

Rami Moussa  
Mechanical Option  
Advisor: Professor Treado  
10/23/10

Peirce Hall, Kenyon College

## Technical Report 2:

Building and Plant  
Energy Analysis Report

## Table of Contents

<b>Executive Summary</b> .....	2
<b>Design Load Estimation</b> .....	3
System Overview	
Exterior and Interior Design Conditions	
Table 1. Interior Design Temperatures	
Table 2. Thermal Properties of Existing and New Envelope Components	
Interior Loads.....	4
Table 3. Occupant Load Contribution	
Ventilation and Exhaust Rates	
Table 4. Ventilation Rates	
Results and Analysis.....	5
Table 5. Major Area Populations	
Table 6. Overall Plant Requirements	
<b>Annual Energy Consumption and Operation Costs</b> .....	6
Basis of Analysis	
Table 7. Utility Cost Rates	
Annual Cost by System	
Table 8. Overall Utility Expenses	
Table 9. Annual Load Cost Breakdown by System.....	7
Graph 1. Monthly Utility Usage	
Graph 2. Monthly Utility Cost.....	8
Chart 1. Electrical Cost Breakdown	
System Emission Rates.....	9
Table 10. Total Emission Factors for Delivered Electricity (Table 3 of National Renewable Energy Laboratory, <i>Source Energy And Emission Factors for Energy Use in Buildings</i> , M. Deru and P. Torcellini, 2007.)	
Table 11. Eastern Interconnection Emissions for Delivered Electricity	
Table 12. Emission Factors for On-Site Combustion in a Commercial.....	10
Boiler (Table 8 of National Renewable Energy Laboratory, <i>Source Energy and Emission Factors for Energy Use in Buildings</i> , M. Deru and P. Torcellini, 2007.)	
Table 13. System Yearly Pollutant Emission	
<b>Appendix</b> .....	11
A.1 Model Design Information	
A.2 Computed vs. Design Document Load and Ventilation Indices	

## Executive Summary

The purpose of this report is to analyze the components of the Peirce Hall mechanical system that influence and provide service for heating and cooling loads and ventilation rates. In this analysis a Trane Trace 700 model was created to approximate characteristics of the mechanical system such as heating and cooling capacities, energy consumption of major system components, utility costs, and emission rates. A design model was provided by Syska Hennessy Group, Inc. to compare calculated values with. This model however, did not contain energy analysis information.

The Peirce Hall mechanical system is composed of 7 air handling units, 1 major fan coil unit and a collection of unit and cabinet unit heaters. Systems were assigned to the same zones as in design documents. However, some zones may have been designed to be served by a different unit through the design process and gotten changed in the design model. Therefore there are some inconsistencies between the design model and analysis model that resulted in larger and smaller supply requirement between systems. These results can be most easily found in Table A.2 Computed vs. design Document Load and Ventilation Indices.

Due to the multiuse functionality of Peirce Hall, many spaces required their own occupancy and air flow specification for internal loads to be calculated to reasonable accuracy. Spaces were more individually designed to analyze zone characteristics. A 250 occupant dining hall may have been adjacent to a kitchen, servery, and lobby. The block cooling load was approximated to within 10% of the design model and the heating load within 3.5%.

Service information was not able to be obtained from Kenyon College, so general data by the name "Northern Power Company," from templates provided in Trane Trace were used. The annual utility cost per square foot was calculated to be 1.378 \$/ft<sup>2</sup>. Pollutant emission data can be found on pages 9 and 10.

## Design Load Estimation

### System Overview

Peirce Hall at Kenyon College in Gambier, Ohio uses a variety of cooling and heating systems to serve the multipurpose facility’s diverse spatial types. Due to the large variety of types of spaces adjacent to one another, spaces were unable to be zoned together and the building had to be analyzed in a space by space manner. Zones were considered to be conditioned at all hours in the design model hence, were similarly modeled in the analysis model. 4 air handling units serve as the means for cooling in the building and 3 additional air handling units provide makeup and ventilation air for kitchens and the basement. Steam is supplied to unit heaters and cabinet unit heaters to serve as the primary providers of heat to spaces. Production of steam is assumed to be coal fueled.

### Exterior and Interior Design Conditions

Gambier, Ohio is a small town in central Ohio. Yearly weather data from Columbus, Ohio was used to approximate the climate of Gambier, as it is located just 55 miles to the Northeast. Conditions used for analysis are 0.4% and 99.6% cooling and heating dry bulb temperatures and can be viewed in Table 1. Interior design temperatures for the majority of spaces including dining rooms, offices, the computer lab, and music room use the same interior conditions. Kitchens have a higher cooling dry bulb temperature and a lower heating dry bulb as recommended by 2009 ASHRAE Handbook of Fundamentals.

Interior Design Temperatures			
Space Type	Cooling [°F]	Heating [°F]	RH [%]
General	75	72	50
Kitchen	78	70	50

Table 1. Interior Design Temperatures

The Peirce Hall project was not simply new construction, but a renovation, expansion, and addition. Hence existing construction types and materials are used in conjunction with newer, much more efficient materials. Due to differences in construction materials between the existing and newly constructed building envelope components, separate thermal resistances were necessary to reasonably analyze building envelope loads. Material properties can be found in Table 2. Infiltration rates were assumed to be “Neutral, Tight Construction” allowing 0.3 air changes per hour.

