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ENERGY ANALYSIS AND ENERGY CONSERVATION OPTIONS FOR THE ADDITION TO RECORDS STORAGE BUILDING

FINAL REPORT

Submitted by

Mohsen Farzad
Dennis L. O'Neal

Prepared For

Energy Efficiency Division
Texas Public Utility Commission
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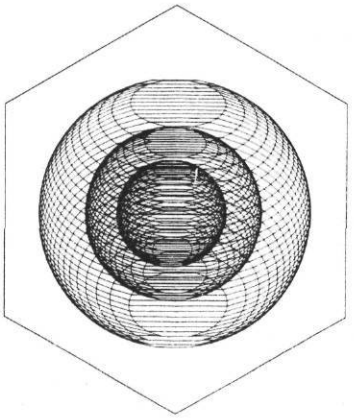

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ABSTRACT

The energy use and peak load requirements of the addition to Records Storage Building in Austin, Texas were analyzed using the DOE 2.1B building energy simulation program. An analysis was made for the building as specified in schematic designs and primary drawings. To reduce the solar heat gain of the building through the windows and skylights, a glass with high reflectivity and low overall heat transfer coefficient was used to study the reduction of glass conduction and glass solar loads. Other options which were studied included increasing the wall and roof insulation, reducing the light level, temperature setback, and implementing the proposed ASHRAE standards. Finally, the energy consumption of the building was compared with the energy consumption of the building with solar film and other options which conformed to the proposed ASHRAE energy standard.

SUMMARY

The energy of the addition to Records Storage building at Austin, Texas was analyzed using the DOE-2.1B building energy simulation program. An analysis was made for the building as specified in the building plans and the specifications provided by the State Purchasing and General Services Commission. The proposed construction of the addition to Records Storage building reflects improvements in energy use over buildings built several years ago.

The energy consumption of the addition to Records Storage building was compared with the energy consumption of the building modified to comply with the ASHRAE standards. The net reduction of 28% was obtained using the ASHRAE standards.

Some of the options for reducing the building energy use, are increasing walls and roof insulation, reducing the light level to 1.8 w/sf, use of solar film on the skylights and windows, and changing the indoor temperature from 75 to 78. These options will not only reduce the peak loads but also reduce the total energy.

CHAPTER 1

INTRODUCTION

The cost of comfort heating and cooling is typically the largest single component of annual energy costs in commercial buildings. The electrical costs in Texas are increasing at current rates of about 12% to 35% per year [1]. In Texas, 63% of the total energy use in the commercial sector is used for heating, ventilation and air-conditioning (HVAC), which is about 8.5% of the total energy consumption of Texas [1].

The Energy Management Group at Texas A&M is working with Texas Public Utility Commission (PUC) and State Purchasing and General Services Commission (SPGSC) to evaluate the energy use for several new state buildings.

The addition to the Records Storage building was chosen for the preliminary studies to evaluate possible conservation strategies and reduce the energy use of the buildings. The addition to Records Storage building is the extension of current Records Storage building for the Texas State Library, Austin, Texas.

The DOE2.1B building energy simulation program [4] was used to analyze the energy consumption of the addition to the Records storage building before its construction started. The proposed ASHRAE Standard [2] has been created to encourage the energy efficient design of new buildings. It provides criteria and minimum standards to reduce energy consumption without constraining the building function or the comfort of the ccupants. It also provides methods for determining compliance with the standard.

CHAPTER 2

DESCRIPTIONS OF THE BUILDING

The addition to Records Storage building consists of administrative and storage buildings. The new administrative section is the extension of existing administrative building. The Schematic Design Proposal and Primary drawings by Wilson Stoeltje Martin, Inc. and mechanical & electrical systems by Gerling-Thomas-Ward, Inc were provided by SPGSC. They included :

1) Expansion and minor remodeling in existing administrative building.

2) Construction of a new single-story Addition to storage building.

Building areas are as follows :

Addition	81,825	sf
Renovation of Existing Building Areas	2,880	sf
Covered Areas at 50%	131	sf
Total Equivalent Area	84,836	sf

The addition to Records Storage building is mainly a storage and administrative building. The construction details of each building is described below along with the assumptions made about the usage of the buildings.

A. Exterior Walls

Exterior facing of new Storage is exposed aggregate concrete tilt-wall panels; pre finished wall panels on steel grids, 3" thick, 2 5/8" high, and 9 5/8" long face brick designed for 3/8" mortar joints. There are 1/2" air gaps between the face brick and the 3.5" insulation batts. The final finishes are 1/2 gypsum. The wall R-value was calculated from the primary drawing in the wall construction.

B. Exterior Windows and Skylights

The exterior glazing is 1/4" "solar gray" with 41% light transmittance exterior and 1/4" clear interior. The skylights are double pane glass, exterior lite tinted, interior lite clear. The are of each skylight is 20 sq.ft. The total area of skylights is 1.9% of the total roof area.

