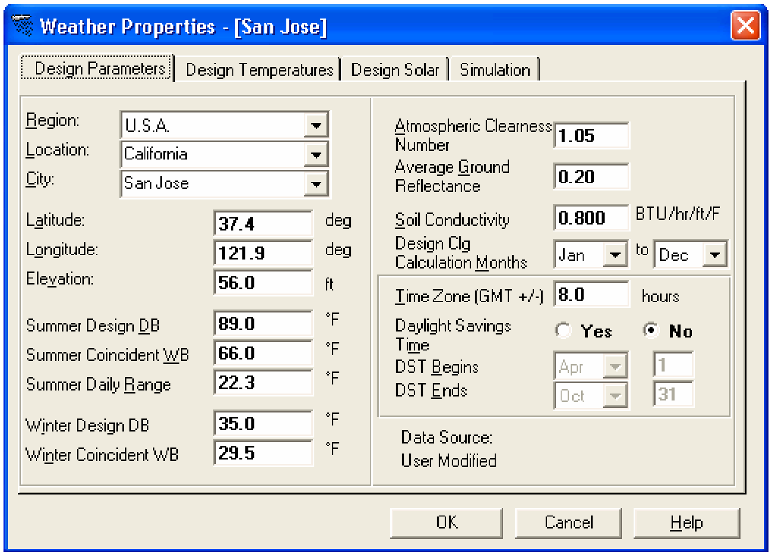
	Actual	Required
AHU-1	5505	9107
AHU-2&3	9319	13399
Total	14824	22506

Table 1 – Ventilation Requirements

Heating and Cooling Loads

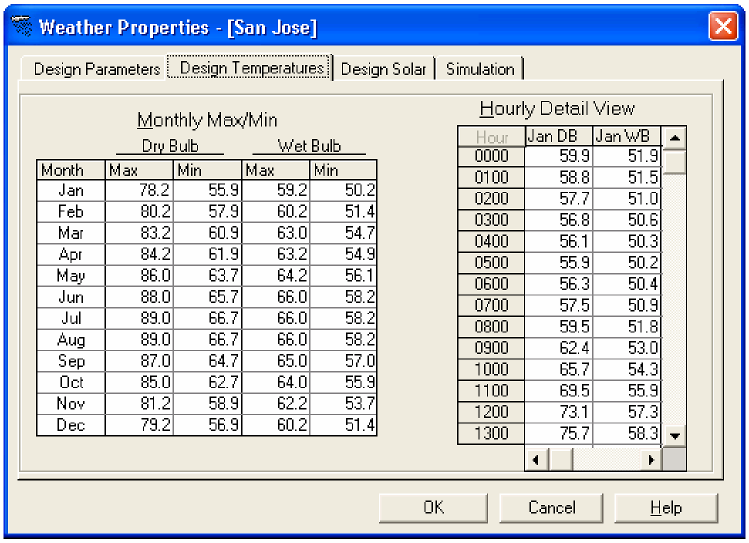
In technical report 2, the design heating and cooling loads were calculated using Carrier's Hourly Analysis Program. Figures 1 and 2 show the design parameters and temperatures of San Jose used in the design process.

Tables 2, 3, and 4 represent the heating and cooling loads that were calculated through HAP.



Region: U.S.A.
Location: California
City: San Jose
Latitude: 37.4 deg
Longitude: 121.9 deg
Elevation: 56.0 ft
Summer Design DB 89.0 °F
Summer Coincident WB 66.0 °F
Summer Daily Range 22.3 °F
Winter Design DB 35.0 °F
Winter Coincident WB 29.5 °F
Atmospheric Clearness Number 1.05
Average Ground Reflectance 0.20
Soil Conductivity 0.800 BTU/hr/ft/F
Design Clg Calculation Months Jan to Dec
Time Zone (GMT +/-) 8.0 hours
Daylight Savings Time ○ Yes ● No
DST Begins Apr 1
DST Ends Oct 31
Data Source:
User Modified