Thermal Properties of Existing and New Envelope Components				
Envelope Component	U-Value by Construction Type		Shading Coefficient	
	Existing	New	Existing	New
Exterior Wall	0.36	0.085		
Window	0.95	0.29	0.95	0.44
Roof	0.1	0.068		

Table 2. Thermal Properties of Existing and New Envelope Components

## Interior Loads

Peirce Hall’s primary use for Kenyon College is as a dining hall. As a result, the loads generated within spaces such as occupant and lighting loads impacted cooling requirements significantly. Most occupancy values were taken from the architectural design drawings. These values were occasionally substituted with values that were more realistic to the intended use of the space. An example of this scenario is in lower dining lobby. Here, what would be considered a corridor with 0 occupants contains sitting areas that can host up to 32 occupants. Interior load contributions from occupants are based on activity levels in spaces. Load values can be found below in Table 3.

<b>Occupant Load Contribution</b>		
Space Type	Sensible [Btu/h]	Latent [Btu/h]
Cafeteria	275	275
Kitchen	275	275
Mechanical Room	250	200
Class Room	250	200
Office Space	250	200
Rest Room	245	155
Storage	245	155

Table 3. Occupant Load Contribution

Heat emitted by lighting was assumed to be the input wattage to lamps. Therefore constructed lighting power densities were used to approximate internal heat gains from lighting. Additional miscellaneous loads were necessary to account for large appliances in some spaces. Offices use a medium load density of 1 Watt per square foot (W/SF) and the computer lab uses a medium/heavy load density of 1.5 W/SF to represent general office equipment. Spaces with more demanding electrical equipment like the pub support, kitchen, servery, and dish room use a 2 W/SF load density.

## Ventilation and Exhaust Rates

Ventilation rates used in the original system design for Peirce Hall air handling units were very generous. Values are a mix of occupant and area based and can be found in the following table. Highly occupied spaces include space types such as the pub, dining areas, lounges, and the kitchen. Medium occupancy spaces include preparation areas, the computer lab, and the servery area.

<b>Ventilation Rates</b>	
Space Type	Rate
High Occupancy	20 [cfm/person]
Medium Occupancy	15 [cfm/ft <sup>2</sup> ]
Storage	0.15 [cfm/ft <sup>2</sup> ]
Circulation	0.05 [cfm/ft <sup>2</sup> ]

Table 4. Ventilation Rates

## Results and Analysis

A design load calculation was previously prepared by Syska Hennessy Group, Inc. One discrepancy that distinguishes the analysis model from the design model is the population values used in select spaces. Rather than using occupancy statistics from the design energy model, most were taken from the architectural design drawings. The difference in total population between models is 123 occupants where the analysis model is designed for the larger occupancy. Major occupancy differences can be found in Table 5. The greatest differences in space occupancy occur in the spaces designed for the largest occupancy. The provided model was most likely designed to anticipate that the space would never be fully occupied. In the case of the main dining hall, The Great Hall, the provided model greatly over compensates for the architectural design occupancy. This could also be an attempt to estimate the most realistic occupancy possible.

Major Area Populations			
Room Name	Area [ft <sup>2</sup> ]	Design Population	
		Analysis	Design
Pub	4001	265	110
Servery	5002	193	104
Student Org. Lounge	359	24	8
Great Hall	4148	277	350

Table 5. Major Area Populations

A comparison of computed loads versus design document load and ventilation indices can be found in Table A.2. An overall comparison of heating and cooling loads can be found below in Table 6.

Overall Plant Requirements						
Load Type	Cooling [ft <sup>2</sup> /ton]		Difference	Heating [MBH]		Difference
	Analysis	Design		Analysis	Design	
Block	265.7	242.5	9.57%			
Peak	278.7	252	10.60%	4.483	4.329	3.56%

Table 6. Overall Plant Requirements

## Annual Energy Consumption and Operation Costs

### Basis of Analysis

Cost rates for utilities could not be obtained from Kenyon College for Peirce Hall’s energy model. Therefore the Northern Power Company template provided by Trane Trace 700 has been used for this analysis. A summary of this template’s values can be viewed in Table 7. The price of coal is assumed to be the 2.26 dollars per million Btu, representing the June 2010 price from the U.S. Energy Information Administration *2010 Monthly Energy Review*.

Utility Cost Rates	
Utility Type	Cost [\$/kW]
Electric Demand On Peak	8.13
Electric Consumption On Peak	0.0319
Gas On Peak	0.466
Water	0.0001
Electric Demand Off Peak	5.87
Electric Consumption Off Peak	0.024

Table 7. Utility Cost Rates

Details on the modeled performance statistics of the scroll type electric chiller and the provided coal steam system are located in Figure A.3.

### Annual Cost by System

A cost analysis was not set up in the design model, however was performed on the analysis to study the operation and consumption costs resulting from use of electricity and coal. From the energy requirements displayed in Table 8, it is clearly evident that more heating is required than cooling in Peirce Hall. Gambier, Ohio is a very cool climate in winter months and the existing exterior wall’s poor insulating characteristics expel a great amount of heat. In terms of dollar value, the cost of heating is double that of cooling. Therefore, during cold months large rises in heating costs are expected, where during hot months there are lower rises in electric costs. This energy and cost relationship is displayed in Table 9, Chart 1, and Graph 1.

