TECHNICAL ASSIGNMENT #2

Building & Plant Energy Analysis Report

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Mechanical Option
Margaret M. Alkek Building for Biomedical Research
Baylor College of Medicine
Houston, TX
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Executive Summary

This report is the building and plant analysis of the Margaret M. Alkek Building for Biomedical Research in Houston, TX. The report looks at the building's compliance with Standard 90: Sections 5 & 9, which deal with the building envelope and lighting densities, and rates the building according to the LEED rating system. This report also discusses lost rentable space and mechanical system first cost. A majority of the report consist of design load and energy analysis of the building using the Hourly Analysis Program put out by Carrier.

The research tower was not designed with the LEED rating system in mind and as such did very poorly when rated by the system. When applying Standard 90: sections 5 & 9 to the building it is found that none of the envelope complies other than the roof. Also the lighting densities does not work when you do the building area method, however some spaces do comply when you use the space by space method. The building loses 15% of its rentable space to mechanical systems however this high percentage is due to an entire floor being dedicated to mechanical systems as requested by the owner. An estimate shows the buildings mechanical systems coming to a first cost of a little over $21 million.

The final part of the report deals with simulations using Carrier's Hourly Analysis Program (HAP). This simulation was used as a basis for comparison for the design load calculated by the MEP engineers. Also this HAP simulation produced an estimate of how much energy the building would consume annually. This allowed for the buildings emissions to be studied.

Assumptions

- Since “Research Facility” is not an option in the Building Area Method the closest building type is “Hospital”.
- Since all rooms were designed to 1.5 W/ft^2 in the research tower, the entire building is 1.5 W/ft^2.
- Research spaces are assumed to be similar to Hospital Exam/Treatment rooms.
- Building operates at 100% from 7am to 7pm and 50% the rest of the time.
- Due to the configuration of the air handlers, each grouping is considered one air handler for the HAP simulation.
- For energy analysis assumptions see that section.

LEED Rating System

The Leadership in Energy and Environmental Design (LEED) Building Rating System is a national standard rating system that is used as a way to determine which buildings can be considered to have green design. The LEED system assigns points for different features, designs, and the like that use less energy, less taxing on the environment or just generally considered "green design". The LEED system is broken down into six categories in which a building can score points towards a LEED certification. The six categories are Sustainable Sites, Water Efficiency, Energy & Atmosphere, Materials & Resources, Indoor Environmental Quality, and Innovation & Design Process. There are different levels to rating a green building according to the LEED standard and they break down like this: Certified (26-32), Silver (33-38), Gold (39-51), and Platinum (52+).

The Margaret M. Alkek Building for Biomedical Research was examined using the LEED rating system for the sake of this report. The building is a 200,000 square foot research tower for the Baylor College of Medicine, as such, there were certain requirements put forth by the owner when the building was to be designed. As with most owners first cost was important and when keeping first cost low it causes newer, more efficient and cutting edge technologies to be kept out of the project. Also as a research tower the building inherently uses a lot of energy, especially with the use of 100% outdoor air units in this building. As a result of this the rating this building received when evaluated according to LEED was a 6. Most of the points were awarded under the Sustainable Sites category because of the building being built upon an existing campus and on top of an existing research facility. To see which specific credits the building received points for see the appendix.

Standard 90: Sections 5 & 9

Standard 90 is put forth by ASHRAE as a way of setting forth minimum requirements for designing an energy efficient building. Specifically, ASHRAE standard 90 states: "The purpose of this standard is to provide minimum requirements for the energy-efficient design of buildings except low-rise residential buildings." There are 12 sections to standard 90, however for the sake of this report building envelope and lighting were the only things considered so sections 5 and 9 were the only ones that were applicable.

Section 5: Building Envelope

As stated above section 5 deals with the building's envelope. Compliance is measured by checking the walls and roof against the given minimum R and maximum U values as well as the windows against the maximum U and SHGC values. The first step is to determine which requirements to compare the building to. As a research tower the building is considered a nonresidential conditioned space. From Table B-1 in Appendix B, Houston, TX is climate zone 2A. This means that the requirements for U and R values for walls and roofs as well as the SHGC and U values for windows will be given by Table 5.5-2.

Bard, Rao + Athanas Consulting Engineers, LLC were the design engineers on this building and provided the R and U values for the building's walls and roof. These values were needed to fill out the City of Houston's Commercial Energy Code Compliance Form for the building to be built. This document also provided the SHGC and U-factor for the windows and vertical glazing percentage. The report states that the building is 19% better than the City of Houston's code. The calculations and the aforementioned document can be found in the appendix.

The following table (Table 1) presents the actual building versus the requirements per section 5 of standard 90. From this table it is determined that none of the exterior walls meet standard 90 however the roof is OK per standard 90.

	Standard 90		Actual Building	
Component	U-Value	R-Value	U-Value	R-Value
North Wall	0.113	13	0.145	10
East Wall	0.113	13	0.145	10
South Wall	0.113	13	0.145	10
West Wall	0.113	13	0.145	10
Roof	0.063	15	0.063	15

Table 1

The next part of section 5 is to check the building to standard 90's fenestration requirements. The building is 19.2% glazing (the calculations can be found in the previously mentioned document in the appendix). The SHGC for the windows is 0.38 and the U-value is .39. According to Table 5.5-2 in standard 90 the maximum U-value for fixed windows is 1.22. The maximum SHGC is .61 for north facing windows and .25 for the rest of the directions. The building doesn't meet the fenestration requirements.

Section 9: Lighting

Section 9 of standard 90 checks the lighting density of the building. Section 9 provides two separate methods of the "Building Area Method" and "Space by Space Method". The Building Area Method gives the maximum W/ft^2 allowed for certain building types. The Space by Space method gives the maximum W/ft^2 for each space type within the building.

As listed in the assumptions section of the report, several assumptions had to be made to be able to use the either method. For the building area method, all spaces within the building were designed for 1.5 W/ft^2 so a safe assumption would be that the building is 1.5 W/ft^2 (the associated design document is attached in the appendix). However since research tower is not a choice in Table 9.5.1, an assumption had to be made as to which building type was closest to a research tower. Hospital was the closest choice and has a maximum of 1.2 W/ft^2 as its criteria. The research tower exceeds this value and for the building area method, fails.

In the space by space method, again most spaces within the research tower are not listed in Table 9.6.1. The buildings spaces can be broken down storage, office-open plan, office-enclosed or research spaces. As mentioned in the assumptions section research spaces are assumed to be Hospital Exam/Treatment rooms. By quick inspection it is seen that the only spaces that do not exceed the section 9 criteria are the research spaces.

There are two things that can be concluded from the results of these 2 methods. The first is that a blanket 1.5 W/ft^2 for lighting in all spaces is too much and wasteful energy wise. The other is that since research towers are unique as well as the spaces contained within each research tower being very unique means that making comparisons to Exam/Treatment rooms is not very accurate. Also assuming that the research tower is similar to a hospital is again not very accurate because of the distinct difference between what happens within the spaces.

Lost Rentable Space

The research tower has 5 redundant levels (levels 4-8). Level 3 is an entire floor made up of space to house all the mechanical systems and a majority of the air handling units. Levels 1 & 2 are animal research facilities. The building loses approximately 15% of its space to mechanical systems. This is much larger than the average building. This is because of the 8 story and 205,000 gross square foot building there is an entire floor dedicated to the mechanical systems. A table with the breakdown of lost rentable space per floor is listed below in Table 2.

Level(s)	Description	Area (ft2)
1	Mechanical Room	150
1	Shaft	0
2	Mechanical Room	0
2	Shaft A	160
2	Shaft B	180
2	Shaft C	290
3	Mechanical Floor	25,000
4-8	Mechanical Room	0
4-8	Shaft A	800
4-8	Shaft B	800
4-8	Shaft C	900
4-8	Shaft D	725
4-8	Shaft E	1450

Table 2

Mechanical Systems First Cost

The Margaret M. Alkek Building for Biomedical Research was estimated by Stephen N. Skabla Jr. The building is 201,129 gross square feet. The estimated first cost of the mechanical systems in the building is $21,114,878. This works out to a Cost/GSF of $104.98. The mechanical systems account for a significant portion of the first cost of the building. It works out to be approximately 30% of the first cost of the building. The front page of the estimate can be found in the appendix.

Design Load Estimation

Carrier's Hourly Analysis Program, version 4.20, (HAP) was used to carry out an estimation of the design loads for this building. Baylor College of Medicine set forth a design narrative in which the criteria for designing the Margaret M. Alkek Building for Biomedical Research. The relevant portions of said design guide can be found in the appendix of this report. The design guide sets forth thermostat set points, lighting and equipment loads where appropriate, ventilation rates, required air changes and any other design information that may be required by the design engineer.

The research tower has a complex mechanical system due to the laboratory spaces as well as the vivarium on the first two levels. Equipment loads tend to be higher in a building such as this due to the specialized equipment that is used. The vivarium on the first level has a cagewash system for cleaning cages before putting future test subjects in their housing unit. This can generate a fair bit of heat from the steam used in cleaning the equipment and robotics involved in moving cages from the dirty to sterile side of the cagewash. Loads for equipments are not included in the W/ft^2 estimates given in the Baylor College of Medicine design narrative. Other specialized equipment, such as Autoclaves on the upper laboratory levels, were also not given. Due to this information having to be selected by the design engineer, heating loads were not available. However, when designing, the engineer tends to include a factor that will cover any equipment that may be selected when they are aware ahead of time of the need to select such equipment.

For an analysis to be carried out on the research tower assumptions had to be made. The first assumption to be made was the operation schedule of the research tower. The building is assumed to be running 100% between the hours of 7am and 7pm and at 50% the rest of the time, 7 days a week. In situations where actual equipment loads were not provided a reasonable guess was used, such as 25 W/ft^2 for equipment load in an electrical room.

The HAP analysis was set up for Houston, TX design conditions. As mentioned in previous reports, the air handlers in the tower have a unique configuration. For instance air handlers AHU-A.1a, AHU-A.1b, AHU-A.1c and AHU-A.1d are stacked in a 2x2 configuration and their supplies dump into a discharge plenum out of which the main supply duct leaves. Due to this the 3 systems are treated as 3 air handlers for simplification. Once all the zones were entered in and assigned to the appropriate air handlers, the design loads could be estimated. The results of the estimation can be seen in Table 3 compared to the actual design done by the MEP engineering firm.

System	Serves	HAP		DESIGN	
		CFM/ft^2	ft^2/ton	CFM/ft^2	ft^2/ton
AHU-A.1a, A.1b, A.1c & A.1d	Animal Research Facilities	2.29	116.1	2.01	101.1
AHU-L.1a & L.1b	Office/Laboratory	1.61	156.1	1.65	123.1
AHU-L.2a & L.2b	Laboratory	1.88	182.4	1.89	107.4

Table 3

The HAP results come out to be a bit higher than the design results. This was not expected because of the tendency of design engineers to over design due to safety

factors that are typically used. However, this inconsistency between what is expected and what actually came out from the simulation can be explained. Since some of the equipment loads in certain rooms had to be "reasonable" guesses this bumped up loads, especially when considering that there are 5 levels that have an identical floor plan. Another reason for the HAP being higher is due to the square foot used in determining the design CFM/ft^2 was over a general area or just using the per floor square foot, while HAP had each room's actual square foot. The design CFM/ft^2 incorporated the square foot that was lost to mechanical shafts, stairwells, wall thickness, etc, where as HAP did not and this is where the discrepancy lies. The complete and detailed HAP calculations results can be found in the appendix.