Figure 1 – Design Parameters of San Jose



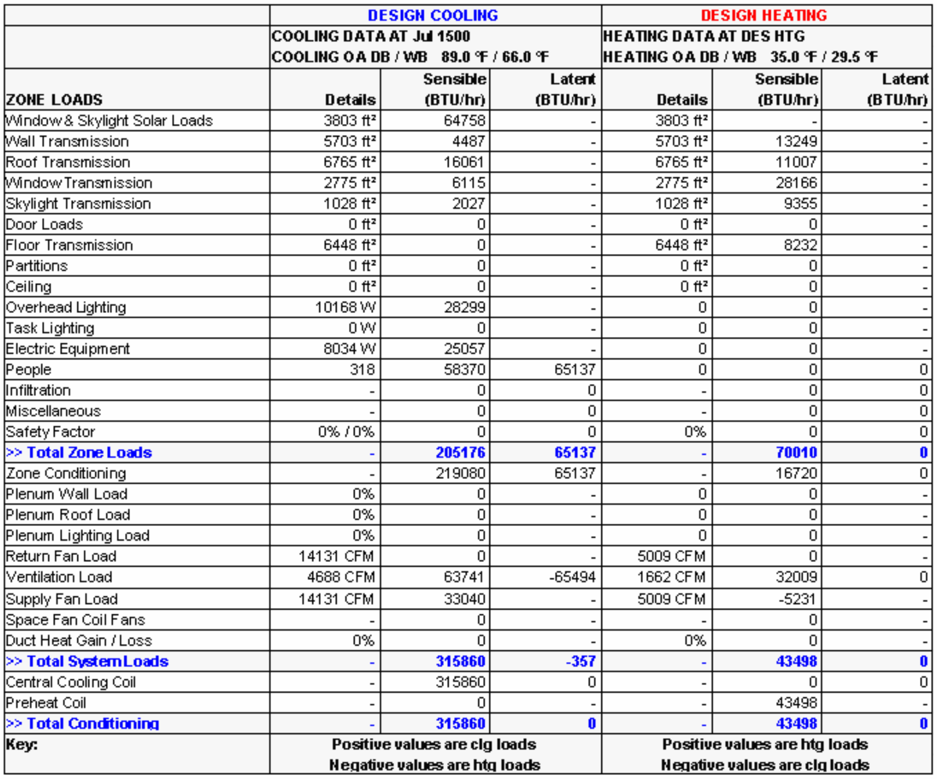
Monthly Max/Min

	Dry Bulb		Wet Bulb	
Month	Max	Min	Max	Min
Jan	78.2	55.9	59.2	50.2
Feb	80.2	57.9	60.2	51.4
Mar	83.2	60.9	63.0	54.7
Apr	84.2	61.9	63.2	54.9
May	86.0	63.7	64.2	56.1
Jun	88.0	65.7	66.0	58.2
Jul	89.0	66.7	66.0	58.2
Aug	89.0	66.7	66.0	58.2
Sep	87.0	64.7	65.0	57.0
Oct	85.0	62.7	64.0	55.9
Nov	81.2	58.9	62.2	53.7
Dec	79.2	56.9	60.2	51.4

Hourly Detail View

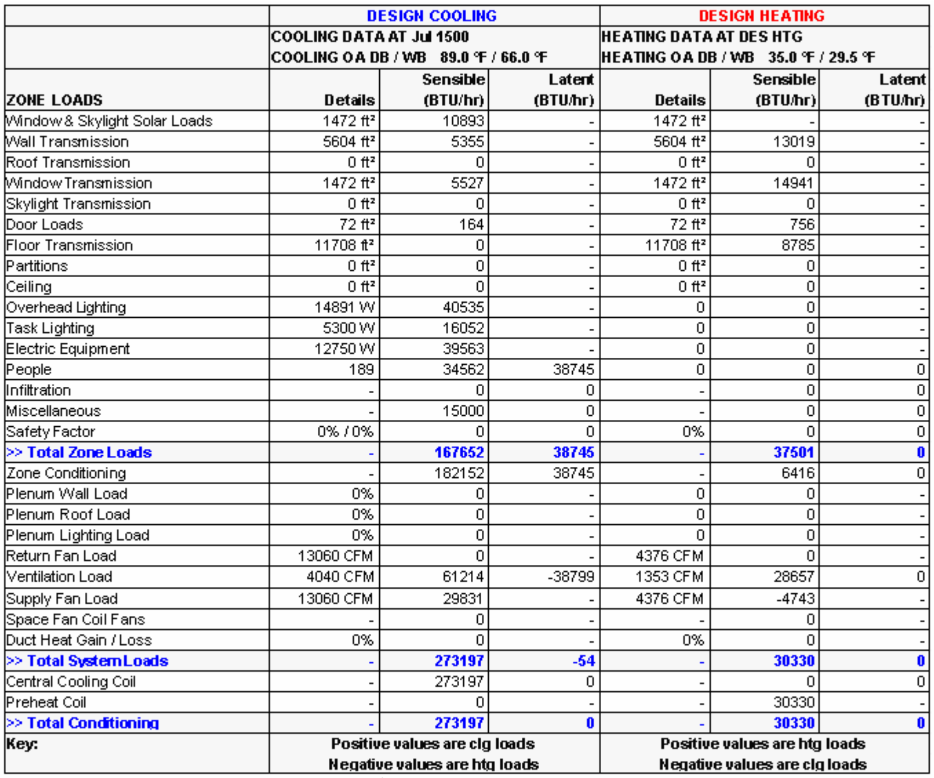
Hour	Jan DB	Jan WB
0000	59.9	51.9
0100	58.8	51.5
0200	57.7	51.0
0300	56.8	50.6
0400	56.1	50.3
0500	55.9	50.2
0600	56.3	50.4
0700	57.5	50.9
0800	59.5	51.8
0900	62.4	53.0
1000	65.7	54.3
1100	69.5	55.9
1200	73.1	57.3
1300	75.7	58.3