Overall Utility Expenses		
Utility	Energy 10 <sup>6</sup> [Btu/yr]	Cost/yr [\$/yr]
Coal	7,423.90	16,778.00
Electricity	5,415.00	75,066.00
Total	12,838.90	91,844.00
<b>Annual Cost/ft<sup>2</sup> [\$/ft<sup>2</sup>]</b>		<b>1.378</b>

Table 8. Overall Utility Expenses

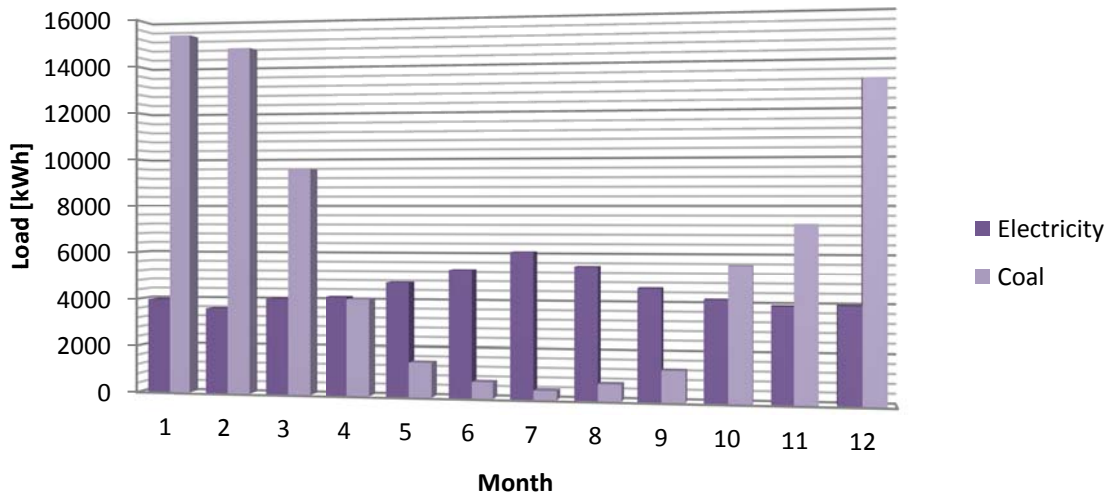
Electrical Cost Break Down			
Load	Energy 10 <sup>6</sup> [Btu/yr]	Cost/yr [\$/yr-ft <sup>2</sup> ]	Load Base %
Primary Heating*	7,587.90	0.27	59.10%
Primary Cooling**	438.05	0.09	3.41%
Cooling Tower	121.01	0.03	0.94%
Supply Fans	1,051.92	0.22	8.19%
Pumps	9.78	0.00	0.08%
Lighting	3,492.55	0.73	27.20%
Receptacle	137.65	0.03	1.07%

\*Primary Heating Cost/yr Includes Coal Cost

\*\* Excludes Cooling Tower Load

Table 9. Annual Utility Cost Breakdown

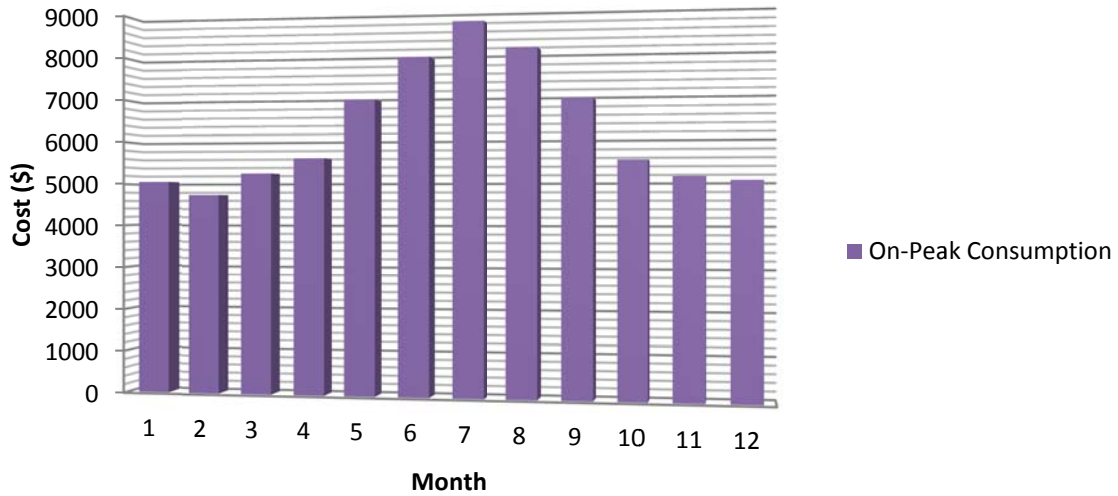
### Monthly Utility Usage



Graph 1. Monthly Utility Usage



## Monthly Utility Costs



Graph 2. Monthly Utility Cost

Of the electrical systems, lighting systems drew more power than the next leading load, supply fan power, by a factor of three. High lighting loads can be attributed largely to the 1500 and 1200W dining space luminaires. The load from pumps seems very low since cooling is required in the facility all year. However since heating relies more heavily on medium pressure steam, pumping loads are minimal.

## Electrical Cost Break Down

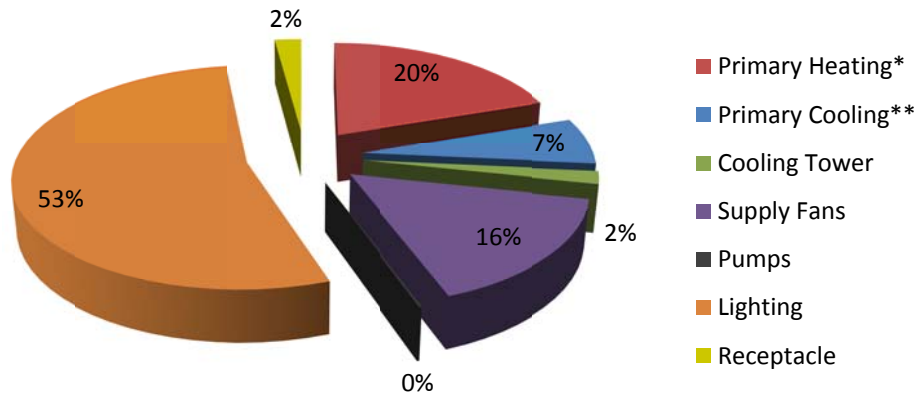


Chart 1. Electrical Cost Breakdown

## System Emission Rates

With any production of energy via combustion, there will be by products that are potentially harmful to the environment. It is important to know how harmful a system can be and an emission study can often be helpful. The origin of the power supply should be examined first. Below, in Table 10 are the emission rates of pollutants created by local power generation in various regions of the United States. Ohio lies in the Eastern region. The pounds of pollutant created per year by Peirce Hall relative to the buildings yearly consumption rates can be found in Table 11.