Annual Energy Consumption & Operating Costs

The following part of this report deals with the energy usage and consumption for the Margaret M. Alkek Building for Biomedical Research. However, at the time of creating this report the research tower had only recently begun construction. Since the building has not been constructed yet yearly electric power use and fossil fuel consumption figures could not be obtained and must be simulated. Also there was no energy analysis performed by the MEP engineers on the project. An energy analysis was not deemed necessary for this research tower because it was deemed unimportant since this building is not reinventing the wheel.

The energy analysis was carried out in Carrier's Hourly Analysis Program (HAP). The same schedule, internal loads, ventilation rates and envelope was used in the energy simulation as was used in the design load estimation. No natural gas or other fossil fuels are consumed on sit except in the case of emergency generation. Hot water and steam for the building are generated by heat exchangers and a clean steam generator that is essentially a shell and tube heat exchanger. Baylor College of Medicine is located on the Texas Medical Center so the new research tower is allowed to tap into the steam loop and utilizes this loop for the hot water and steam generation. All air and water flow rates used can be found in the appendix for the design load estimation and in the pages on this energy analysis. The $/kWh used to this analysis was $ .0816/kWh determined from the Energy User News publication.

The energy analysis was performed with these parameters. It was found that the research tower consumes 14,021,399 kWh of energy each year at a cost of about $1.2 million. The on site energy consumption is said to be 49,537,755 kBTU of which 16,619,203 kBTU is used by the HVAC system. Assuming an electric generating efficiency of 28% the total energy generated to supply this building is 172,556,787 kBTU. Due to the limitations of HAP and that it is geared more towards HVAC design it is assumed that the actual energy consumption for the entire building would be higher. HAP did not account for equipment such as unit heaters, fan coil units, all the specialty exhaust, the specialty research equipment, etc, etc. However the figure could be lower because of how the schedule was assumed since the real schedule of operation is not available. It's tough to say without another analysis to compare too. For a more detailed breakdown of the energy consumption and costs from the HVAC system according to HAP, the complete results can be found in the appendix.

With the information found in the HAP energy analysis the amount of emission the research tower is responsible for can be determined. As of 2000 the grid mix in Texas was 46% natural gas, 41% coal and 13% nuclear (information was found here: http://www.texasep.org/html/nrg/nrg_2ele.html). Results from the emission study can be found in Table 4 below.

		lb_m Pollutant/kWh (TEXAS GRID)				Annual lb_m Pollutant for tower			
Fuel	**% Mix U.S.**	**Particulates**	**SO_2/kWh**	**NO_x/kWh**	**CO_2/kWh**	**Particulates**	**SO_2/kWh**	**NO_x/kWh**	**CO_2/kWh**
Coal	41.0	4.51E-04	5.24E-03	3.04E-03	8.82E-01	6323.6	73466.0	42583.6	12360129.5
Oil	0.0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.0	0.0	0.0	0.0
Nat. Gas	46.0	0.00E+00	6.21E-06	1.17E-03	6.17E-01	0.0	87.0	16365.0	8646223.5
Nuclear	13.0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.0	0.0	0.0	0.0
Hydro/Wind	0.0	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.0	0.0	0.0	0.0
Totals	100.0	4.51E-04	5.25E-03	4.20E-03	1.50E+00	6323.6	73553.0	58948.5	21006353.0

Table 4

Appendix

Leed Rating System Checklist

Sustainable Sites

Credit	Credit Title	Y	?	N
1	Site Selection	x		
2	Urban Redevelopment	x		
3	Brownfield Redevelopment			x
4.1	Alternative Transportation	x		
4.2	Alternative Transportation	x		
4.3	Alternative Transportation			x
4.4	Alternative Transportation	x		
5.1	Reduced Site Disturbance			x
5.2	Reduced Site Disturbance		x	
6.1	Stormwater Management			x
6.2	Stormwater Management			x
7.1	Heat Island Effect			x
7.2	Heat Island Effect			x
8	Light Pollution Reduction			x

Water Efficiency

Credit	Credit Title	Y	?	N
1.1	Water Efficient Landscaping			x
1.2	Water Efficient Landscaping			x
2	Innovative Wastewater Technology			x
3.1	Water Use Reduction			x
3.2	Water Use Reduction			x

Energy & Atmosphere

Credit	Credit Title	Y	?	N
1	Optimize Energy Performance			x
2.1	Renewable Energy			x
2.2	Renewable Energy			x
2.3	Renewable Energy			x
3	Additional Commissioning			x
4	Ozone Depletion			x
5	Measurement & Verification			x
6	Green Power			x

Materials & Resources

Credit	Credit Title	Y	?	N
1.1	Building Reuse		x	
1.2	Building Reuse		x	
1.3	Building Reuse		x	
2.1	Construction Waste Management			x
2.2	Construction Waste Management			x
3.1	Resource Reuse			x
3.2	Resource Reuse			x
4.1	Recycled Content			x
4.2	Recycled Content			x
5.1	Local/Regional Materials			x
5.2	Local/Regional Materials			x
6	Rapidly Renewable Materials			x

7	Certified Wood			x

Indoor Environmental Quality

Credit	Credit Title	Y	?	N
1	Carbon Dioxide (CO_2) Monitoring			x
2	Ventilation Effectiveness			x
3.1	Construction IAQ Management Plan			x
3.2	Construction IAQ Management Plan			x
4.1	Low-Emitting Materials			x
4.2	Low-Emitting Materials			x
4.3	Low-Emitting Materials			x
4.4	Low-Emitting Materials			x
5	Indoor Chemical & Pollutant Source Control	x		
6.1	Controllability of Systems			x
6.2	Controllability of Systems			x
7.1	Thermal Comfort			x
7.2	Thermal Comfort			x
8.1	Daylight & Views			x
8.2	Daylight & Views			x

Innovation & Design Process

Credit	Credit Title	Y	?	N
1.1	Innovation in Design			x
1.2	Innovation in Design			x
1.3	Innovation in Design			x
1.4	Innovation in Design			x
2	LEED™ Accredited Professional			x

City of Houston
Commercial Energy Code Compliance Form
Prescriptive Method – CHAPTER 8 IECC

Part I - Form. ***Complete this form using the tables in Part II, and the instructions in Part III.***

1) Contact Name: / Phone Number:	2) Project Address:	3) Project Number:
Ted Athanas /(617) 254-0016	**Baylor College of Medicine Research Tower**	

4) Is your project exempt?
☐ YES - check box below
- ☐ Historical building – documentation required
- ☐ Work does not affect energy compliance (STOP)
- ☐ Low Energy Building
- ☐ Unconditioned building (MUST STILL MEET ELEC AND PLUMB)

☒ NO - continue

5) Project Data

Sq. Ft. 204,640 Project Area (lease, remodel, etc.)

Sq. Ft. 204,640 Total Bldg. Area

6) Glazing Percentage

Sq. Ft. 23,986 Glazing

Sq. Ft. 124,796 Above Grade Bldg. Envelope Walls

= 19.2 % Glazing

(Divide glazing by the above grade wall area and multiply by 100)

7) Type of Occupancy/Use

Lab/Vivarium

8) Using Software?
☒ YES - *check box, attach report from ComCheck EZ 2001 IECC*

☐ NO

9) Scope of work: (check all that apply)
☒ New Construction
☐ Addition
☐ Remodel
☐ Other: _____

10) Compliance Data The proposed work will affect the following areas: (check all that apply)
☒ Building Envelope ☒ Mechanical ☐ Electrical ☐ Service Water Heating

11) Building Envelope Requirements (Fill in the applicable information or check *Not Applicable*)
Note: Details must be shown on plans

A. Insulation *(Check one and complete the table)*
☒ All insulation meets minimums
☐ Values averaged (If not using software attach calculations)

Element	Area (Sq. Ft.)	Proposed R-value	Not Applicable
Ceiling-Attic			X
Ceiling-Roof	25,525	15.0	
Floor over outside air			X
Floors over unconditioned space	1800	2.0	X
Walls	100,810	10.0	
Basement Walls			X
Crawlspace	25,525	2.0	

B. Glazing *(Check one and complete the table)*
☒ All glazing meets minimums
☐ Glazing Varies – Values averaged
(If not using software attach calculations)

Element	Area (Sq. Ft.)	Proposed SHGC	Proposed U-Factor	Not Applicable
Windows	23,986	0.38	0.39	
Glass Doors				X
Other Glazing				X

C. Projection Factor
☒ All projection factors are equal for all glazing.
☐ Projection factors vary—Values averaged.
(if not using software show calculations)

PROJECTION FACTOR = 0 (If applicable)

12) Mechanical Requirements –
All equipment is existing ☒ YES, stop ☐ NO, complete applicable information for new equipment in table below

Equipment Type (i.e. air conditioner/heat)	Category (i.e. Split System/Single Pkg)	Efficiency Rating (i.e. 10 SEER/ 78% AFUE)	Not Applicable (i.e. Plug in appliance)

- Piping shall be insulated to the table in Part II.
- Ducts shall be insulated to R-5 in unconditioned space and R-8 when located outside the building envelope.

Remarks - Primary chiller and boiler plant equipment are existing campus (chilled water) and TECO (steam) distribution networks.

City of Houston
Commercial Energy Code Compliance Form
Prescriptive Method – CHAPTER 8 IECC

INTERIOR LIGHTING POWER FOR COMMERCIAL BUILDINGS (805.4.2)

☐ **EXEMPT FROM LIGHTING BUDGET.** Lighting is being:

☐ relocated with existing fixtures, or

☐ reduced, (explain scope) *Note: In order to qualify for a reduction, it must be shown on the plans* _____

_____

Switching requirements still apply. ***Stop.***

A	B	C	D	E	F
BUILDING OR AREA TYPE	**Entire building (W/ft^2)**	**Tenant area or portion of building (W/ft^2)**	**Area of building or space (sq. ft.)**	**Allowed watts (B or C x D)**	**Actual Watts[e]**
Auditorium	NA	1.6	0		
Bank/financial institution[a]	NA	2.0	0		
Classroom/lecture hall[b]	NA	1.6	0		
Convention, conference or meeting center[a]	NA	1.5	0		
Corridor, restroom, support area	NA	0.8	0		
Dining[a]	NA	1.4	0		
Exercise center[a]	1.4	1.1	0		
Exhibition hall	NA	3.3	0		
Grocery store[c]	1.9	2.1	0		
Gymnasium playing surface	NA	1.9	0		
Hotel function[a]	NA	2.4	0		
Industrial work, < 20 ft ceiling height	NA	2.1	0		
Industrial work, ≥ 20 ft ceiling height	NA	3.0	0		
Kitchen	NA	2.2	0		
Library[a]	1.5	1.8	0		
Lobby-hotel[a]	NA	1.9	0		
Lobby-other[a]	NA	1.0	0		
Mall, arcade or atrium	NA	1.4	0		
Medical and clinical care[b, d]	1.6	1.6	163986	262378	211617
Museum[b]	1.6	1.6	0		
Office[b]	1.3	1.5	0		
Religious worship[a]	2.2	3.2	0		
Restaurant[a]	1.7	1.7	0		
Retail sales, wholesale showroom[c]	1.9	2.1	0		
School	1.5	NA	0		
Storage, industrial and commercial	0.6	1.0	0		
Theater-motion picture	1.1	1.0	0		
Theater-performance[a]	1.4	1.5	0		
All others	0.6	1.0			

Electrical Eng / Master Elec. / Architect **License # / Seal**

SIGNATURE:

_____

TOTAL ALLOWED WATTS	**TOTAL ACTUAL[f] WATTS**
262378	211617

NA = Not Applicable

a. Where lighting equipment is specified to be installed for decorative appearances in addition to lighting equipment specified for general lighting and is switched or dimmed on circuits different from the circuits for general lighting, the smaller of the actual wattage of the decorative lighting equipment or 1.0 W/ft^2 times the area of the space that the decorative lighting equipment is in shall be added to the interior lighting power determined in accordance with this line item.

b. Where lighting equipment is specified to be installed to meet requirements of visual display terminals as the primary viewing task, the smaller of the actual wattage of the lighting equipment or 0.35 W/ft^2 times the area of the space that the lighting equipment is in shall be added to the interior lighting power determined in accordance with this line item.

c. Where lighting equipment is specified to be installed to highlight specific merchandise in addition to lighting equipment specified for general lighting and is switched or dimmed on circuits different from the circuits for general lighting, the smaller of the actual wattage of the lighting equipment installed specifically for merchandise, or 1.6 W/ft^2 times the area of the specific display, or 3.9 W/ft^2 times the actual case or shelf area for displaying and selling fine merchandise such as jewelry, fine apparel and accessories, or china and silver, shall be added to the interior lighting power determined in accordance with this line item.

d. Where lighting equipment is specified to be installed, the smaller of the actual wattage of the lighting equipment, or 1.0 W/ft^2 times the area of the emergency, recovery medical supply and pharmacy space shall be added to the interior lighting power determined in accordance with this line item.

e. Actual watts = Number of fixtures x Watts per fixture

f. Project compliance = Total Actual Watts must be less-than-or-equal-to Total Allowed Watts.