Figure 2 – Design Temperatures of San Jose



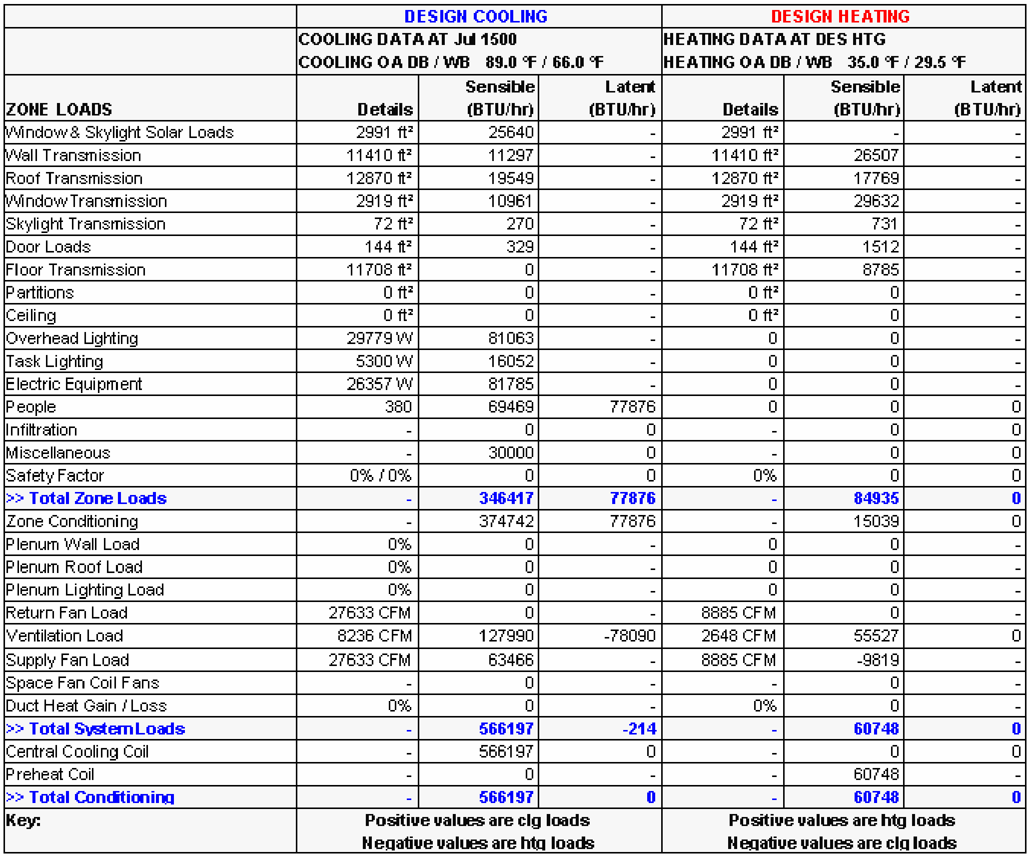
	DESIGN COOLING			DESIGN HEATING		
	COOLING DATA AT Jul 1500 COOLING OA DB / WB 89.0 °F / 66.0 °F			HEATING DATA AT DES HTG HEATING OA DB / WB 35.0 °F / 29.5 °F		
ZONE LOADS	Details	Sensible (BTU/hr)	Latent (BTU/hr)	Details	Sensible (BTU/hr)	Latent (BTU/hr)
Window & Skylight Solar Loads	3803 ft²	64758	-	3803 ft²	-	-
Wall Transmission	5703 ft²	4487	-	5703 ft²	13249	-
Roof Transmission	6765 ft²	16061	-	6765 ft²	11007	-
Window Transmission	2775 ft²	6115	-	2775 ft²	28166	-
Skylight Transmission	1028 ft²	2027	-	1028 ft²	9355	-
Door Loads	0 ft²	0	-	0 ft²	0	-
Floor Transmission	6448 ft²	0	-	6448 ft²	8232	-
Partitions	0 ft²	0	-	0 ft²	0	-
Ceiling	0 ft²	0	-	0 ft²	0	-
Overhead Lighting	10168 W	28299	-	0	0	-
Task Lighting	0 W	0	-	0	0	-
Electric Equipment	8034 W	25057	-	0	0	-
People	318	58370	65137	0	0	0
Infiltration	-	0	0	-	0	0
Miscellaneous	-	0	0	-	0	0
Safety Factor	0% / 0%	0	0	0%	0	0
>> Total Zone Loads	**-**	**205176**	**65137**	**-**	**70010**	**0**
Zone Conditioning	-	219080	65137	-	16720	0
Plenum Wall Load	0%	0	-	0	0	-
Plenum Roof Load	0%	0	-	0	0	-
Plenum Lighting Load	0%	0	-	0	0	-
Return Fan Load	14131 CFM	0	-	5009 CFM	0	-
Ventilation Load	4688 CFM	63741	-65494	1662 CFM	32009	0
Supply Fan Load	14131 CFM	33040	-	5009 CFM	-5231	-
Space Fan Coil Fans	-	0	-	-	0	-
Duct Heat Gain / Loss	0%	0	-	0%	0	-
>> Total System Loads	**-**	**315860**	**-357**	**-**	**43498**	**0**
Central Cooling Coil	-	315860	0	-	0	0
Preheat Coil	-	0	-	-	43498	-
>> Total Conditioning	**-**	**315860**	**0**	**-**	**43498**	**0**
Key:	**Positive values are clg loads Negative values are htg loads**			**Positive values are htg loads Negative values are clg loads**		

Table 2 – AHU-1 Heating and Cooling Loads



	DESIGN COOLING			**DESIGN HEATING**		
	COOLING DATA AT Jul 1500 **COOLING OA DB / WB 89.0 °F / 66.0 °F**			**HEATING DATA AT DES HTG** **HEATING OA DB / WB 35.0 °F / 29.5 °F**		
ZONE LOADS	**Details**	**Sensible (BTU/hr)**	**Latent (BTU/hr)**	**Details**	**Sensible (BTU/hr)**	**Latent (BTU/hr)**
Window & Skylight Solar Loads	1472 ft²	10893	-	1472 ft²	-	-
Wall Transmission	5604 ft²	5355	-	5604 ft²	13019	-
Roof Transmission	0 ft²	0	-	0 ft²	0	-
Window Transmission	1472 ft²	5527	-	1472 ft²	14941	-
Skylight Transmission	0 ft²	0	-	0 ft²	0	-
Door Loads	72 ft²	164	-	72 ft²	756	-
Floor Transmission	11708 ft²	0	-	11708 ft²	8785	-
Partitions	0 ft²	0	-	0 ft²	0	-
Ceiling	0 ft²	0	-	0 ft²	0	-
Overhead Lighting	14891 W	40535	-	0	0	-
Task Lighting	5300 W	16052	-	0	0	-
Electric Equipment	12750 W	39563	-	0	0	-
People	189	34562	38745	0	0	0
Infiltration	-	0	0	-	0	0
Miscellaneous	-	15000	0	-	0	0
Safety Factor	0% / 0%	0	0	0%	0	0
>> Total Zone Loads	**-**	**167652**	**38745**	**-**	**37501**	**0**
Zone Conditioning	-	182152	38745	-	6416	0
Plenum Wall Load	0%	0	-	0	0	-
Plenum Roof Load	0%	0	-	0	0	-
Plenum Lighting Load	0%	0	-	0	0	-
Return Fan Load	13060 CFM	0	-	4376 CFM	0	-
Ventilation Load	4040 CFM	61214	-38799	1353 CFM	28657	0
Supply Fan Load	13060 CFM	29831	-	4376 CFM	-4743	-
Space Fan Coil Fans	-	0	-	-	0	-
Duct Heat Gain / Loss	0%	0	-	0%	0	-
>> Total System Loads	**-**	**273197**	**-54**	**-**	**30330**	**0**
Central Cooling Coil	-	273197	0	-	0	0
Preheat Coil	-	0	-	-	30330	-
>> Total Conditioning	**-**	**273197**	**0**	**-**	**30330**	**0**
Key:	**Positive values are clg loads** **Negative values are htg loads**			**Positive values are htg loads** **Negative values are clg loads**		