**Total Emission Factors for Delivered Electricity**  
(lb of pollutant per kWh of electricity)

Pollutant (lb)	National	Eastern	Western	ERCOT	Alaska	Hawaii
CO <sub>2e</sub>	1.67E+00	1.74E+00	1.31E+00	1.84E+00	1.71E+00	1.91E+00
CO <sub>2</sub>	1.57E+00	1.64E+00	1.22E+00	1.71E+00	1.55E+00	1.83E+00
CH <sub>4</sub>	3.71E-03	3.59E-03	3.51E-03	5.30E-03	6.28E-03	2.96E-03
N <sub>2</sub> O	3.73E-05	3.87E-05	2.97E-05	4.02E-05	3.05E-05	2.00E-05
NO <sub>x</sub>	2.76E-03	3.00E-03	1.95E-03	2.20E-03	1.95E-03	4.32E-03
SO <sub>x</sub>	8.36E-03	8.57E-03	6.82E-03	9.70E-03	1.12E-02	8.36E-03
CO	8.05E-04	8.54E-04	5.46E-04	9.07E-04	2.05E-03	7.43E-03
TNMOC	7.13E-05	7.26E-05	6.45E-05	7.44E-05	8.40E-05	1.15E-04
Lead	1.31E-07	1.39E-07	8.95E-08	1.42E-07	6.30E-08	1.32E-07
Mercury	3.05E-08	3.36E-08	1.86E-08	2.79E-08	3.80E-08	1.72E-07
PM10	9.16E-05	9.26E-05	6.99E-05	1.30E-04	1.09E-04	1.79E-04
Solid Waste	1.90E-01	2.05E-01	1.39E-01	1.66E-01	7.89E-02	7.44E-02

Table 10. Total Emission Factors for Delivered Electricity (Table 3 of National Renewable Energy Laboratory, *Source Energy and Emission Factors for Energy Use in Buildings*, M. Deru and P. Torcellini, 2007.)

<b>Eastern Interconnection Emissions for Delivered Electricity</b>	
Pollutant	Mass of Emitted Pollutant (lbm)
CO <sub>2E</sub>	2,760,654.42
CO <sub>2</sub>	2,601,996.12
N <sub>2</sub> O	61.40
NO <sub>x</sub>	4,759.75
SO <sub>x</sub>	13,597.02
PM10	146.92

Table 11. Eastern Interconnection Emissions for Delivered Electricity

Next the pollutants emitted by the system should be considered. In the energy analysis run in Trane Trace, the steam plant was modeled as a coal fueled steam boiler. After running the analysis 74,239 therms was determined to be the total consumption value. With this and the assumption that 1 lb of bituminous coal produces 12.465 kBtu of energy (as defined by Energy Star) emitted pollutants can be calculated with Table 12. Results of these calculations can be found in Table 13.

Emission Factors for On-Site Combustion in a Commercial Boiler  
(lb of pollutant per unit of fuel)

Pollutant (lb)	Commercial Boiler					
	Bituminous Coal *	Lignite Coal **	Natural Gas	Residual Fuel Oil	Distillate Fuel Oil	LPG
	1000 lb	1000 lb	1000 ft <sup>3</sup> ***	1000 gal	1000 gal	1000 gal
CO <sub>2e</sub>	2.74E+03	2.30E+03	1.23E+02	2.56E+04	2.28E+04	1.35E+04
CO <sub>2</sub>	2.63E+03	2.30E+03	1.22E+02	2.55E+04	2.28E+04	1.32E+04
CH <sub>4</sub>	1.15E-01	2.00E-02	2.50E-03	2.31E-01	2.32E-01	2.17E-01
N <sub>2</sub> O	3.68E-01	ND †	2.50E-03	1.18E-01	1.19E-01	9.77E-01
NO <sub>x</sub>	5.75E+00	5.97E+00	1.11E-01	6.41E+00	2.15E+01	1.57E+01
SO <sub>x</sub>	1.66E+00	1.29E+01	6.32E-04	4.00E+01	3.41E+01	0.00E+00
CO	2.89E+00	4.05E-03	9.33E-02	5.34E+00	5.41E+00	2.17E+00
VOC	ND †	ND †	6.13E-03	3.63E-01	2.17E-01	3.80E-01
Lead	1.79E-03	6.86E-02	5.00E-07	1.51E-06	ND †	ND †
Mercury	6.54E-04	6.54E-04	2.60E-07	1.13E-07	ND †	ND †
PM10	2.00E+00	ND †	8.40E-03	4.64E+00	1.88E+00	4.89E-01

\* from the U.S. LCI data module: Bituminous Coal Combustion in an Industrial Boiler (NREL 2005)

\*\* from the U.S. LCI data module: Lignite Coal Combustion in an Industrial Boiler (NREL 2005)

\*\*\* Gas volume at 60°F and 14.70 psia.