PART II- Basic Code Requirements.

TABLE 803.3.7 MINIMUM PIPE INSULATION

(thickness in inches)

Fluid	Nominal Pipe Diameter	
	≤ 1.5"	> 1.5"
Steam	1.5	3.0
Hot water	1.0	2.0
Chilled water, brine or refrigerant	1.0	1.5

For SI: 1 inch = 25.4 mm, 1 foot = 304.8 mm, °C = [(°F)-32]/1.8.

a. For piping exposed to outdoor air, increase insulation thickness by 0.5 inch.
b. Runouts not exceeding 12 feet in length to individual terminal units.
c. Inside pipe diameter.

AVERAGE WEIGHTED AREA CALCULATION EXAMPLE

Given: 4 Windows

2 each of Window Type 1 (W_1) = 15 square feet, U-factor = .72
2 each of Window Type 2 (W_2) = 21 square feet, U-factor = .30

Calculation for average weighted area U-factor:

$$\frac{(15 \times .72) + (15 \times .72) + (21 \times .30) + (21 \times .30)}{15+15+21+21} = \frac{34.2}{72}$$

35.7 / 72 = .475

Average weighted area U= .475

HOUSTON DESIGN CRITERIA

Condition	Value
Winter, Design Dry Bulb	28
Summer, Design Dry Bulb	96
Summer, Design Wet Bulb	80
Degree days heating	1371
Degree days cooling	3058
Climate Zone	3b

TABLE 802.2(1-4) ZONE 3b BUILDING ENVELOPE REQUIREMENTS [a]
WINDOW AND GLAZED DOOR AREA (0-10 / >10-25 / >25-40 / >40-50) PERCENT OF ABOVE GRADE WALL AREA

ELEMENT	CONDITION/VALUE		
Skylights (U-factor)	1		
Slab or below-grade wall (R-value)	R-0		
Windows and glass doors	**SHGC**	**U – factor**	
Projection Factor < 0.25	Any / 0.50 / 0.4 / 0.4*	Any / Any / 0.7 / 0.7*	
0.25≤ Projection Factor < 0.50	Any / 0.6 / 0.5 / 0.5*	Any / Any / 0.7 / 0.7*	
Projection Factor ≥ 0.50	Any / 0.7 / 0.6 / 0.6*	Any / Any / 0.7 / 0.7*	
Roof assemblies (R-value)	**Insulation between framing**	**Continuous insulation**	
All wood joist/truss	R – 19	R – 12	
Metal joist/truss	R – 19	R – 13	
Concrete slab or deck	NA	R – 12	
Metal purlin with thermal block	R – 19	R – 13	
Metal purlin without thermal block	R – 30	R – 13	
Floors over outdoor air or unconditioned space (R-value)	**Insulation between framing**	**Continuous insulation**	
All wood joist/truss	R – 11	R – 4	
Metal joist/truss	R – 11	R – 4	
Concrete slab or deck	NA	R – 2	
Above-grade walls (R-value)	**No framing**	**Metal framing**	**Wood framing**
Framed			
R-value cavity	NA	R – 0 / R – 0 / R – 0 / R – 7*	R – 0 / R – 0 / R – 0 / R – 7*
R-value continuous	NA	R – 0	R – 0
CMU.> 8 in. with integral insulation			
R-value	NA	R – 0	R - 4
R-value continuous	R – 0	R – 0	R – 0
Other masonry walls			
R-value cavity	NA	R – 0	R – 4
R-value continuous	R – 0	R – 0	R – 0

*** Values shown are dependant upon the amount of glazing 0-10 / > 10-25 / > 25-40 / > 40-50 percent.**

Permit Number

Checked By/Date

Envelope Compliance Certificate
2001 IECC

COM*check-EZ* Software Version 3.0 Release 2a
Data filename: C:\Program Files\Check\COMcheck-EZ\Baylor\Baylor 9-14-05.cck

Section 1: Project Information

Project Name:	Baylor School of Medicine Research Tower
Designer/Contractor:	
	LORD AECK SARGENT Architecture Bard, Rao + Athanas Consulting Engineers, LLC.
Document Author:	
	BE / NAJ
Notes:	
	2001 IECC Envelope Analysis

Section 2: General Information

Building Location (for weather data):	Houston, Texas
Climate Zone:	4b
Heating Degree Days (base 65 degrees F):	1371
Cooling Degree Days (base 65 degrees F):	3012
Project Type:	New Construction
Window / Wall Ratio:	0.19

Building Type	Floor Area
Medical and Clinical Care	204640

Section 3: Requirements Checklist

Bldg. Dept. Use		
		Air Leakage, Component Certification, and Vapor Retarder Requirements
[ ]	1.	All joints and penetrations are caulked, gasketed, weather-stripped, or otherwise sealed.
[ ]	2.	Windows, doors, and skylights certified as meeting leakage requirements.
[ ]	3.	Component R-values & U-factors labeled as certified.

Climate-Specific Requirements

Component Name/Description	Gross Area or Perimeter	Cavity R-Value	Cont. R-Value	Proposed U-Factor	Budget U-Factor
NORTH:					
North Gross Wall: Metal Frame, 16" o.c.	34970	10.0	0.0	0.145	0.250
North Vision Glass:					
Metal Frame with Thermal Break:Double Pane with Low-E Clear, SHGC 0.38	8825	---	---	0.390	1.230
EAST:					
East Gross Wall: Metal Frame, 16" o.c.	19374	10.0	0.0	0.145	0.250
East Vision Glass:					
Metal Frame with Thermal Break:Double Pane with Low-E Clear, SHGC 0.38	1199	---	---	0.390	1.230
SOUTH:					
South Gross Wall: Metal Frame, 16" o.c.	39136	10.0	0.0	0.145	0.250
South Vision Glass:					
Metal Frame with Thermal Break:Double Pane with Low-E Clear, SHGC 0.38	8439	---	---	0.390	1.230
WEST:					
West Gross Wall: Metal Frame, 16" o.c.	31316	10.0	0.0	0.145	0.250
West Vision Glass:					
Metal Frame with Thermal Break:Double Pane with Low-E Clear, SHGC 0.38	5523	---	---	0.390	1.230
UNSPECIFIED ORIENTATION:					
Roof Metal Roofwith Thermal Blocks	25525	0.0	15.0	0.063	0.067

(a) Budget U-factors are used for software baseline calculations ONLY, and are not code requirements.

Envelope PASSES: Design 19% better than code

Section 4: Compliance Statement

The proposed envelope design represented in this document is consistent with the building plans, specifications and other calculations submitted with this permit application. The proposed envelope system has been designed to meet the 2001 IECC, Chapter 8, requirements in COM*check-EZ* Version 3.0 Release 2a and to comply with the mandatory requirements in the Requirements Checklist.

Principal Envelope Designer-Name _____ Signature _____ Date _____

1.3 DESIGN CRITERIA

A. Outside Conditions

1. Summer: 97°F db/80°F wb
2. Winter: 20°F
3. Air Cooled Condensers: 115°F db

B. Space Design Criteria

Space Type	Minimum O.A. Ventilation Rate	Summer Design		Winter Design		Pressurization	Minimum Supply Air Filtration	Remarks
		Max. Temperature (F)	Max. Relative Humidity (%rh)	Min. Temperature (F)	Min. Relative Humidity (%rh)			
Public Spaces and Office Areas								
Offices	20 cfm / person	74	55%	72	30%	Note 1	90%	-
Office Support	20 cfm / person	74	155%	72	30%	-	90%	-
Common Areas / Lobbies	20 cfm / person	74	55%	72	30%	Note 1	90%	-
Conference Rooms	20 cfm / person	74	55%	72	30%	-	90%	-
Conference Center	20 cfm / person	74	55%	72	30%	-	90%	-
Coffee / Break	20 cfm / person	74	55%	72	30%	-	90%	-
Laboratory Spaces								
Lab Workstation	100% / 6 ach	74	55%	72	30%	(-)	90%	-
Open Lab	100% / 6 ach	74	55%	72	30%	(--)	90%	-
Lab Support	100% / 6 ach	74	55%	72	30%	(---)	90%	-
Tissue Culture	100% / 6 ach	74	55%	72	30%	(+)	90%	-
Microscopy	100% / 6 ach	74	55%	72	30%	(+)	90%	-
Equipment Room	100% / 6 ach	74	55%	72	30%	(---)	90%	-
Glasswash	100% / 6 ach	74	65%	72	30%	(---)	90%	-
Glasswash Equipment	100% / 6 ach	85	65%	72	30%	(---)	90%	-
Darkroom	100% / 6 ach	74	55%	72	30%	(---)	90%	-
Cold Room	0.5 cfm / sq.ft.	-	-	-	-	None	90%	Note 2
Equipment Corridor	100% / 6 ach	78	55%	72	30%	(-)	90%	Note 5
Animal Facility Spaces								
Animal Holding Rooms	100% / 15 ach	Note 4	55%	Note 3	30%	Note 4	HEPA	Note 6

Space Type	Minimum O.A. Ventilation Rate	Summer Design		Winter Design		Pressurization	Minimum Supply Air Filtration	Remarks
		Max. Temperature (F)	Max. Relative Humidity (%rh)	Min. Temperature (F)	Min. Relative Humidity (%rh)			
Animal Procedure	100% / 15 ach	Note 4	55%	Note 3	30%	Note 4	HEPA	Note 6
Animal Hold Corridor	100% / 10 ach	74	55%	72	30%	Note 4	HEPA	Note 6
Animal Bedding / Feed	100% / 10 ach	74	55%	72	30%	(-)	HEPA	-
Dirty Cagewash	100% / 15 ach	78	65%	72	30%	(--)	HEPA	-
Clean Cagewash	100% / 15 ach	78	65%	72	30%	(+)	HEPA	-
Sterile Cagewash	100% / 15 ach	78	65%	72	30%	(++)	HEPA	-
Animal Corridor	100% / 10 ach	78	55%	72	30%	(+)	HEPA	-
Animal Gown	100% / 10 ach	78	55%	72	30%	(++)	HEPA	-
Specialty Spaces								
Specialty Lab	100% / 6 ach	74	55%	72	30%	TBD	90%	-
Miscellaneous Spaces								
Mech. / Elec. Rooms	Recirculation	85	60%	65	-	None	20%	-
Tel/Data Rooms	-	75	55%	60	30%	None	20%	-
Elevator Machine Rooms	-	78	60%	65	20%	None	20%	-
Receiving/Storage	100% Exhaust	78	-	65	-	None	20%	-
General Storage	-	78	-	72	-	None	20%	-
Hazardous Storage	100% Exhaust	78	-	72	-	(-)	20%	-
Waste Storage	100% Exhaust	78	-	72	-	(-)	20%	-
Toilet / Locker Rooms	100% Exhaust	78	-	72	-	(-)	80%	-
Housekeeping Closets	100% Exhaust	78	-	72	-	(-)	-	-

Note 1: Space pressurization is positive relative to adjacent labs and otherwise neutral.
Note 2: Environmental room temperature control is by Division 11.
Note 3: Animal holding and procedure spaces will have temperatures adjustable between 68°F and 80°F.
Note 4: Animal holding and procedure space pressurization will be adjustable from positive to negative.
Note 5: Equipment space will be provided with minimum air and house fed chilled water fan coil units to offset the equipment sensible heat load.
Note 6: Animal Room exhaust will include dander filter.