Table 3 – AHU-2&3 1st Floor Heating and Cooling Loads

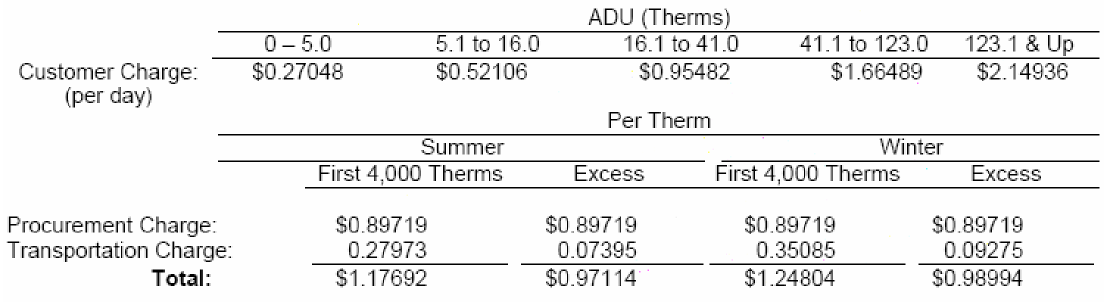


	DESIGN COOLING			DESIGN HEATING		
	COOLING DATA AT Jul 1500 COOLING OA DB / WB 89.0 °F / 66.0 °F			HEATING DATA AT DES HTG HEATING OA DB / WB 35.0 °F / 29.5 °F		
ZONE LOADS	Details	Sensible (BTU/hr)	Latent (BTU/hr)	Details	Sensible (BTU/hr)	Latent (BTU/hr)
Window & Skylight Solar Loads	2991 ft²	25640	-	2991 ft²	-	-
Wall Transmission	11410 ft²	11297	-	11410 ft²	26507	-
Roof Transmission	12870 ft²	19549	-	12870 ft²	17769	-
Window Transmission	2919 ft²	10961	-	2919 ft²	29632	-
Skylight Transmission	72 ft²	270	-	72 ft²	731	-
Door Loads	144 ft²	329	-	144 ft²	1512	-
Floor Transmission	11708 ft²	0	-	11708 ft²	8785	-
Partitions	0 ft²	0	-	0 ft²	0	-
Ceiling	0 ft²	0	-	0 ft²	0	-
Overhead Lighting	29779 W	81063	-	0	0	-
Task Lighting	5300 W	16052	-	0	0	-
Electric Equipment	26357 W	81785	-	0	0	-
People	380	69469	77876	0	0	0
Infiltration	-	0	0	-	0	0
Miscellaneous	-	30000	0	-	0	0
Safety Factor	0% / 0%	0	0	0%	0	0
>> Total Zone Loads	**-**	**346417**	**77876**	**-**	**84935**	**0**
Zone Conditioning	-	374742	77876	-	15039	0
Plenum Wall Load	0%	0	-	0	0	-
Plenum Roof Load	0%	0	-	0	0	-
Plenum Lighting Load	0%	0	-	0	0	-
Return Fan Load	27633 CFM	0	-	8885 CFM	0	-
Ventilation Load	8236 CFM	127990	-78090	2648 CFM	55527	0
Supply Fan Load	27633 CFM	63466	-	8885 CFM	-9819	-
Space Fan Coil Fans	-	0	-	-	0	-
Duct Heat Gain / Loss	0%	0	-	0%	0	-
>> Total System Loads	**-**	**566197**	**-214**	**-**	**60748**	**0**
Central Cooling Coil	-	566197	0	-	0	0
Preheat Coil	-	0	-	-	60748	-
>> Total Conditioning	**-**	**566197**	**0**	**-**	**60748**	**0**
Key:	**Positive values are clg loads Negative values are htg loads**			**Positive values are htg loads Negative values are clg loads**		