† no data available

## Appendix

### A.1 Model Design Information

Design Weather Data

**Weather Overrides**

**Summer Design Cooling**

User Standard -----ASHRAE MaxDB/MCWB -----  
 Override  Default  0.4%  1%  2%

Dry bulb	<input type="text"/>	90	90.7	88.3	85.9	*F
Wet bulb	<input type="text"/>	75	74.2	73.1	71.7	*F

Weather overrides apply to entire year?

**Winter Design Heating**

User Standard  
 Override  Default  99.6%  99%

Dry bulb	<input type="text"/>	5	1.4	7	*F
----------	----------------------	---	-----	---	----

**Optional Direct Dehumidification Weather**

-----ASHRAE MaxDP/MCDB -----  
 None  0.4%  1%  2%

Dry bulb	<input type="text"/>	81.8	80.5	79.4	*F
Wet bulb	<input type="text"/>	76	74.7	73.5	*F
Dew point	<input type="text"/>	73.9	72.5	71.2	*F

Modeling Method

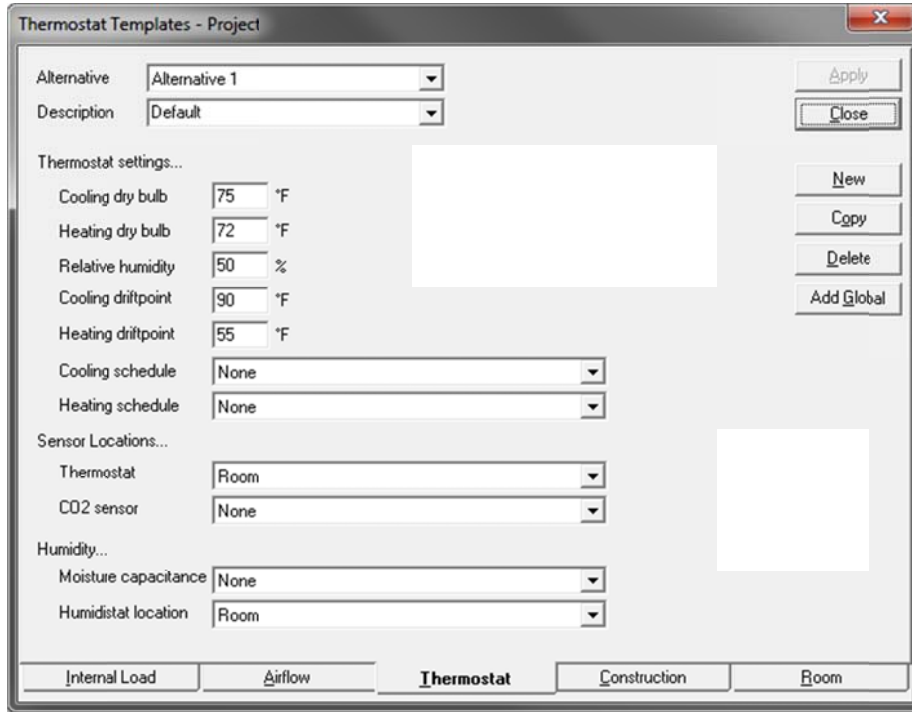
**Seasonal Values**

	Summer	Winter
Clearness number	<input type="text" value="0.85"/>	<input type="text" value="0.85"/>
Ground reflectance	<input type="text" value="0.2"/>	<input type="text" value="0.2"/>

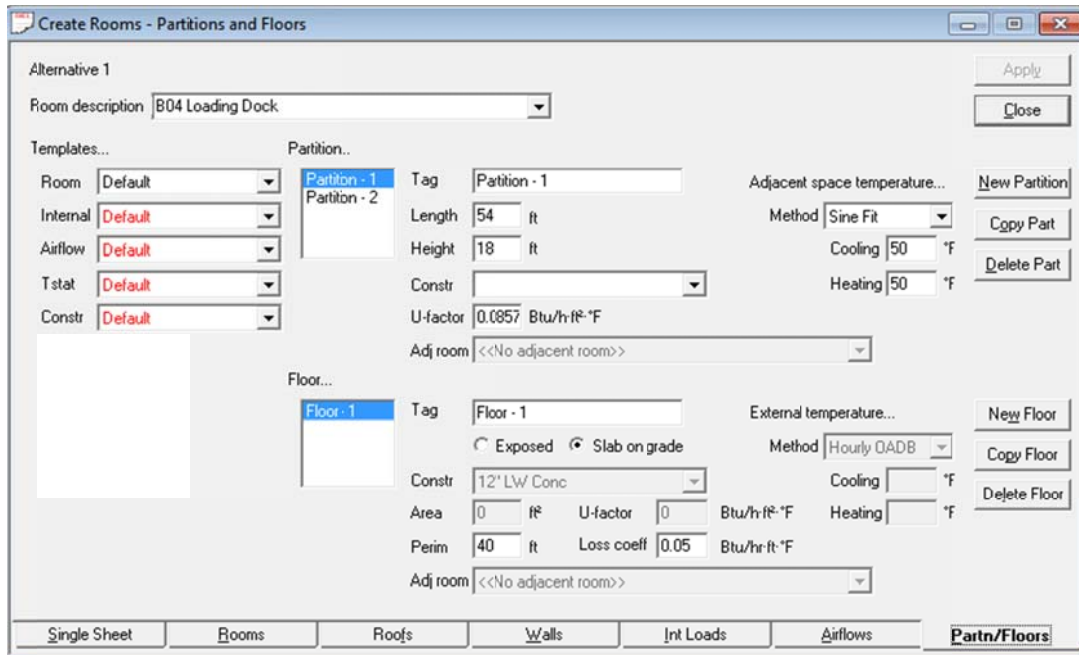
Outdoor carbon dioxide level  ppm

OK  
Cancel  
Help

### General Indoor Temperature Settings



### Sample Slab-on-Grade Floor and Grade Wall



### Sample Air Flow Template

Alternative 1  
Room description: L32 Admin Office  
Adjacent air transfer from room: <<No adjacent air trans>>