C. Internal Load Criteria

Space Type	People Load	Lighting Load	Equipment Load	Remarks
Public Spaces and Office Areas				
Offices	100 gsf/person	1.5 W/gsf	4.0 W/gsf	-
Office Support	250 gsf/person	1.5 W/gsf	4.0 W/gsf	-
Common Areas / Lobbies	250 gsf/person	1.5 W/gsf	0.5 W/gsf	-
Conference Rooms	25 gsf/person	1.5 W/gsf	2.0 W/gsf	-
Conference Center	25 gsf/person	1.5 W/gsf	0.5 W/gsf	-
Coffee / Break	25 gsf/person	1.5 W/gsf	0.5 W/gsf	-
Laboratory Spaces				
Lab Workstation	100 gsf/person	1.5 W/gsf	8 W/gsf	-
Open Lab	100 gsf/person	1.5 W/gsf	8 W/gsf	-
Lab Support	100 gsf/person	1.5 W/gsf	16 W/gsf	-
Tissue Culture	100 gsf/person	1.5 W/gsf	16 W/gsf	-
Microscopy	100 gsf/person	1.5 W/gsf	16 W/gsf	-
Equipment Room	100 gsf/person	1.5 W/gsf	16 W/gsf	-
Glasswash	200 gsf/person	1.5 W/gsf	Note 2	-
Glasswash Equipment	-	1.5 W/gsf	Note 2	-
Darkroom	100 gsf/person	1.5 W/gsf	8 W/gsf	-
Cold Room	-	-	-	-
Equipment Space	100 gsf/person	1.5 W/gsf	40W/gsf	-
Animal Facility Spaces				
Animal Holding Rooms	Note 1	1.5 W/gsf	Note 2	-
Animal Procedure	Note 1	1.5 W/gsf	Note 2	-
Animal Hold Corridor	200 gsf/person	1.5 W/gsf	-	-
Animal Bedding / Feed	200 gsf/person	1.5 W/gsf	Note 2	-
Dirty Cagewash	200 gsf/person	1.5 W/gsf	Note 2	-
Clean Cagewash	200 gsf/person	1.5 W/gsf	Note 2	-
Sterile Cagewash	200 gsf/person	1.5 W/gsf	Note 2	-
Animal Corridor	200 gsf/person	1.5 W/gsf	0.5 W/gsf	-
Animal Gown	100 gsf/person	1.5 W/gsf	0.5 W/gsf	-
Specialty Spaces				
Specialty Lab	100 gsf/person	1.5 W/gsf	8 W/gsf	
Miscellaneous Spaces				
Mech. / Elec. Rooms	-	-	-	Note 3
Tel/Data Rooms	-	1.5 W/gsf	Note 5	-
Elevator Machine Rooms	-	1.5 W/gsf	Note 2	-
Receiving/Storage	200 gsf/person	1.5 W/gsf	1.5 W/gsf	-
General Storage	200 gsf/person	1.5 W/gsf	1.5 W/gsf	-

Space Type	People Load	Lighting Load	Equipment Load	Remarks
Hazardous Storage	-	-	-	Note 4
Waste Storage	-	-	-	Note 4
Toilet / Locker Rooms	-	-	-	Note 4
Housekeeping Closets	-	-	-	Note 4

Note 1: People (animal) loads are based on actual count of people (animals).
Note 2: Equipment loads are based on actual equipment heat gains as published by the manufacturer.
Note 3: Space loads are based on estimated equipment heat gain.
Note 4: Exhaust requirements dictate air flow quantity (minimal cooling load).
Note 5: Tel/Data MDF and Server Room equipment load = 35,000 btu/hr. IDF Room equipment load = 20,000 btu/hr.

D. Acoustical Criteria

1. Private Offices: NC 35
2. Open Offices: NC 40
3. Public Areas and Corridors: NC 40
4. Conference Rooms: NC 35
5. Conference Center: NC 30
6. Research Laboratories: NC 55
7. Animal Holding Spaces: NC 45
8. Animal Procedure Spaces: NC 45

1.4 HEAT GENERATION (STEAM AND CONDENSATE) SYSTEMS DESCRIPTION

A. The primary source for building heat and humidification (via clean steam generation) will be the existing TECO high pressure steam system. Steam will be used for building heat (preheat, reheat, envelope), domestic water heaters, humidification and process equipment (sterilizers, glasswashers).

B. Connections to the existing TECO high pressure steam (225 psig; 398°F) distribution network will be within the TMF basement mechanical room. The projected peak connected steam load is estimated at 22,000 lbs./hr. The incoming services will be sized for a total diversified steam load of 17,600 lbs./hr. (approximately 80% of connected).

C. Consumption of high pressure steam will be metered by TECO.

April 11, 2005

Baylor College of Medicine
TMF Tower
Houston, Texas

CSI Breakdown

	Value	Cost/GSF
Allowances	$ 1,082,000	$ 5.38
Other Allowances in Specific CSI Division		
Sitework	$ 952,878	$ 4.74
Concrete	$ 1,509,247	$ 7.50
Masonry	$ 1,005,836	$ 5.00
Metals	$ 7,769,209	$ 38.63
Wood and Plastics	$ 330,186	$ 1.64
Thermal and Moisture Protection	$ 988,812	$ 4.92
Doors and Windows	$ 7,226,391	$ 35.93
Finishes	$ 4,994,096	$ 24.83
Specialties	$ 685,039	$ 3.41
Equipment	$ 182,541	$ 0.91
Furnishings	$ 250,695	$ 1.25
Conveying Systems	$ 1,074,775	$ 5.34
Mechanical	$ 21,114,878	$ 104.98
Electrical	$ 7,282,689	$ 36.21
Subtotal Cost of Work	$ 56,449,273	$ 280.66
Design Contingency on Cost of Work - 4%	$ 2,257,971	$ 11.23
CM Contingency on Cost of Work - 4%	$ 2,257,971	$ 11.23
Subtotal	$ 60,965,214	$ 303.11
CM General Conditions	$ 3,903,937	$ 19.62
Subtotal	$ 64,869,151	$ 322.53
CM Construction Phase Fee	$ 2,270,420	$ 11.29
Subtotal	$ 67,139,572	$ 333.81
Equipment List Budget	$ -	$ -
Subtotal	$ 67,139,572	$ 333.81
Laboratory Casework and Fume Hoods	$ -	$ -
Subtotal	$ 67,139,572	$ 333.81
FFE Equipment Budget	$0	$ -
TOTAL CDR Estimate	**$ 67,139,572**	**$ 333.81**

Air System Sizing Summary for AHU-A.1a, A.1b, A.1c & A.1d

Project Name: Baylor College Of Medicine — 10/31/2005
Prepared by: psuae — 03:37AM

Air System Information

Air System Name	**AHU-A.1a, A.1b, A.1c & A.1d**		Number of zones	**8**
Equipment Class	**CW AHU**		Floor Area	**31696.0** ft²
Air System Type	**VAV**		Location	**Houston, Texas**

Sizing Calculation Information

Zone and Space Sizing Method:

Zone CFM	**Sum of space airflow rates**		Calculation Months	**Jan to Dec**
Space CFM	**Individual peak space loads**		Sizing Data	**Calculated**

Central Cooling Coil Sizing Data

Total coil load	**272.9**	Tons	Load occurs at	**Aug 1500**	
Total coil load	**3275.1**	MBH	OA DB / WB	**96.0 / 77.0**	°F
Sensible coil load	**1847.2**	MBH	Entering DB / WB	**96.0 / 77.0**	°F
Coil CFM at Aug 1500	**40949**	CFM	Leaving DB / WB	**54.1 / 53.0**	°F
Max block CFM at Sep 1500	**71404**	CFM	Coil ADP	**49.4**	°F
Sum of peak zone CFM	**72646**	CFM	Bypass Factor	**0.100**	
Sensible heat ratio	**0.564**		Resulting RH	**39**	%
ft²/Ton	**116.1**		Design supply temp.	**55.0**	°F
BTU/(hr-ft²)	**103.3**		Zone T-stat Check	**8 of 8**	OK
Water flow @ 15.0 °F rise	**436.92**	gpm	Max zone temperature deviation	**0.0**	°F

Preheat Coil Sizing Data

Max coil load	**561.3**	MBH	Load occurs at	**Des Htg**	
Coil CFM at Des Htg	**22687**	CFM	Ent. DB / Lvg DB	**27.0 / 50.0**	°F
Max coil CFM	**71404**	CFM			
Water flow @ 30.0 °F drop	**37.44**	gpm			

Humidifier Sizing Data

Max steam flow at Des Htg	**249.49**	lb/hr	Air mass flow	**101692.30**	lb/hr
Airflow Rate	**22687**	CFM	Moisture gain	**.00245**	lb/lb

Supply Fan Sizing Data

Actual max CFM at Sep 1500	**71404**	CFM	Fan motor BHP	**49.90**	BHP
Standard CFM	**71125**	CFM	Fan motor kW	**37.21**	kW
Actual max CFM/ft²	**2.25**	CFM/ft²			

Outdoor Ventilation Air Data

Design airflow CFM	**65850**	CFM	CFM/person	**167.19**	CFM/person
CFM/ft²	**2.08**	CFM/ft²			

Zone Sizing Summary for AHU-A.1a, A.1b, A.1c & A.1d

Project Name: Baylor College Of Medicine
Prepared by: psuae

10/31/2005
03:37AM

Air System Information

Air System Name ..... **AHU-A.1a, A.1b, A.1c & A.1d**
Equipment Class ..... **CW AHU**
Air System Type ..... **VAV**

Number of zones **8**
Floor Area ..... **31696.0** ft²
Location ..... **Houston, Texas**

Sizing Calculation Information

Zone and Space Sizing Method:

Zone CFM ..... **Sum of space airflow rates**
Space CFM ..... **Individual peak space loads**

Calculation Months ..... **Jan to Dec**
Sizing Data ..... **Calculated**

Zone Sizing Data

Zone Name	Maximum Cooling Sensible (MBH)	Design Air Flow (CFM)	Minimum Air Flow (CFM)	Time of Peak Load	Maximum Heating Load (MBH)	Zone Floor Area (ft²)	Zone CFM/ft²
Zone 1	135.6	15265	3335	Jun 1700	15.6	8315.0	1.84
Zone 2	398.6	16110	8055	Jan 2000	0.0	6030.0	2.67
Zone 3	19.8	919	459	Jan 2000	0.0	80.0	11.48
Zone 4	22.5	696	348	Jan 2000	0.0	275.0	2.53
Zone 5	374.4	37825	9573	Oct 1500	45.2	16231.0	2.33
Zone 6	5.8	236	118	Jan 2000	0.0	550.0	0.43
Zone 7	21.0	976	488	Jan 2000	0.0	85.0	11.48
Zone 8	20.0	619	310	Jan 2000	0.0	130.0	4.76