Table 4 – AHU-2&3 2nd Floor Heating and Cooling Loads

Annual Energy Usage and Cost

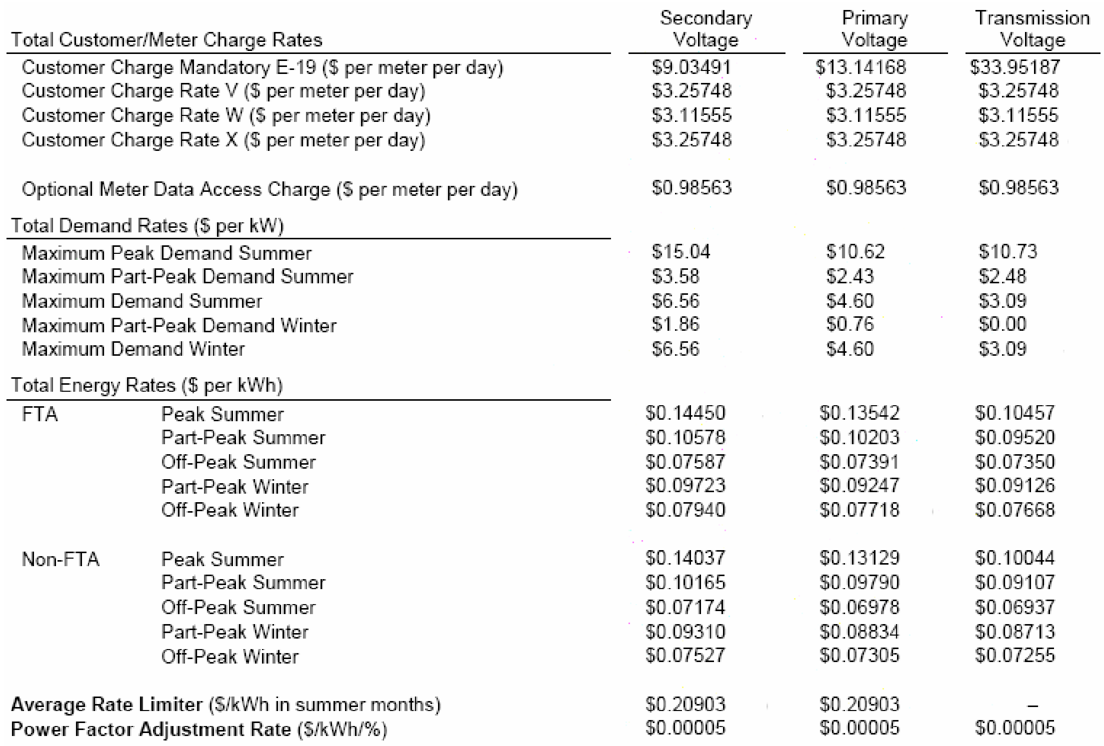
The Harker School Science and Technology Building is serviced by Pacific Gas and Electric Company (PG&E) for all of its energy needs. This includes both electric and natural gas. Tables 5 and 6 show the rates of each gas and electricity respectively.



	ADU (Therms)				
	0 – 5.0	5.1 to 16.0	16.1 to 41.0	41.1 to 123.0	123.1 & Up
Customer Charge: (per day)	$0.27048	$0.52106	$0.95482	$1.66489	$2.14936

	Per Therm			
	Summer		Winter	
	First 4,000 Therms	Excess	First 4,000 Therms	Excess
Procurement Charge:	$0.89719	$0.89719	$0.89719	$0.89719
Transportation Charge:	0.27973	0.07395	0.35085	0.09275
Total:	$1.17692	$0.97114	$1.24804	$0.98994

Table 5 – Gas Rates

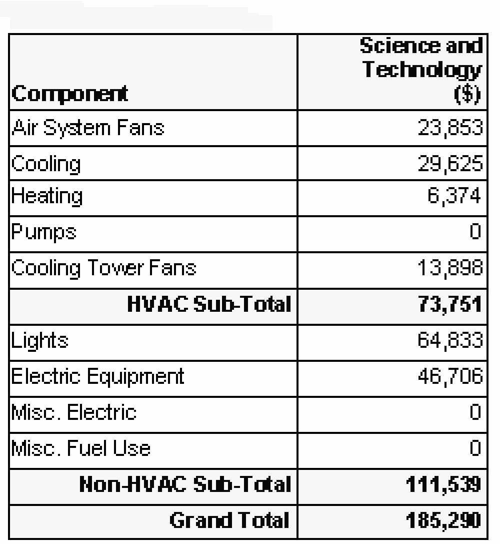


Total Customer/Meter Charge Rates		Secondary Voltage	Primary Voltage	Transmission Voltage
Customer Charge Mandatory E-19 ($ per meter per day)		$9.03491	$13.14168	$33.95187
Customer Charge Rate V ($ per meter per day)		$3.25748	$3.25748	$3.25748
Customer Charge Rate W ($ per meter per day)		$3.11555	$3.11555	$3.11555
Customer Charge Rate X ($ per meter per day)		$3.25748	$3.25748	$3.25748
Optional Meter Data Access Charge ($ per meter per day)		$0.98563	$0.98563	$0.98563
Total Demand Rates ($ per kW)				
Maximum Peak Demand Summer		$15.04	$10.62	$10.73
Maximum Part-Peak Demand Summer		$3.58	$2.43	$2.48
Maximum Demand Summer		$6.56	$4.60	$3.09
Maximum Part-Peak Demand Winter		$1.86	$0.76	$0.00
Maximum Demand Winter		$6.56	$4.60	$3.09
Total Energy Rates ($ per kWh)				
FTA	Peak Summer	$0.14450	$0.13542	$0.10457
	Part-Peak Summer	$0.10578	$0.10203	$0.09520
	Off-Peak Summer	$0.07587	$0.07391	$0.07350
	Part-Peak Winter	$0.09723	$0.09247	$0.09126
	Off-Peak Winter	$0.07940	$0.07718	$0.07668
Non-FTA	Peak Summer	$0.14037	$0.13129	$0.10044
	Part-Peak Summer	$0.10165	$0.09790	$0.09107
	Off-Peak Summer	$0.07174	$0.06978	$0.06937
	Part-Peak Winter	$0.09310	$0.08834	$0.08713
	Off-Peak Winter	$0.07527	$0.07305	$0.07255
Average Rate Limiter ($/kWh in summer months)		$0.20903	$0.20903	–
Power Factor Adjustment Rate ($/kWh/%)		$0.00005	$0.00005	$0.00005