Templates...  
Room: Default  
Internal: Default  
Airflow: Default  
Tstat: Default  
Constr: Default

Main supply...  
Cooling: To be calculated  
Heating: To be calculated

Ventilation...  
Apply ASHRAE Std62.1-2004/2007: No  
Type: General Office Space  
Cooling: 20 cfm/person  
Heating: 20 cfm/person  
Schedule: Available (100%)

Infiltration...  
Type: Neutral, Tight Const.  
Cooling: 0.3 air changes/hr  
Heating: 0.3 air changes/hr  
Schedule: Available (100%)

Auxiliary supply...  
Cooling: To be calculated  
Heating: To be calculated

Std 62.1-2004/2007...  
Clg Ez: Custom  
Htg Ez: Custom  
Er: Default based on system typ

Room exhaust...  
Rate: 0 cfm  
Schedule: Available (100%)

VAV minimum...  
Rate: % ClgAirflow  
Schedule: Available (100%)  
Type: Default

Single Sheet | Rooms | Roofs | Walls | Int Loads | **Airflows** | Partn/Floors

### Sample Interior Load Template

Alternative 1  
Room description: L01 Memorial Stair Tower

Templates...  
Room: Default  
Internal: Default  
Airflow: Default  
Tstat: Default  
Constr: Default

People... Activity: Cafeteria  
Density: 0 People  
Schedule: Cooling&Heating  
Sensible: 275 Btu/h  
Latent: 275 Btu/h

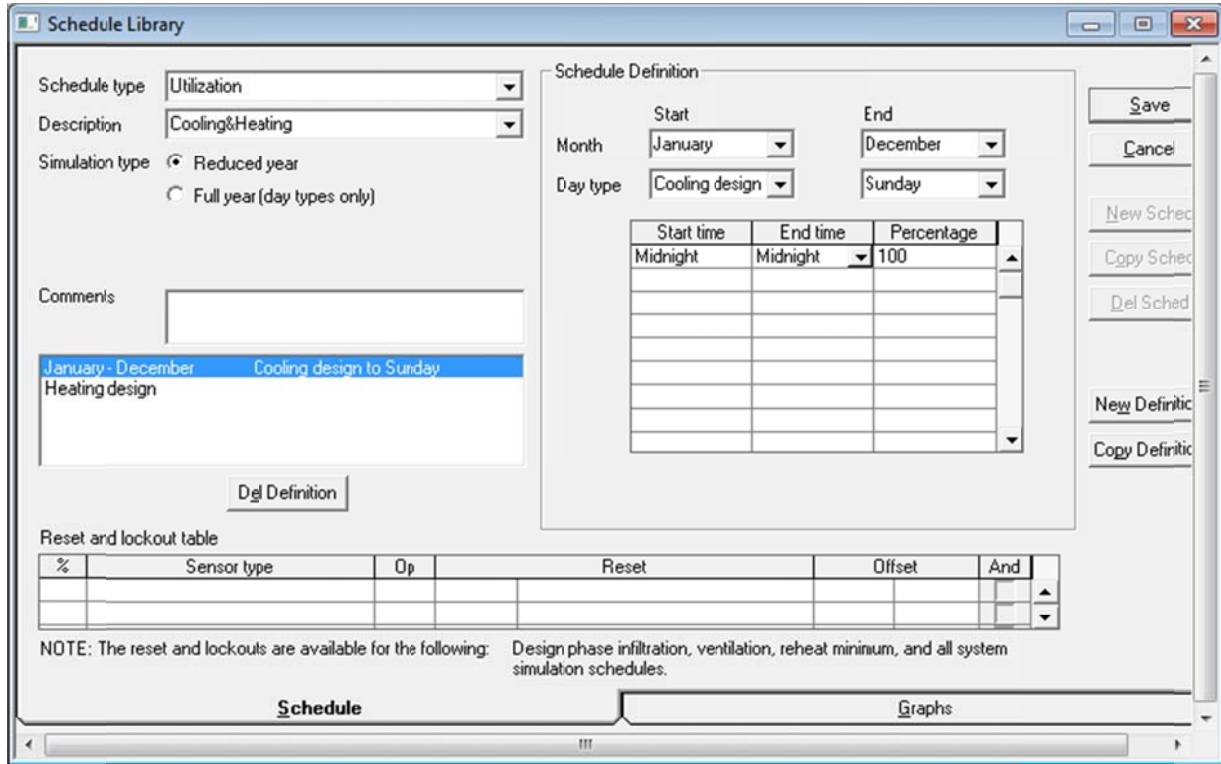
Workstations...  
Density: 1 workstation/person

Lights...  
Type: Recessed fluorescent, not vented, 80% load to space  
Heat gain: 1.4 W/sq ft  
Schedule: Cooling Only (Design)