Zone Terminal Sizing Data

Zone Name	Reheat Coil Load (MBH)	Reheat Coil Water gpm @ 30.0 °F	Zone Htg Coil Load (MBH)	Zone Htg Water gpm @ 30.0 °F	Mixing Box Fan Airflow (CFM)
Zone 1	61.0	4.07	15.6	1.04	0
Zone 2	147.3	9.83	0.0	0.00	0
Zone 3	8.4	0.56	0.0	0.00	0
Zone 4	3.7	0.25	0.0	0.00	0
Zone 5	175.1	11.68	45.2	3.02	0
Zone 6	2.2	0.14	0.0	0.00	0
Zone 7	8.9	0.60	0.0	0.00	0
Zone 8	3.3	0.22	0.0	0.00	0

Space Loads and Airflows

Zone Name / Space Name	Mult.	Cooling Sensible (MBH)	Time of Load	Air Flow (CFM)	Heating Load (MBH)	Floor Area (ft²)	Space CFM/ft²
Zone 1							
Level 1: AHR 126A,D	2	3.4	Jan 2000	370	0.0	115.0	3.22
Level 1: AHR 126B,C	2	3.6	Jan 2000	394	0.0	125.0	3.15
Level 1: AHR 126F,H,J	2	18.9	Jan 2000	2069	0.0	750.0	2.76
Level 1: AHR 126G	1	3.8	Jan 2000	417	0.0	135.0	3.09
Level 1: AHR 126K	1	3.1	Jan 2000	334	0.0	100.0	3.34
Level 1: Proc 126JA,HA	1	4.3	Jan 2000	474	0.0	130.0	3.65
Level 1: Proc. 126FA	1	5.2	Jan 2000	572	0.0	160.0	3.58
Level 1: Corridor	1	0.7	Jan 2000	76	0.0	90.0	0.84
Level 1: Corridor R102	1	5.9	Jun 1700	643	5.2	125.0	5.15
Level 1: Corridor R1C2	1	8.9	Jun 1700	972	5.2	520.0	1.87
Level 1: Corridor/Janito	1	6.1	Jan 2000	672	0.0	800.0	0.84
Level 1: Break/Training	1	15.9	Jun 1700	1737	5.2	535.0	3.25
Level 1: Fire Command	1	4.0	Jan 2000	439	0.0	195.0	2.25
Level 1: Meeting	1	1.8	Jan 2000	192	0.0	85.0	2.26

Zone Sizing Summary for AHU-A.1a, A.1b, A.1c & A.1d

Project Name: Baylor College Of Medicine
Prepared by: psuae

10/31/2005
03:37AM

Zone Name / Space Name	Mult.	Cooling Sensible (MBH)	Time of Load	Air Flow (CFM)	Heating Load (MBH)	Floor Area (ft²)	Space CFM/ft²
Level 1: Men's R102(1)	1	0.0	Jan 0000	170	0.0	340.0	0.50
Level 1: Office R104B	1	1.7	Jan 2000	191	0.0	85.0	2.25
Level 1: Office R106	1	1.5	Jan 2000	169	0.0	75.0	2.25
Level 1: Office R108	1	1.5	Jan 2000	169	0.0	75.0	2.25
Level 1: Pass Through	1	1.1	Jan 2000	122	0.0	145.0	0.84
Level 1: R1C3 + R114	1	11.6	Jan 2000	1268	0.0	1510.0	0.84
Level 1: Staging	1	1.1	Jan 2000	122	0.0	145.0	0.84
Level 1: Ster. Pass Thro	1	1.2	Jan 2000	134	0.0	160.0	0.84
Level 1: Sterile R1C5	1	1.3	Jan 2000	139	0.0	165.0	0.84
Level 1: Vest + Corridor	1	1.2	Jan 2000	126	0.0	150.0	0.84
Level 1: Vestibule R126	1	0.8	Jan 2000	92	0.0	110.0	0.84
Level 1: Women's R102B	1	0.0	Jan 0000	170	0.0	340.0	0.50
Level 1: Feed Stor R134	1	1.8	Jan 2000	196	0.0	160.0	1.23
Zone 2							
Level 1: Clean Cage	1	124.3	Jan 2000	5024	0.0	1400.0	3.59
Level 1: Dirty Cage	1	124.3	Jan 2000	5024	0.0	1400.0	3.59
Level 1: Gown R128	1	1.5	Jan 2000	60	0.0	165.0	0.36
Level 1: Robotic Transit	1	30.6	Jan 2000	1238	0.0	345.0	3.59
Level 1: Sterile Cage	1	99.9	Jan 2000	4037	0.0	1125.0	3.59
Level 1: Sterile R1C5	1	1.3	Jan 2000	51	0.0	165.0	0.31
Level 1: Ster. Pass Thro	1	1.2	Jan 2000	50	0.0	160.0	0.31
Level 1: Decon Storage	1	5.6	Jan 2000	226	0.0	500.0	0.45
Level 1: Domestic Pump	1	1.6	Jan 2000	66	0.0	145.0	0.45
Level 1: Elev Mach Rm	1	2.6	Jan 2000	105	0.0	120.0	0.87
Level 1: Fire Pump	1	1.3	Jan 2000	52	0.0	115.0	0.45
Level 1: Storage R116	1	2.0	Jan 2000	79	0.0	175.0	0.45
Level 1: Storage R124	1	1.3	Jan 2000	52	0.0	115.0	0.45
Level 1: Storage R130	1	1.1	Jan 2000	45	0.0	100.0	0.45
Zone 3							
Level 1: IDF	1	19.8	Jan 2000	919	0.0	80.0	11.48
Zone 4							
Level 1: Electrical	1	19.2	Jan 2000	595	0.0	125.0	4.76
Level 1: Mechanical	1	3.2	Jan 2000	101	0.0	150.0	0.67
Zone 5							
Level 2: AHR R203	1	14.8	Jan 2000	1431	0.0	540.0	2.65
Level 2: AHR R204,8,10	3	22.4	Jul 1700	2160	2.6	655.0	3.30
Level 2: AHR R207	1	10.3	Jan 2000	992	0.0	330.0	3.01
Level 2: AHR R209	1	15.5	Jan 2000	1494	0.0	570.0	2.62
Level 2: AHR R223	1	17.2	Jan 2000	1661	0.0	650.0	2.56
Level 2: AHR R224	1	17.2	Jan 2000	1661	0.0	650.0	2.56
Level 2: AHR R227	1	17.3	Jan 2000	1672	0.0	655.0	2.55
Level 2: AHR R228	1	19.4	Jan 2000	1870	0.0	750.0	2.49
Level 2: AHR R229	1	17.3	Jan 2000	1672	0.0	655.0	2.55
Level 2: AHR R230	1	17.3	Jan 2000	1672	0.0	655.0	2.55
Level 2: AHR R234	1	15.1	Jan 2000	1462	0.0	555.0	2.64
Level 2: AHR R238	1	14.9	Jan 2000	1444	0.0	546.0	2.64
Level 2: AHR R240	1	19.1	Jan 2000	1849	0.0	740.0	2.50
Level 2: Corridor R2C2	1	6.9	Jan 2000	668	0.0	900.0	0.74
Level 2: Corridor R2C4	1	4.8	Jan 2000	467	0.0	630.0	0.74
Level 2: Corridor R2C5	1	12.3	Nov 1400	1188	4.4	475.0	2.50
Level 2: Corridor R2C6	1	4.8	Jan 2000	464	0.0	625.0	0.74
Level 2: Dirty Staging	1	2.1	Jan 2000	204	0.0	275.0	0.74
Level 2: Elevator Lobby	1	2.4	Jan 2000	234	0.0	315.0	0.74
Level 2: Proc R204A	1	5.3	Jul 1700	513	0.9	135.0	3.80
Level 2: Proc R204B	1	3.8	Jan 2000	369	0.0	135.0	2.73
Level 2: Proc R208A	1	4.9	Jul 1700	472	0.9	115.0	4.10
Level 2: Feed Storage	1	1.1	Jan 2000	108	0.0	100.0	1.08

Zone Sizing Summary for AHU-A.1a, A.1b, A.1c & A.1d

Project Name: Baylor College Of Medicine 10/31/2005
Prepared by: psuae 03:37AM

Zone Name / Space Name	Mult.	Cooling Sensible (MBH)	Time of Load	Air Flow (CFM)	Heating Load (MBH)	Floor Area (ft^2)	Space CFM/ft^2
Level 2: R203A,3B,9A,9B	4	3.2	Jan 2000	306	0.0	105.0	2.91
Level 2: R2C1+R200,etc	1	21.8	Jun 1700	2108	13.9	1150.0	1.83
Level 2: R2C5+R211+etc	1	38.0	Nov 1400	3672	17.3	650.0	5.65
Level 2: Vest + Ster	1	5.0	Jan 2000	482	0.0	650.0	0.74
Level 2: Vestibule	1	3.0	Jan 2000	293	0.0	395.0	0.74
Zone 6							
Level 2: Gown R237	1	1.3	Jan 2000	53	0.0	145.0	0.36
Level 2: Storage	1	1.2	Jan 2000	48	0.0	105.0	0.45
Level 2: Storage + Irrad	1	3.4	Jan 2000	136	0.0	300.0	0.45
Zone 7							
Level 2: IDF	1	21.0	Jan 2000	976	0.0	85.0	11.48
Zone 8							
Level 2: Electrical	1	20.0	Jan 2000	619	0.0	130.0	4.76

Air System Design Load Summary for AHU-A.1a, A.1b, A.1c & A.1d

Project Name: Baylor College Of Medicine 10/31/2005
Prepared by: psuae 03:37AM

	DESIGN COOLING			DESIGN HEATING		
	COOLING DATA AT Aug 1500 COOLING OA DB / WB 96.0 °F / 77.0 °F			HEATING DATA AT DES HTG HEATING OA DB / WB 27.0 °F / 22.7 °F		
ZONE LOADS	Details	Sensible (BTU/hr)	Latent (BTU/hr)	Details	Sensible (BTU/hr)	Latent (BTU/hr)
Window & Skylight Solar Loads	3160 ft²	38224	-	3160 ft²	-	-
Wall Transmission	1200 ft²	2421	-	1200 ft²	5398	-
Roof Transmission	0 ft²	0	-	0 ft²	0	-
Window Transmission	3160 ft²	22976	-	3160 ft²	55458	-
Skylight Transmission	0 ft²	0	-	0 ft²	0	-
Door Loads	0 ft²	0	-	0 ft²	0	-
Floor Transmission	0 ft²	0	-	0 ft²	0	-
Partitions	0 ft²	0	-	0 ft²	0	-
Ceiling	0 ft²	0	-	0 ft²	0	-
Overhead Lighting	50246 W	156450	-	0	0	-
Task Lighting	0 W	0	-	0	0	-
Electric Equipment	206236 W	675945	-	0	0	-
People	394	85849	80742	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	**-**	**981865**	**80742**	**-**	**60856**	**0**
Zone Conditioning	-	977252	80742	-	46870	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	4409 CFM	0	-	1723 CFM	0	-
Ventilation Load	40949 CFM	828898	1347173	22687 CFM	1003135	263163
Supply Fan Load	40949 CFM	41072	-	22687 CFM	-17856	-
Space Fan Coil Fans	-	0	-	-	0	-
Duct Heat Gain / Loss	0%	0	-	0%	0	-
>> Total System Loads	**-**	**1847222**	**1427915**	**-**	**1032150**	**263163**
Central Cooling Coil	-	1847222	1427915	-	0	0
Preheat Coil	-	0	-	-	561341	-
Humidification Load	-	-	0	-	-	263163
Terminal Reheat Coils	-	0	-	-	409953	-
Zone Heating Unit Coils	-	0	-	-	60856	-
>> Total Conditioning	**-**	**1847222**	**1427915**	**-**	**1032150**	**263163**
Key:	**Positive values are clg loads Negative values are htg loads**			**Positive values are htg loads Negative values are clg loads**		