Table 6 – Electric Rates

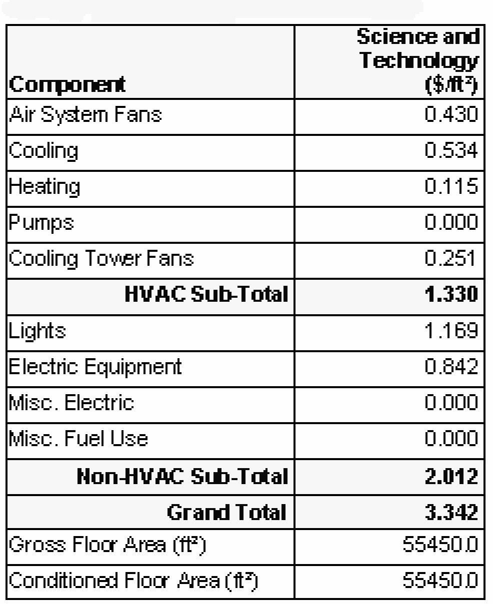
Carrier's Hourly Analysis Program (HAP) was used to estimate annual energy usage and cost. Annual cost broken down by component is shown in Table 7, and it is broken down further to show the cost per unit area in Table 8. Figure 3 shows that most of the energy consumption is due to non-HVAC electrical use. Figure 4 shows that in monthly detail. Since San Jose, CA wasn't in HAP's database of simulation cities, I chose the nearest one to use in it's place which ended up being Sunnyvale, CA.

Since the building is still currently under construction, there is no operating system history to compare it to.



Component	Science and Technology ($)
Air System Fans	23,853
Cooling	29,625
Heating	6,374
Pumps	0
Cooling Tower Fans	13,898
HVAC Sub-Total	**73,751**
Lights	64,833
Electric Equipment	46,706
Misc. Electric	0
Misc. Fuel Use	0
Non-HVAC Sub-Total	**111,539**
Grand Total	**185,290**

Table 7 – Annual Cost by Component



Component	Science and Technology ($/$ft^2$)
Air System Fans	0.430
Cooling	0.534
Heating	0.115
Pumps	0.000
Cooling Tower Fans	0.251
HVAC Sub-Total	**1.330**
Lights	1.169
Electric Equipment	0.842
Misc. Electric	0.000
Misc. Fuel Use	0.000
Non-HVAC Sub-Total	**2.012**
Grand Total	**3.342**
Gross Floor Area (ft^2)	55450.0
Conditioned Floor Area (ft^2)	55450.0

Table 8 – Annual Cost by Component per Unit Area

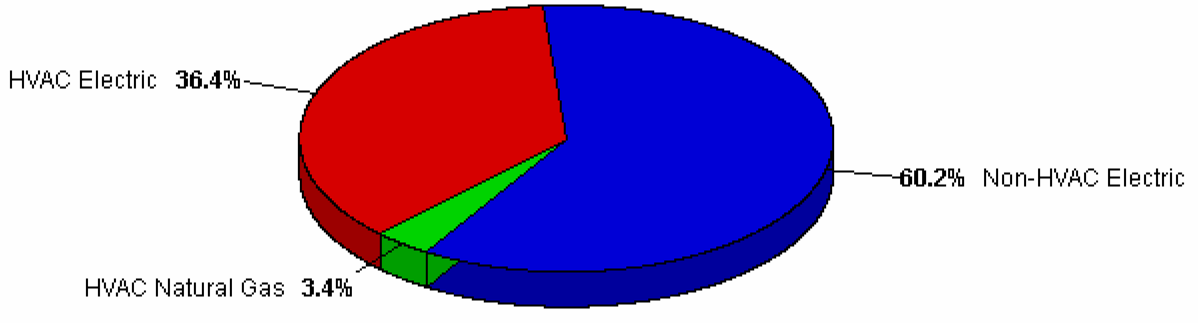


Figure 3 – Annual Energy Cost by Type

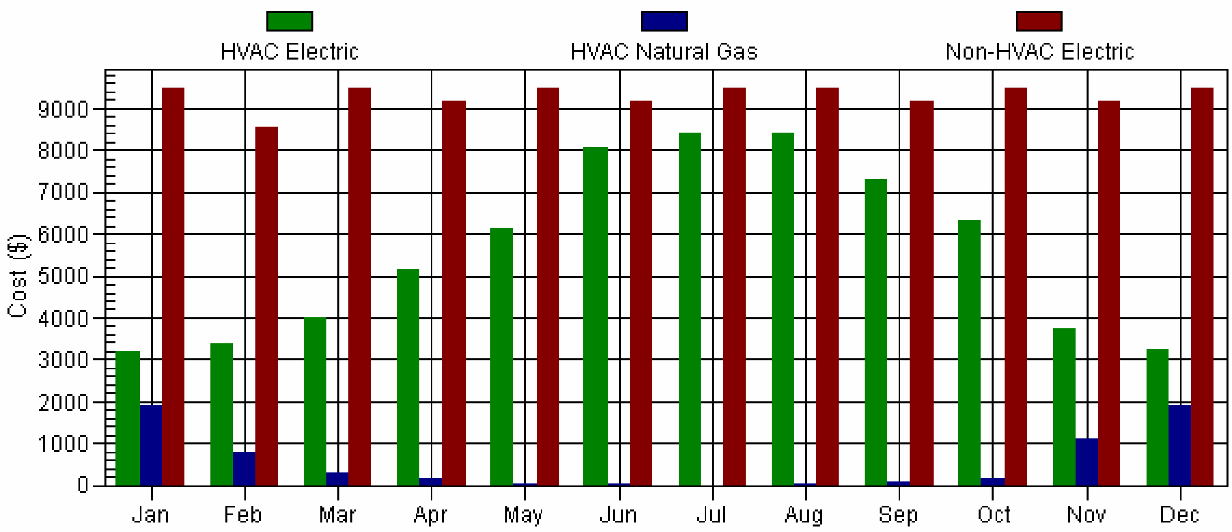


Figure 4 – Monthly Energy Cost by Type

Cost Factors

Three big factors when in the middle of the design process are first cost, operating and maintenance cost, and lost rentable space. In this case, lost rentable space is almost a non-issue as almost all of the mechanical equipment is located on the roof or in the ceiling. The amount lost is only about 1% of the gross floor area.