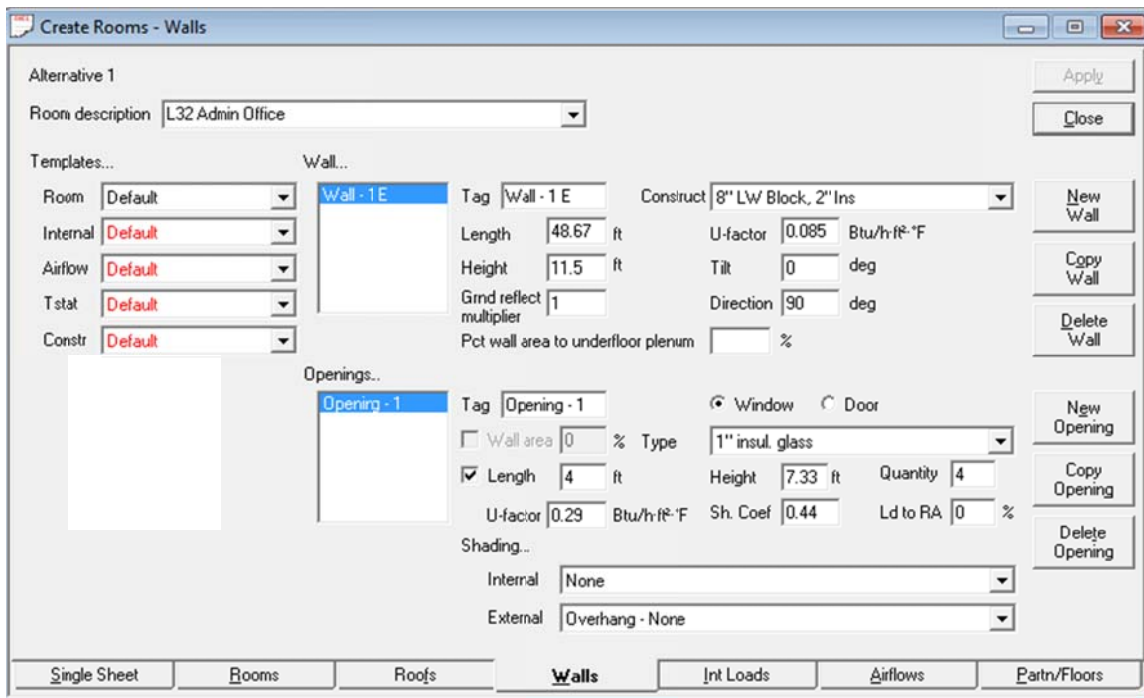
Miscellaneous loads...  
Misc Load 1  
Tag: Misc Load 1  
Energy: 0 W/sq ft  
Type: None  
Schedule: Cooling Only (Design)

Single Sheet | Rooms | Roofs | Walls | **Int Loads** | Airflows | Partn/Floors

### Schedule Template



### Sample Exterior Wall Template



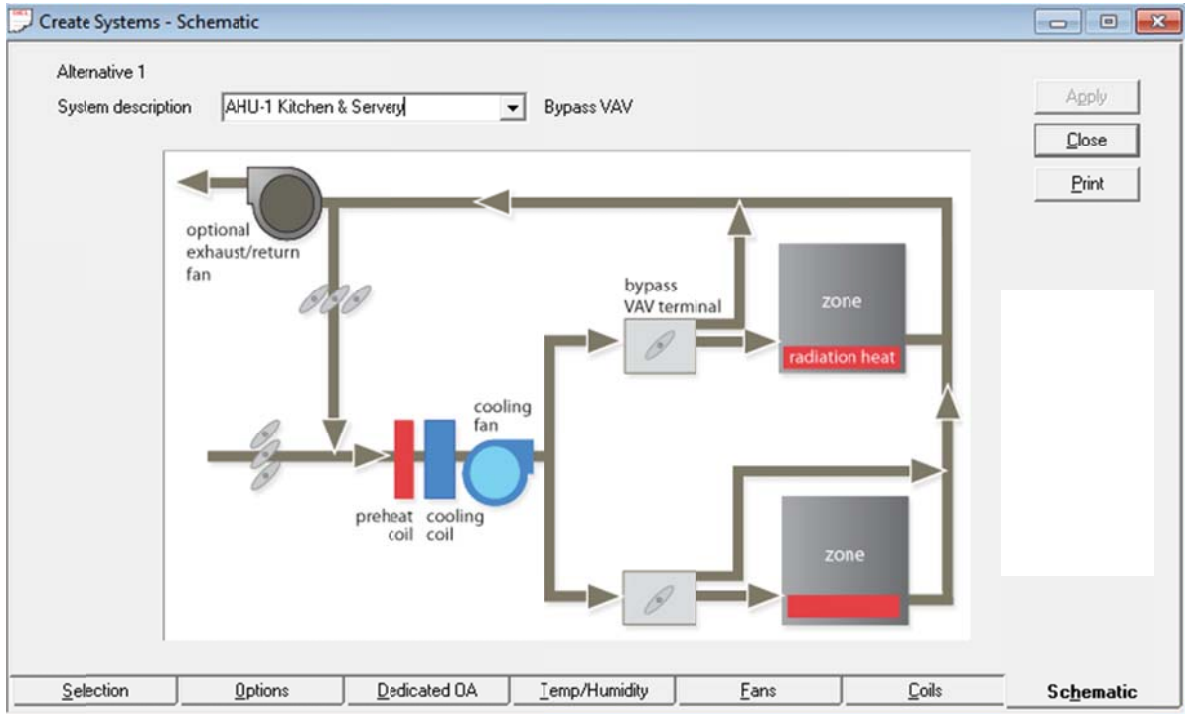


### Sample Roof Template

### Sample Room Template



Sample System Schematic



Sample System Fan Override

Alternative 1  
System description: AHU-1 Kitchen & Servary Bypass VAV  
Fan cycling schedule: No fan cycling