Air System Sizing Summary for AHU-L.1a & L.1b

Project Name: Baylor College Of Medicine — 10/31/2005
Prepared by: psuae — 04:14AM

Air System Information

Air System Name	**AHU-L.1a & L.1b**		Number of zones	**2**	
Equipment Class	**CW AHU**		Floor Area	**56220.0**	ft²
Air System Type	**VAV**		Location	**Houston, Texas**	

Sizing Calculation Information

Zone and Space Sizing Method:

Zone CFM	**Peak zone sensible load**		Calculation Months	**Jan to Dec**	
Space CFM	**Individual peak space loads**		Sizing Data	**Calculated**	

Central Cooling Coil Sizing Data

Total coil load	**360.1**	Tons	Load occurs at	**Aug 1500**	
Total coil load	**4321.2**	MBH	OA DB / WB	**96.0 / 77.0**	°F
Sensible coil load	**2664.8**	MBH	Entering DB / WB	**88.7 / 72.0**	°F
Coil CFM at Aug 1500	**70776**	CFM	Leaving DB / WB	**53.7 / 52.5**	°F
Max block CFM at Sep 1600	**89983**	CFM	Coil ADP	**49.8**	°F
Sum of peak zone CFM	**90695**	CFM	Bypass Factor	**0.100**	
Sensible heat ratio	**0.617**		Resulting RH	**45**	%
ft²/Ton	**156.1**		Design supply temp.	**55.0**	°F
BTU/(hr-ft²)	**76.9**		Zone T-stat Check	**2 of 2**	OK
Water flow @ 15.0 °F rise	**576.47**	gpm	Max zone temperature deviation	**0.0**	°F

Preheat Coil Sizing Data

Max coil load	**1003.0**	MBH	Load occurs at	**Des Htg**	
Coil CFM at Des Htg	**45348**	CFM	Ent. DB / Lvg DB	**29.4 / 50.0**	°F
Max coil CFM	**89983**	CFM			
Water flow @ 30.0 °F drop	**66.90**	gpm			

Humidifier Sizing Data

Max steam flow at Des Htg	**576.59**	lb/hr	Air mass flow	**203269.20**	lb/hr
Airflow Rate	**45348**	CFM	Moisture gain	**.00284**	lb/lb

Supply Fan Sizing Data

Actual max CFM at Sep 1600	**89983**	CFM	Fan motor BHP	**49.90**	BHP
Standard CFM	**89632**	CFM	Fan motor kW	**37.21**	kW
Actual max CFM/ft²	**1.60**	CFM/ft²			

Outdoor Ventilation Air Data

Design airflow CFM	**56950**	CFM	CFM/person	**71.74**	CFM/person
CFM/ft²	**1.01**	CFM/ft²			

Zone Sizing Summary for AHU-L.1a & L.1b

Project Name: Baylor College Of Medicine
Prepared by: psuae

10/31/2005
04:14AM

Air System Information

Air System Name ..... **AHU-L.1a & L.1b**
Equipment Class ..... **CW AHU**
Air System Type ..... **VAV**

Number of zones **2**
Floor Area ..... **56220.0** ft²
Location ..... **Houston, Texas**

Sizing Calculation Information

Zone and Space Sizing Method:

Zone CFM ..... **Peak zone sensible load**
Space CFM ..... **Individual peak space loads**

Calculation Months ..... **Jan to Dec**
Sizing Data ..... **Calculated**

Zone Sizing Data

Zone Name	Maximum Cooling Sensible (MBH)	Design Air Flow (CFM)	Minimum Air Flow (CFM)	Time of Peak Load	Maximum Heating Load (MBH)	Zone Floor Area (ft²)	Zone CFM/ft²
Zone 1	704.1	34445	17223	Jul 1700	144.8	34795.0	0.99
Zone 2	919.0	56250	28125	Oct 1400	47.7	21425.0	2.63

Zone Terminal Sizing Data

Zone Name	Reheat Coil Load (MBH)	Reheat Coil Water gpm @ 30.0 °F	Zone Htg Coil Load (MBH)	Zone Htg Water gpm @ 30.0 °F	Mixing Box Fan Airflow (CFM)
Zone 1	315.0	21.01	144.8	9.66	0
Zone 2	514.4	34.31	47.7	3.18	0

Space Loads and Airflows

Zone Name / Space Name	Mult.	Cooling Sensible (MBH)	Time of Load	Air Flow (CFM)	Heating Load (MBH)	Floor Area (ft²)	Space CFM/ft²
Zone 1							
Lev 4-8: Off R402-404	5	11.3	Jun 1700	554	3.9	385.0	1.44
Lev 4-8: Off R411-413	5	14.5	Jul 1700	708	3.9	350.0	2.02
Lev 4-8: Off R415-417	5	14.7	Nov 1400	722	3.8	345.0	2.09
Lev 4-8: Office (S4)	5	19.6	Jul 1700	959	5.3	460.0	2.08
Lev 4-8: Meeting (S1)	5	10.8	Jun 1700	526	3.9	230.0	2.29
Lev 4-8: Meeting R414	5	11.1	Sep 1600	542	3.9	230.0	2.36
Lev 4-8: Elev Lobby	5	12.4	Jan 2000	606	0.0	1615.0	0.38
Lev 4-8: Break Area	5	16.2	Jan 2000	793	0.0	785.0	1.01
Lev 4-8: Bathroom	5	6.6	Jan 2000	323	0.0	320.0	1.01
Lev 4-8: Conference	5	12.9	Jan 2000	631	0.0	625.0	1.01
Lev 4-8: Corridor R4C7	5	5.8	Jan 2000	282	0.0	750.0	0.38
Lev 4-8: Corridor R4C6	5	4.9	Jan 2000	240	0.0	640.0	0.38
Level 1: Lobby/Elevetor	1	12.7	Jun 1700	622	7.0	575.0	1.08
Level 1: Corridor R1C1	1	17.6	Jun 1700	860	14.2	545.0	1.58
Zone 2							
Lev 4-8: Lab W R430.L	5	29.6	Nov 1400	1449	4.8	585.0	2.48
Lev 4-8: Lab W R431.L	5	33.9	Jan 2000	1661	0.0	1005.0	1.65
Lev 4-8: Lab W R450.L	5	24.2	Jun 1700	1182	4.8	585.0	2.02
Lev 4-8: Lab W R451.L	5	33.9	Jan 2000	1661	0.0	1005.0	1.65
Lev 4-8: Fume Hood (S14)	5	8.1	Jan 2000	398	0.0	135.0	2.94
Lev 4-8: Fume Hood (S15)	5	8.1	Jan 2000	398	0.0	135.0	2.94
Lev 4-8: Lab S (S13)	5	8.4	Jan 2000	412	0.0	140.0	2.94
Lev 4-8: Lab S (S16)	5	8.4	Jan 2000	412	0.0	140.0	2.94
Lev 4-8: Equip (S17)	5	17.2	Jan 2000	839	0.0	285.0	2.94
Lev 4-8: Tis Cul R439	5	8.1	Jan 2000	398	0.0	135.0	2.94
Lev 4-8: Tis Cul R457	5	8.1	Jan 2000	398	0.0	135.0	2.94

Zone Sizing Summary for AHU-L.1a & L.1b

Project Name: Baylor College Of Medicine 10/31/2005
Prepared by: psuae 04:14AM

Air System Design Load Summary for AHU-L.1a & L.1b

Project Name: Baylor College Of Medicine
Prepared by: psuae

10/31/2005
04:14AM

	DESIGN COOLING			DESIGN HEATING		
	COOLING DATA AT Aug 1500 COOLING OA DB / WB 96.0 °F / 77.0 °F			HEATING DATA AT DES HTG HEATING OA DB / WB 27.0 °F / 22.7 °F		
ZONE LOADS	**Details**	**Sensible (BTU/hr)**	**Latent (BTU/hr)**	**Details**	**Sensible (BTU/hr)**	**Latent (BTU/hr)**
Window & Skylight Solar Loads	10168 ft²	156084	-	10168 ft²	-	-
Wall Transmission	3120 ft²	6419	-	3120 ft²	14036	-
Roof Transmission	0 ft²	0	-	0 ft²	0	-
Window Transmission	10168 ft²	73930	-	10168 ft²	178448	-
Skylight Transmission	0 ft²	0	-	0 ft²	0	-
Door Loads	0 ft²	0	-	0 ft²	0	-
Floor Transmission	0 ft²	0	-	0 ft²	0	-
Partitions	0 ft²	0	-	0 ft²	0	-
Ceiling	0 ft²	0	-	0 ft²	0	-
Overhead Lighting	91076 W	283583	-	0	0	-
Task Lighting	0 W	0	-	0	0	-
Electric Equipment	276373 W	905821	-	0	0	-
People	794	173028	162735	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	**-**	**1598865**	**162735**	**-**	**192484**	**0**
Zone Conditioning	-	1568863	162735	-	172282	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	28705 CFM	0	-	16523 CFM	0	-
Ventilation Load	44794 CFM	994653	1493649	42713 CFM	1919798	608184
Supply Fan Load	70776 CFM	101306	-	45348 CFM	-68914	-
Space Fan Coil Fans	-	0	-	-	0	-
Duct Heat Gain / Loss	0%	0	-	0%	0	-
>> Total System Loads	**-**	**2664822**	**1656384**	**-**	**2023166**	**608184**
Central Cooling Coil	-	2664823	1656387	-	0	0
Preheat Coil	-	0	-	-	1002952	-
Humidification Load	-	-	0	-	-	608184
Terminal Reheat Coils	-	0	-	-	829338	-
Zone Heating Unit Coils	-	0	-	-	190875	-
>> Total Conditioning	**-**	**2664823**	**1656387**	**-**	**2023166**	**608184**
Key:	**Positive values are clg loads Negative values are htg loads**			**Positive values are htg loads Negative values are clg loads**		

Air System Sizing Summary for AHU-L.2a & L.2b

Project Name: Baylor College Of Medicine — 10/31/2005
Prepared by: psuae — 03:37AM

Air System Information

Air System Name	**AHU-L.2a & L.2b**		Number of zones	**3**	
Equipment Class	**CW AHU**		Floor Area	**43625.0**	ft²
Air System Type	**VAV**		Location	**Houston, Texas**	

Sizing Calculation Information

Zone and Space Sizing Method:

Zone CFM	**Peak zone sensible load**		Calculation Months	**Jan to Dec**	
Space CFM	**Individual peak space loads**		Sizing Data	**Calculated**	

Central Cooling Coil Sizing Data

Total coil load	**239.2**	Tons	Load occurs at	**Aug 1500**	
Total coil load	**2870.8**	MBH	OA DB / WB	**96.0 / 77.0**	°F
Sensible coil load	**2160.2**	MBH	Entering DB / WB	**82.0 / 66.2**	°F
Coil CFM at Aug 1500	**70477**	CFM	Leaving DB / WB	**53.5 / 52.2**	°F
Max block CFM at Oct 1500	**81964**	CFM	Coil ADP	**50.4**	°F
Sum of peak zone CFM	**82043**	CFM	Bypass Factor	**0.100**	
Sensible heat ratio	**0.752**		Resulting RH	**41**	%
ft²/Ton	**182.4**		Design supply temp.	**55.0**	°F
BTU/(hr-ft²)	**65.8**		Zone T-stat Check	**3 of 3**	OK
Water flow @ 15.0 °F rise	**382.98**	gpm	Max zone temperature deviation	**0.0**	°F