The first cost is a bit on the pricey side as it is a fairly new system. This type of direct/indirect evaporative cooling system is one of only a handful in the greater San Francisco Bay Area. The total first cost is $2,658,743 or $52.09/SQFT.

The big potential savings are in the operating costs of the system. According to the main Harker School representative, they anticipate that the operating costs will end up being only a fraction of the operating costs of a traditional Freon based compressor/gas-fired heating package unit.

Major Equipment

AHUs

There are a total of three AHUs in the building. They use a direct/indirect evaporative cooling system to condition the air along with a traditional 2-pipe boiler. They serve the classrooms, laboratories, and offices in the two wings of the building. AHU-1 serves the West wing, and AHU-2 and 3 serve the East wing. Table 9 contains the characteristics for each of the AHUs.

AHU	Serves	Total CFM	Min OSA CFM		Supply Fan			Heating Coil				
			High	Low	BHP	HP	RPM	EADB	LAT	CFM	CAP	GPM
1	West Wing	17,000	5100	3300	18.9	20	1887	29	55	5700	177 MBH	2.5
2	East Wing	15,500	4450	4450	14.5	20	1887	29	55	5700	177 MBH	2.5
3	East Wing	15,500	4450	4450	14.5	20	1887	29	55	5700	177 MBH	2.5

Table 9 – Air Handling Units

AHU	Indirect Evaporative Cooling							Direct Evaporative Cooling				
	EADB	EAWB	CAP	EFF	LADB	LAWB	SENS	EFF	EADB	EAWB	LADB	LAWB
1	91	67	323 MBH	69%	75	61	237 MBH	94%	75	61	62	61
2	91	67	298 MBH	70%	74.5	61	214 MBH	93%	74.5	61	62	61
3	91	67	298 MBH	70%	74.5	61	214 MBH	93%	74.5	61	62	61

Table 9 Cont.

VAV Boxes

There are 33 VAV boxes serving the main rooms in the building. Located in the ceiling plenum, there are several types of VAVs depending on the CFM required for the space being served. See Table 10 for more detail.

VAV	Service	Cooling CFM		Heating CFM		Hot Water Reheat Coil					
		Max	Min	Max	Min	EAT	LAT	Cap	EWT	LWT	GPM
101	Classroom	1600	400	450	400	55	84	14.1	180	140	0.7
102	Media	1600	400	450	400	55	84	14.1	180	140	0.7
103	Future Tech	1600	400	450	400	55	84	14.1	180	140	0.7
104	Classroom	1600	400	450	400	55	84	14.1	180	140	0.7
105	Classroom	1600	400	450	400	55	84	14.1	180	140	0.7
106	Classroom	1600	400	450	400	55	84	14.1	180	140	0.7
107	Classroom	1600	400	450	400	55	84	14.1	180	140	0.7
108	Classroom	1600	400	450	400	55	84	14.1	180	140	0.7
109	Classroom	1600	400	450	400	55	84	14.1	180	140	0.7
110	Robotics Lab	1600	400	450	400	55	84	14.1	180	140	0.7
111	Classroom	1600	400	450	400	55	84	14.1	180	140	0.7
112	Lounge/ Copy	800	250	250	250	55	-	-	180	140	0.7
113	Office	750	150	150	150	55	-	-	180	140	0.7
114	Sound/ Office	500	150	150	150	55	-	-	180	140	0.7
115	Lounge/ Office	800	250	250	250	55	-	-	180	140	0.7
201	Classroom	1600	400	450	400	55	84	14.1	180	140	0.7
202	Classroom	1600	400	450	400	55	84	14.1	180	140	0.7
203	Classroom	1600	400	450	400	55	84	14.1	180	140	0.7
204	Classroom	1600	400	450	400	55	84	14.1	180	140	0.7
205	Classroom	1600	400	450	400	55	84	14.1	180	140	0.7
206	Classroom	1600	400	450	400	55	84	14.1	180	140	0.7
207	Classroom	1600	400	450	400	55	84	14.1	180	140	0.7
208	Special Projects	1600	400	450	400	55	84	14.1	180	140	0.7
209	Classroom	1600	400	450	400	55	84	14.1	180	140	0.7
210	Classroom	1600	400	450	400	55	84	14.1	180	140	0.7
211	Classroom	1600	400	450	400	55	84	14.1	180	140	0.7
212	Lecture Room	3000	1515	1515	1515	55	74	30.6	180	140	1.5
213	Lecture Room	3000	1515	1515	1515	55	74	30.6	180	140	1.5
214	Conference	635	220	220	220	55	75	4.7	180	140	0.2
215	Storage/ Electrical	300	0	0	0	-	-	-	-	-	-
216	Bio Prep	930	300	300	300	55	-	-	180	140	-
217	Chem Prep	930	300	300	300	55	-	-	180	140	-
218	Optical	375	140	140	140	55	-	-	180	140	-

Table 10 – VAV Boxes

Boiler

There is only one boiler in the building. It is used to supply hot water for building heating to the VAV boxes, AHUs, and the radiant flooring in the forum. The schedule in Table 11 details the characteristics of the boiler.