	Type	Static Pressure (in. wg)	Full Load Energy Rate	Full Load Energy Rate Units	Schedule
Primary	FC Centrifugal vav/inlet vn	2	0.00032	kW/Cfm-in wg	Available (100%)
Secondary	None	0	0	kW	Available (100%)
Return	FC Centrifugal vav/inlet vn	1.5	0.00032	kW/Cfm-in wg	Available (100%)
System exhaust	None	0	0	kW	Available (100%)
Room exhaust	None	0	0	kW	Available (100%)
Optional ventilation	None	0	0	kW	Available (100%)
Auxiliary	None	0	0	kW	Available (100%)

90.1 Primary Fan Power Adjustment: 0 in. wg

### Cooling Plant Equipment Model

Create Plants

Cooling Equipment - Alternative 1

Cooling plant: Cooling plant - 001  
 Equipment tag: Air-cooled chiller - 001  
 Category: Air-cooled chiller  
 Equipment type: Air Cooled Scroll Chiller  
 Sequencing type: Single  
 Energy source:   
 Rejec: condenser heat: Heat rejection equipment  
 Rejec: heat to plant:   
 Heat Rejection: Type: Cooling Tower w/ 12' Range  
 Hourly ambient wet bulb offset:   
 Thermal Storage: Type: None  
 Capacity: 0 ton-hr  
 Schedule: Storage

Operating mode	Capacity	Energy rate
Cooling	241 tons	0.63 kW/ton
Heat recovery	tons	kW/ton
Tank charging	tons	kW/ton
Tank charging & heat recovery	tons	kW/ton

Pumps	Type	Full load consumption
Primary chilled water	Cnst vol chill water pump	4.8 ft water
Condenser water	None	0 ft water
Heat recovery or aux condenser	None	0 ft water

Buttons: Apply, Close, New Equip, Copy Equip, Delete Equip, Controls..., Packaged Energy Breakout...

Configuration: **Cooling Equipment**, Heating Equipment, Base Utility / Misc. Accessory

### Heating Plant Equipment Model

Create Plants

Heating Equipment - Alternative 1

Heating plant: Heating plant - 002  
 Equipment tag: Boiler - 001  
 Category: Boiler  
 Equipment type: Coal Fired Steam Boiler  
 Capacity: 2500 Mbh  
 Energy rate: 83.3 Percent efficient  
 Thermal Storage: Type: None  
 Capacity: 0 ton-hr  
 Schedule: Storage  
 Controls: Equipment schedule: Available (100%)  
 Demand limiting priority:   
 Hot Water Pump: Type: None  
 Full load consumption: 0 ft water

Buttons: Apply, Close, New Equip, Copy Equip, Delete Equip

Configuration: Configuration, **Heating Equipment**, Cooling Equipment, Base Utility / Misc. Accessory

Sample Economic Data Template

**Rate Structure Library**

Description: Northern Power Company

Comments: This is a sample utility rate.

**Defined rates**

Electric demand On peak	January - December
Electric consumption On peak	January - December
Gas On peak	January - December
Water	January - December
Electric demand Off peak	January - December
Electric consumption Off peak	January - December
Oil	January - December

**Rate Definition**

Utility: Electric demand

Minimum charge: [ ]

Start period: January

End period: December

Rate type: On peak

Minimum demand: [ ] %

Fuel adjustment: [ ]

Customer Charge: [ ]

kWh/kW flag: No

**Rate schedule (\$/kW)**

Rate	Cutoff
\$8.130000	

Buttons: Save, Close, New Structure, Copy Structure, Del Structure, New Definition

## A.2 Computed vs. Design Document Load and Ventilation Indices

System	Cooling [ft <sup>2</sup> /ton]		Difference	Heating [Btu/h-ft <sup>2</sup> ]		Difference	Total Supply Air [cfm/ft <sup>2</sup> ]		Difference	Ventilation Supply [cfm]		Difference
	Analysis	Design		Analysis	Design		Analysis	Design		Analysis	Design	
AHU-1 Kitchen/Servery	191.6	265.5	-27.83%	40.63	29.29	38.72%	1.74	1.37	27.01%	3530	2095	68.50%
AHU-2 Pub/Great Hall	113.3	135.3	-16.26%	102.74	103.2	-0.45%	3.14	2.78	12.95%	10840	9200	17.83%
AHU-3 Tower	276.9	314.7	-12.01%	49.4	42.82	15.37%	1.26	1.23	2.44%	2952	1797	64.27%
AHU-4 Dining Hall	151	130.2	15.98%	63.53	69.82	-9.01%	2.14	2.36	-9.32%	14306	14965	-4.40%
AHU-5 Catering Make-Up	0	0	0.00%	636.7	636	0.11%	8.34	8.33	0.12%	7500	7500	0.00%
AHU-6 Servery Make-Up	0	0	0.00%	158.68	152.87	3.80%	2.08	2	4.00%	10400	10400	0.00%
AHU-7 Loading Dock B04	0	0	0.00%	3.39	17.6	-80.74%	0.02	0.26	-92.31%	38	55	-30.91%
FCU-1 Bemis Music Room	132.3	140.3	-5.70%	102.47	111.06	-7.73%	3.5	3.18	10.06%	1079	1079	0.00%
CUH Mechanical Room	0	0	0.00%	3.02	11.82	-74.45%	0.05	0.21	-76.19%	0	0	0.00%
CUH Non-Cooled Spaces	0	0	0.00%	7.95	16.87	-52.87%	0.09	0.16	-43.75%	801	304	163.49%
CUH Stairs	0	0	0.00%	39.51	68.73	-42.51%	0.62	1.14	-45.61%	106	93	13.98%
CUH Storage	0	0	0.00%	20.55	58.05	-64.60%	0.24	0.84	-71.43%	148	56	164.29%