Preheat Coil Sizing Data

Max coil load	**20.3**	MBH	Load occurs at	**Des Htg**	
Coil CFM at Des Htg	**820**	CFM	Ent. DB / Lvg DB	**27.0 / 50.0**	°F
Max coil CFM	**81964**	CFM			
Water flow @ 30.0 °F drop	**1.35**	gpm			

Humidifier Sizing Data

Max steam flow at Des Htg	**9.21**	lb/hr	Air mass flow	**3677.56**	lb/hr
Airflow Rate	**820**	CFM	Moisture gain	**.00251**	lb/lb

Supply Fan Sizing Data

Actual max CFM at Oct 1500	**81964**	CFM	Fan motor BHP	**49.90**	BHP
Standard CFM	**81644**	CFM	Fan motor kW	**37.21**	kW
Actual max CFM/ft²	**1.88**	CFM/ft²			

Outdoor Ventilation Air Data

Design airflow CFM	**18000**	CFM	CFM/person	**48.23**	CFM/person
CFM/ft²	**0.41**	CFM/ft²			

Zone Sizing Summary for AHU-L.2a & L.2b

Project Name: Baylor College Of Medicine
Prepared by: psuae

10/31/2005
03:37AM

Air System Information

Air System Name ..... **AHU-L.2a & L.2b**
Equipment Class ..... **CW AHU**
Air System Type ..... **VAV**

Number of zones **3**
Floor Area ..... **43625.0** ft²
Location ..... **Houston, Texas**

Sizing Calculation Information

Zone and Space Sizing Method:

Zone CFM ..... **Peak zone sensible load**
Space CFM ..... **Individual peak space loads**

Calculation Months ..... **Jan to Dec**
Sizing Data ..... **Calculated**

Zone Sizing Data

Zone Name	Maximum Cooling Sensible (MBH)	Design Air Flow (CFM)	Minimum Air Flow (CFM)	Time of Peak Load	Maximum Heating Load (MBH)	Zone Floor Area (ft²)	Zone CFM/ft²
Zone 1	1499.2	73347	733	Oct 1400	72.9	42400.0	1.73
Zone 2	115.4	5362	54	Jan 2000	0.0	525.0	10.21
Zone 3	107.6	3334	33	Jan 2000	0.0	700.0	4.76

Zone Terminal Sizing Data

Zone Name	Reheat Coil Load (MBH)	Reheat Coil Water gpm @ 30.0 °F	Zone Htg Coil Load (MBH)	Zone Htg Water gpm @ 30.0 °F	Mixing Box Fan Airflow (CFM)
Zone 1	0.0	0.00	72.9	4.86	0
Zone 2	0.0	0.00	0.0	0.00	0
Zone 3	0.0	0.00	0.0	0.00	0

Space Loads and Airflows

Zone Name / Space Name	Mult.	Cooling Sensible (MBH)	Time of Load	Air Flow (CFM)	Heating Load (MBH)	Floor Area (ft²)	Space CFM/ft²
Zone 1							
Lev 4-8: Chem Storage	5	1.5	Jan 2000	71	0.0	130.0	0.55
Lev 4-8: Corr R4C2	5	2.9	Jan 2000	141	0.0	375.0	0.38
Lev 4-8: Corr R4C3	5	4.9	Jan 2000	238	0.0	635.0	0.38
Lev 4-8: Corr R4C5	5	4.4	Jan 2000	216	0.0	575.0	0.38
Lev 4-8: Dark Room	5	9.9	Jan 2000	486	0.0	165.0	2.94
Lev 4-8: Equip (S34)	5	17.2	Jan 2000	839	0.0	285.0	2.94
Lev 4-8: Fume Hood (S37)	5	8.1	Jan 2000	398	0.0	135.0	2.94
Lev 4-8: Fume Hood (S38)	5	8.1	Jan 2000	398	0.0	135.0	2.94
Lev 4-8: Lab	5	11.3	Jan 2000	554	0.0	335.0	1.65
Lev 4-8: Lab W R430.M	5	14.7	Nov 1400	717	2.5	290.0	2.47
Lev 4-8: Lab W R430.R	5	29.6	Nov 1400	1449	4.8	585.0	2.48
Lev 4-8: Lab W R431.M	5	17.4	Jan 2000	851	0.0	515.0	1.65
Lev 4-8: Lab W R431.R	5	33.9	Jan 2000	1661	0.0	1005.0	1.65
Lev 4-8: Lab W R450.M	5	12.0	Jun 1700	588	2.5	290.0	2.03
Lev 4-8: Lab W R450.R	5	24.2	Jun 1700	1182	4.8	585.0	2.02
Lev 4-8: Lab W R451.M	5	17.4	Jan 2000	851	0.0	515.0	1.65
Lev 4-8: Lab W R451.R	5	33.9	Jan 2000	1661	0.0	1005.0	1.65
Lev 4-8: Microscopy S21	5	3.0	Jan 2000	147	0.0	50.0	2.94
Lev 4-8: Microscopy S28	5	3.0	Jan 2000	147	0.0	50.0	2.94
Lev 4-8: Microscopy S40	5	3.0	Jan 2000	147	0.0	50.0	2.94
Lev 4-8: Microscopy S41	5	3.0	Jan 2000	147	0.0	50.0	2.94
Lev 4-8: Tis Cul R454	5	8.1	Jan 2000	398	0.0	135.0	2.94
Lev 4-8: Tis Cul R439	5	8.1	Jan 2000	398	0.0	135.0	2.94
Lev 4-8: Lab S (S20)	5	13.5	Jan 2000	663	0.0	225.0	2.94

Zone Sizing Summary for AHU-L.2a & L.2b

Project Name: Baylor College Of Medicine
Prepared by: psuae

10/31/2005
03:37AM

Zone Name / Space Name	Mult.	Cooling Sensible (MBH)	Time of Load	Air Flow (CFM)	Heating Load (MBH)	Floor Area (ft^2)	Space CFM/ft^2
Lev 4-8: Lab S (S31)	5	13.5	Jan 2000	663	0.0	225.0	2.94
Zone 2							
Lev 4-8: IDF	5	23.1	Jan 2000	1072	0.0	105.0	10.21
Zone 3							
Lev 4-8: Electrical	5	21.5	Jan 2000	667	0.0	140.0	4.76

Air System Design Load Summary for AHU-L.2a & L.2b

Project Name: Baylor College Of Medicine
Prepared by: psuae

10/31/2005
03:37AM

	DESIGN COOLING			DESIGN HEATING		
	COOLING DATA AT Aug 1500 COOLING OA DB / WB 96.0 °F / 77.0 °F			HEATING DATA AT DES HTG HEATING OA DB / WB 27.0 °F / 22.7 °F		
ZONE LOADS	**Details**	**Sensible (BTU/hr)**	**Latent (BTU/hr)**	**Details**	**Sensible (BTU/hr)**	**Latent (BTU/hr)**
Window & Skylight Solar Loads	3920 ft²	37869	-	3920 ft²	-	-
Wall Transmission	910 ft²	1713	-	910 ft²	4094	-
Roof Transmission	0 ft²	0	-	0 ft²	0	-
Window Transmission	3920 ft²	28502	-	3920 ft²	68796	-
Skylight Transmission	0 ft²	0	-	0 ft²	0	-
Door Loads	0 ft²	0	-	0 ft²	0	-
Floor Transmission	0 ft²	0	-	0 ft²	0	-
Partitions	0 ft²	0	-	0 ft²	0	-
Ceiling	0 ft²	0	-	0 ft²	0	-
Overhead Lighting	70673 W	220052	-	0	0	-
Task Lighting	0 W	0	-	0	0	-
Electric Equipment	406763 W	1333179	-	0	0	-
People	373	81345	76506	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	**-**	**1702659**	**76506**	**-**	**72890**	**0**
Zone Conditioning	-	1672238	76506	-	50871	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	52477 CFM	0	-	87 CFM	0	-
Ventilation Load	18000 CFM	377512	634001	820 CFM	37064	9720
Supply Fan Load	70477 CFM	110442	-	820 CFM	-27426	-
Space Fan Coil Fans	-	0	-	-	0	-
Duct Heat Gain / Loss	0%	0	-	0%	0	-
>> Total System Loads	**-**	**2160192**	**710507**	**-**	**60510**	**9720**
Central Cooling Coil	-	2160192	710594	-	-23012	0
Preheat Coil	-	0	-	-	20300	-
Humidification Load	-	-	0	-	-	9720
Terminal Reheat Coils	-	0	-	-	0	-
Zone Heating Unit Coils	-	0	-	-	63222	-
>> Total Conditioning	**-**	**2160192**	**710594**	**-**	**60510**	**9720**
Key:	**Positive values are clg loads Negative values are htg loads**			**Positive values are htg loads Negative values are clg loads**		

Energy Budget by System Component - BCM Research Tower

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1. Annual Coil Loads

Component	Load (kBTU)	(kBTU/ft²)
Cooling Coil Loads	51,281,000	389.848
Heating Coil Loads	1,697,024	12.901
Grand Total	**52,978,024**	**402.749**

2. Energy Consumption by System Component

Component	Site Energy (kBTU)	Site Energy (kBTU/ft²)	Source Energy (kBTU)	Source Energy (kBTU/ft²)
Air System Fans	2,210,349	16.804	7,894,103	60.013
Cooling	8,788,251	66.810	31,386,612	238.607
Heating	1,697,024	12.901	1,697,024	12.901
Pumps	536,344	4.077	1,915,515	14.562
Cooling Towers	3,387,235	25.750	12,097,270	91.966
HVAC Sub-Total	**16,619,203**	**126.342**	**54,990,523**	**418.049**
Lights	6,336,376	48.170	22,629,912	172.037
Electric Equipment	26,582,176	202.083	94,936,352	721.724
Misc. Electric	0	0.000	0	0.000
Misc. Fuel Use	0	0.000	0	0.000
Non-HVAC Sub-Total	**32,918,552**	**250.253**	**117,566,264**	**893.761**
Grand Total	**49,537,755**	**376.596**	**172,556,787**	**1311.810**

Notes:

1. 'Cooling Coil Loads' is the sum of all air system cooling coil loads.
2. 'Heating Coil Loads' is the sum of all air system heating coil loads.
3. Site Energy is the actual energy consumed.
4. Source Energy is the site energy divided by the electric generating efficiency (28.0%).
5. Source Energy for fuels equals the site energy value.
6. Energy per unit floor area is based on the gross building floor area.
   Gross Floor Area ..... **131541.0** ft²
   Conditioned Floor Area ..... **131541.0** ft²

Energy Budget by Energy Source - BCM Research Tower

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1. Annual Coil Loads

Component	Load (kBTU)	(kBTU/ft²)
Cooling Coil Loads	51,281,000	389.848
Heating Coil Loads	1,697,024	12.901
Grand Total	**52,978,024**	**402.749**

2. Energy Consumption by Energy Source

Component	Site Energy (kBTU)	Site Energy (kBTU/ft²)	Source Energy (kBTU)	Source Energy (kBTU/ft²)
HVAC Components				
Electric	14,921,924	113.439	53,292,584	405.141
Natural Gas	0	0.000	0	0.000
Fuel Oil	0	0.000	0	0.000
Propane	0	0.000	0	0.000
Remote Hot Water	373,890	2.842	373,890	2.842
Remote Steam	1,323,135	10.059	1,323,135	10.059
Remote Chilled Water	0	0.000	0	0.000
HVAC Sub-Total	**16,618,948**	**126.340**	**54,989,608**	**418.042**
Non-HVAC Components				
Electric	32,919,014	250.257	117,567,888	893.774
Natural Gas	0	0.000	0	0.000
Fuel Oil	0	0.000	0	0.000
Propane	0	0.000	0	0.000
Remote Hot Water	0	0.000	0	0.000
Remote Steam	0	0.000	0	0.000
Non-HVAC Sub-Total	**32,919,014**	**250.257**	**117,567,888**	**893.774**
Grand Total	**49,537,962**	**376.597**	**172,557,496**	**1311.815**

Notes:

1. 'Cooling Coil Loads' is the sum of all air system cooling coil loads.
2. 'Heating Coil Loads' is the sum of all air system heating coil loads.
3. Site Energy is the actual energy consumed.
4. Source Energy is the site energy divided by the electric generating efficiency (28.0%).
5. Source Energy for fuels equals the site energy value.
6. Energy per unit floor area is based on the gross building floor area.