Boiler	Service	Type	Capacity MBH		LWT	EWT	GPM	Eff	Fuel	Voltage	Operating Weight
			Input	Output							
1	Building Heating	Outdoor Stackless	1200	1080	180	126	40	90%	Natural Gas	230V/1Φ/ 60HZ	1500

Table 11 – Boiler

Pumps

There are two pumps used to distribute the hot water from the boiler. The first one is located on the roof with the boiler which distributes the water throughout the buildling. The second pump is located on the first floor in the forum, and it supplies the radiant flooring system with hot water. Table 12 has the full schedule with the pump details.

Pump	Service	Type	GPM	Head (ft.)	NPSH	RPM	BHP	HP	Voltage	Operating Weight
1	Building Heating	End Suction	40	40	3.7	1750	0.75	1	460V/3Φ/ 60Hz	200
2	Forum Radiant	Inline Canned	6	8	-	2590	92 Watts	1/22	115V/1Φ/ 60Hz	6

Table 12 – Pumps

Figure 5 is a graphical representation of the flow of the water from the boiler, through the pumps, through the building, and back.

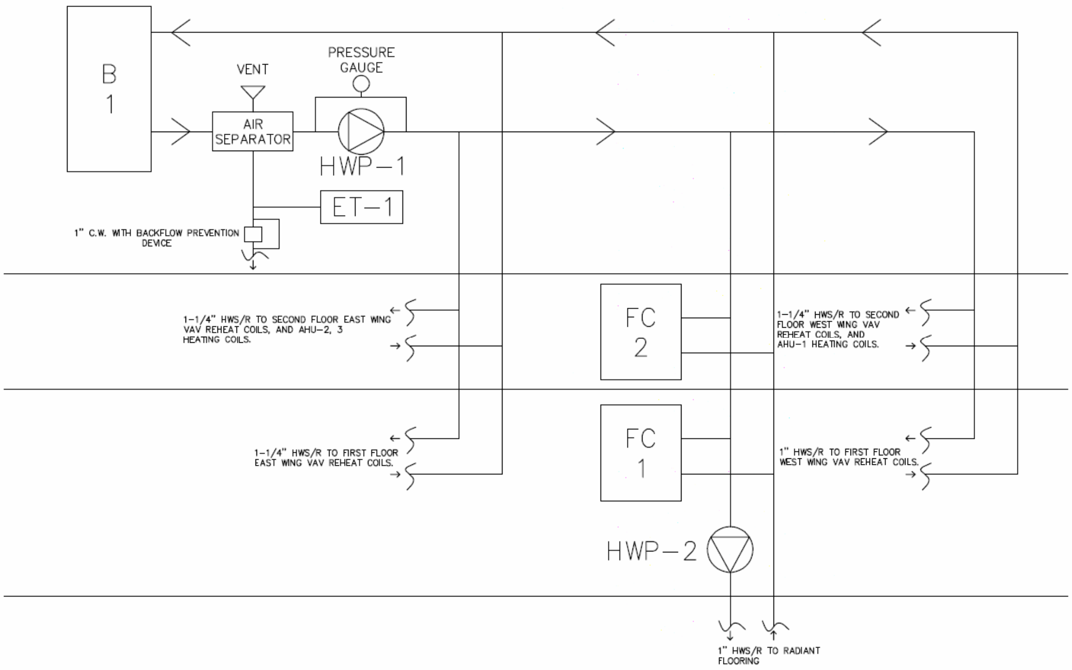


Figure 5 – Flow Diagram

Gravity Ventilators

There are two gravity ventilators located above the doors at the South entrance to the forum for cooling purposes. Characteristics are located in Table 13.

Gravity Ventilator	Service	Type	Airflow CFM	SP in WG	Throat Size	Area	Height	Operating Weight
1	Forum Relief	Horiz Cabinet	6000	0.05	32"x60"	13.33 SQFT	19"	200
2	Forum Relief	Inline Canned	6000	0.05	32"x60"	13.33 SQFT	92 Watts	6

Table 13 – Gravity Ventilators

Expansion Tank

The single expansion tank used in the building is located on the roof with the boiler. It serves the building with chilled water. The schedule in Table 14 has the details of the type used.

Expansion Tank	Service	Type	Pressure				Vol. (gal)	Operating Weight
			Pre-Charge	Fill	Relief	Max		
1	Chilled Water	Replaceable Bladder	12 PSIG	10	75	125	10	125 lbs

Table 14 – Expansion Tank

Critique of System

While this system has many good and promising ideas implemented it, there are also several potential problems with it as well. The first one that jumps out is of course the under ventilation of the building as was discussed in technical report one. While it isn't a difficult problem to overcome, it is still one that needs to be addressed.

The other issues all have to do with the AHUs chosen for the project. When using newer technology, there is always a chance that problems will arise. The first such problem could have to do with the perceived lower operational costs. Lower costs may be anticipated, but since there are so few systems of its kind actually in use in the area there is a chance that their estimation could be off by a little or maybe even a lot.

One other potential problem is the maintenance of the system. Again, with it being as new and so little utilized as it is, there may not be as many people out there who are qualified to perform maintenance or repairs on such a system. The cost to bring in a qualified tradesman may end up being much higher than it would be to bring in a maintenance person or crew for a traditional system.

These last few issues are of course hypothetical, and are in no way a certainty to be problematic, but the opportunity for them to be is still there. This system is somewhat of a gamble, but if it all works out it will pay off greatly with the savings in the long run.