Gross Floor Area ..... **131541.0** ft²
Conditioned Floor Area ..... **131541.0** ft²

Table 1. Annual Costs

Component	BCM Research Tower ($)
Air System Fans	56,034
Cooling	222,787
Heating	0
Pumps	13,597
Cooling Tower Fans	85,868
HVAC Sub-Total	**378,285**
Lights	160,631
Electric Equipment	673,872
Misc. Electric	0
Misc. Fuel Use	0
Non-HVAC Sub-Total	**834,503**
Grand Total	**1,212,788**

Table 2. Annual Cost per Unit Floor Area

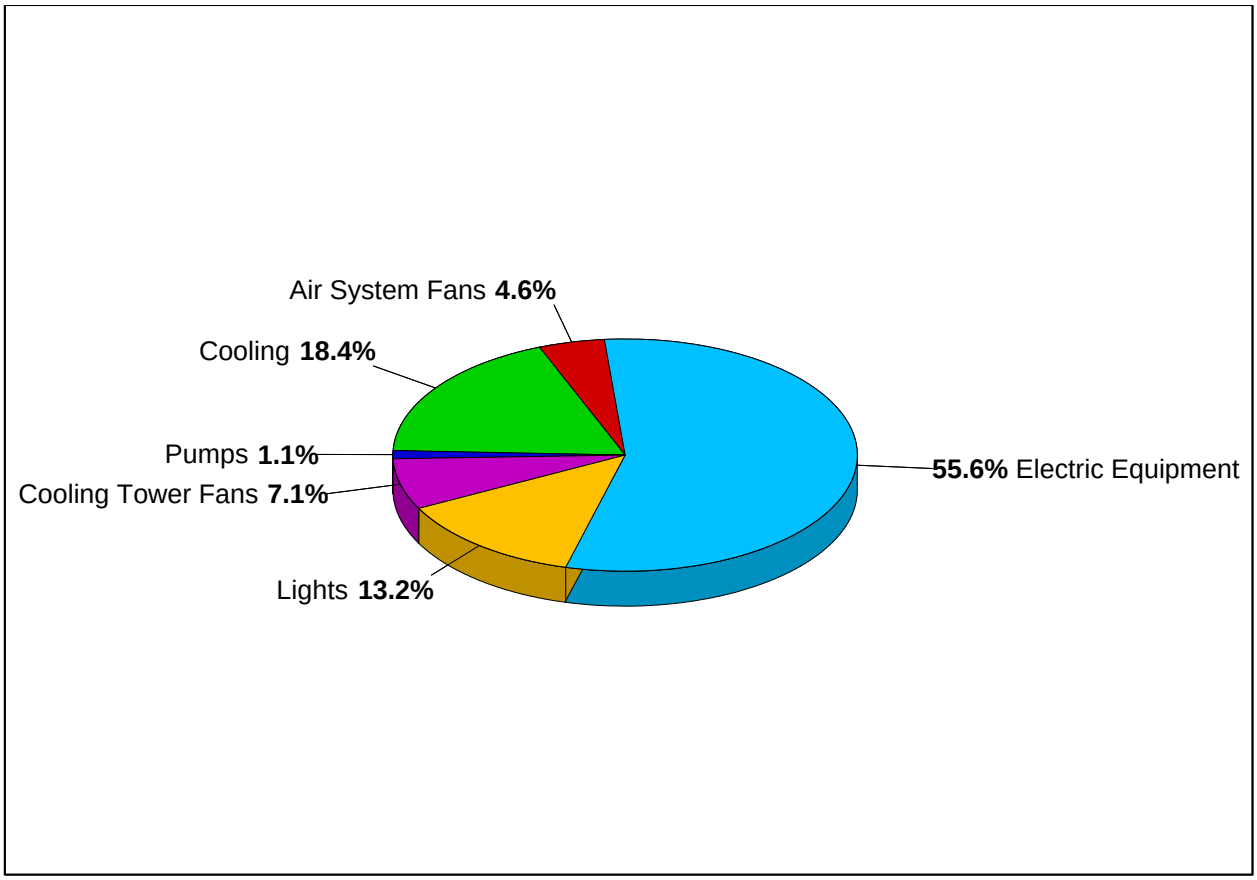
Component	BCM Research Tower ($/ft²)
Air System Fans	0.426
Cooling	1.694
Heating	0.000
Pumps	0.103
Cooling Tower Fans	0.653
HVAC Sub-Total	**2.876**
Lights	1.221
Electric Equipment	5.123
Misc. Electric	0.000
Misc. Fuel Use	0.000
Non-HVAC Sub-Total	**6.344**
Grand Total	**9.220**
Gross Floor Area (ft²)	131541.0
Conditioned Floor Area (ft²)	131541.0

Note: Values in this table are calculated using the Gross Floor Area.

Table 3. Component Cost as a Percentage of Total Cost

Component	BCM Research Tower (%)
Air System Fans	4.6
Cooling	18.4
Heating	0.0
Pumps	1.1
Cooling Tower Fans	7.1
HVAC Sub-Total	**31.2**
Lights	13.2
Electric Equipment	55.6
Misc. Electric	0.0
Misc. Fuel Use	0.0
Non-HVAC Sub-Total	**68.8**
Grand Total	**100.0**

Annual Component Costs - BCM Research Tower



1. Annual Costs

Component	Annual Cost ($)	($/ft²)	Percent of Total (%)
Air System Fans	56,034	0.426	4.6
Cooling	222,787	1.694	18.4
Heating	0	0.000	0.0
Pumps	13,597	0.103	1.1
Cooling Tower Fans	85,868	0.653	7.1
HVAC Sub-Total	**378,285**	**2.876**	**31.2**
Lights	160,630	1.221	13.2
Electric Equipment	673,872	5.123	55.6
Misc. Electric	0	0.000	0.0
Misc. Fuel Use	0	0.000	0.0
Non-HVAC Sub-Total	**834,503**	**6.344**	**68.8**
Grand Total	**1,212,788**	**9.220**	**100.0**

Note: Cost per unit floor area is based on the gross building floor area.

Gross Floor Area ..... **131541.0** ft²
Conditioned Floor Area ..... **131541.0** ft²

Billing Details - Electric - BCM Research Tower

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1. Component Charges

Billing Period	Energy Charges ($)	Demand Charges ($)	Customer Charges ($)	Taxes ($)	Total Charge ($)
Jan	83,943	0	0	5,037	88,980
Feb	75,860	0	0	4,552	80,412
Mar	89,082	0	0	5,345	94,427
Apr	93,346	0	0	5,601	98,947
May	102,896	0	0	6,174	109,070
Jun	105,627	0	0	6,338	111,965
Jul	109,436	0	0	6,566	116,002
Aug	109,027	0	0	6,542	115,569
Sep	103,343	0	0	6,201	109,543
Oct	98,371	0	0	5,902	104,273
Nov	88,395	0	0	5,304	93,699
Dec	84,820	0	0	5,089	89,910
Totals	1,144,146	0	0	68,649	1,212,795

2. Totals

Billing Period	Total Charges ($)	Total Consumption (kWh)	Avg Price ($/kWh)
Jan	88,980	1,028,717	0.0865
Feb	80,412	929,656	0.0865
Mar	94,427	1,091,690	0.0865
Apr	98,947	1,143,946	0.0865
May	109,070	1,260,979	0.0865
Jun	111,965	1,294,449	0.0865
Jul	116,002	1,341,126	0.0865
Aug	115,569	1,336,114	0.0865
Sep	109,543	1,266,455	0.0865
Oct	104,273	1,205,527	0.0865
Nov	93,699	1,083,274	0.0865
Dec	89,910	1,039,466	0.0865
Totals	1,212,795	14,021,399	0.0865

3. Consumption Totals

Billing Period	Peak (kWh)	Mid-Peak (kWh)	Normal Peak (kWh)	Off-Peak (kWh)	Overall (kWh)
Jan	0	0	0	0	1,028,717
Feb	0	0	0	0	929,656
Mar	0	0	0	0	1,091,690
Apr	0	0	0	0	1,143,946
May	0	0	0	0	1,260,979
Jun	0	0	0	0	1,294,449
Jul	0	0	0	0	1,341,126
Aug	0	0	0	0	1,336,114
Sep	0	0	0	0	1,266,455
Oct	0	0	0	0	1,205,527
Nov	0	0	0	0	1,083,274
Dec	0	0	0	0	1,039,466
Totals	0	0	0	0	14,021,399

4. Billing Demands

Billing Period	Peak (kW)	Mid-Peak (kW)	Normal Peak (kW)	Off-Peak (kW)	Overall (kW)
Jan	0.0	0.0	0.0	0.0	1683.3
Feb	0.0	0.0	0.0	0.0	1679.2
Mar	0.0	0.0	0.0	0.0	1713.7
Apr	0.0	0.0	0.0	0.0	1799.9
May	0.0	0.0	0.0	0.0	1935.3
Jun	0.0	0.0	0.0	0.0	1964.3
Jul	0.0	0.0	0.0	0.0	1951.6
Aug	0.0	0.0	0.0	0.0	1939.0
Sep	0.0	0.0	0.0	0.0	1943.3
Oct	0.0	0.0	0.0	0.0	1873.4
Nov	0.0	0.0	0.0	0.0	1727.3
Dec	0.0	0.0	0.0	0.0	1708.7

5. Maximum Demands

Billing Period	Peak (kW)	Mid-Peak (kW)	Normal Peak (kW)	Off-Peak (kW)	Overall (kW)
Jan	0.0	0.0	0.0	0.0	1683.3
Feb	0.0	0.0	0.0	0.0	1679.2
Mar	0.0	0.0	0.0	0.0	1713.7
Apr	0.0	0.0	0.0	0.0	1799.9
May	0.0	0.0	0.0	0.0	1935.3
Jun	0.0	0.0	0.0	0.0	1964.3
Jul	0.0	0.0	0.0	0.0	1951.6
Aug	0.0	0.0	0.0	0.0	1939.0
Sep	0.0	0.0	0.0	0.0	1943.3
Oct	0.0	0.0	0.0	0.0	1873.4
Nov	0.0	0.0	0.0	0.0	1727.3
Dec	0.0	0.0	0.0	0.0	1708.7

6. Time Of Maximum Demands

Billing Period	Peak (m/d/h)	Mid-Peak (m/d/h)	Normal Peak (m/d/h)	Off-Peak (m/d/h)	Overall (m/d/h)
Jan	n/a	n/a	n/a	n/a	1/24/1400
Feb	n/a	n/a	n/a	n/a	2/1/1200
Mar	n/a	n/a	n/a	n/a	3/3/1100
Apr	n/a	n/a	n/a	n/a	4/9/1600
May	n/a	n/a	n/a	n/a	5/8/1400
Jun	n/a	n/a	n/a	n/a	6/11/1800
Jul	n/a	n/a	n/a	n/a	7/26/1500
Aug	n/a	n/a	n/a	n/a	8/18/1400
Sep	n/a	n/a	n/a	n/a	9/4/1500
Oct	n/a	n/a	n/a	n/a	10/11/1200
Nov	n/a	n/a	n/a	n/a	11/26/1200
Dec	n/a	n/a	n/a	n/a	12/8/1100