C. Lighting and Office Equipments

Power to lighting in the addition to Records Storage buildings was estimated to be 1.94 Watts per sqaure foot using the floor plans. The lights included 34 Watt fluorescent and incandescent lights. Office equipment (typewriters, copy machines, calculators, and computers, etc.) in administrative section is assumed to generate a maximum of 1 w/sf. The equipment in storage section is assumed to be 0.25 w/sf. The equipment and lighting schedules are shown in Tables 2.1 and 2.2. During the work hours, it is assumed that a maximum of 75% of the lights and office equipments are on at any instance. During the non-working hours, weekends, and holidays, 20% of the lights are on due to the security reasons.

D. Infiltration

Infiltration was calculated using the air-change method: 0.25 air-change/hr were assumed for the Record Storage building. Seven CFM per hour per person of outdoor air is assumed for the administrative section. The time of infiltration was assumed to be from 8 am through 6 pm during Monday through Friday. No infiltration was assumed during weekends, holidays, and nonworking hours due to the lack of people moving through the entrance and loading & unloading doors.

Table 2.1 - Lighting Schedules For the Buildings
(1.0 equals to 1.94 w/sf)

Time	Monday -Friday	Holidays & Weekends
1am - 7am	0.2	0.2
8am - 5pm	0.75	0.2
6pm - 12am	0.2	0.2

Table 2.2 - Equipment Schedules For the Buildings
(1.0 equals to 1 w/sf)

Time	Monday -Friday	Holidays & Weekends
1am - 8am	0.2	0.2
8am - 5pm	0.95	0.2
6pm - 12am	0.2	0.2

E. Occupancy

The occupancy is assumed to be 250 square feet per person in the adminstrative section. The number of people in the Records Storage building is assumed to be a maximum of 15. The building's operating hours are on weekdays from 8 P.M. through 5 P.M. The occupency schedule for the administrative section is shown in Table 2.3.

Table 2.3 - Occupancy Schedules For all the Buildings
(1.0 equals to 250 sf/Person)

Time	Monday -Friday	Holidays & Weekends
1am - 7am	0.0	0.0
8am - 12pm	0.9	0.0
12pm - 2pm	0.6	0.0
2pm - 5pm	0.9	0.0
6pm - 12am	0.0	0.0

F. Roof Construction

Roofing at the building is pre-finished, 22 ga. steel, 0.5 oz/sf coated galvalume standing seam panels at the Storage area and build-up coal-tar roofing with metal flashings, copings, and trim at the office area.It has an overall U-value of 0.045 (Btu per Hour SF degree Fahrenheit).

G. HVAC System

The HVAC system for Records Storage building is a Variable Air Volume (VAV) with an economizer cycle which can take advantage of night cooling. VAV systems vary the quantity of a constant temperature of air to match system loads. A temperature based economizer cycle was assumed to operate with the HVAC system [1]. Variable speed fans were assumed with the HVAC system. Two Air Handling Units (AHU) are used for Storage building. The AHU schedules are shown in Table 2.4. Heat pumps are used in the Office area. The Coefficient Of Performance (COP) for the heat pumps is assumed to be 2.0.

The temperature for cooling and heating was set at 75 F during days, nights, weekends and holidays. There is no temperature setback at nights. The fresh outside air to control air quality, and spaces that are continuously occupied requires 7 cfm/hr per person [3]. The relative humidity in the building was assumed to be 40%.

Table 2.4 - Air Handling Units Schedules
For The Records Storage Building

Time of Operation	Monday-Friday	Holiday & Weekends
1am - 5am	off	off
5am - 10am	on	off
10am - 3pm	on	on
3pm - 8pm	on	off
8pm - 12pm	off	off

CHAPTER 3

BASE CASE ANALYSIS

The energy consumption of the addition to Records Storage building was analyzed using the DOE2.1b building energy simulation program [4]. DOE2.1b is a public domain computer program which can be used to evalute the energy consumption and hourly loads of buildings and their associated HVAC systems. It calculates hourly performance and response of a building or a zone whose description has been provided by the user. In addition, DOE2.1b can simulate the peak loads of a building and is capable of producing an economic analysis of the energy use and the costs and benefits of making alterations in design.

The Records Storage building and the office area were assigned to two seperate zones. The total cooling and heating peak loads of the building consist of peak loads on walls, roofs, glass, occupants, lights, equipments, and infiltration. Appendix A provides the cooling and heating peak load components of the building as well as system monthly loads for each zone. This total cooling heating peak loads occurs on August 11 at 4 P.M. and January 30 at 9 A.M. respectively. Figures 3.1 and 3.2 show the distribution of the total peak cooling and heating loads for the base building. As can be shown in Figure 3.1, infiltration constitutes the major portion of the total cooling energy use (35.2%). Lighting accounts for 30.7% of the total cooling load. Glass solar and glass conduction are a small portion of energy use (14.4%) compared to other office buildings (i.e. Travis and Supreme Courts and Attorney General buildings) due to the small exterior glaze area.

Figure 3.2 shows the distribution of the peak heating loads for the building. The major contributor is the infiltration (81%). The rest of heating loads are the walls and roof conduction losses (16.2%), followed by glass conduction. The infiltration loads, in case of heating, are much more significant than cooling, because the indoor-outdoor temperature difference is much greater in winter than summer.

Tables 3.1 and 3.2 show the peak loads and the total energy consumption, respectively for the Records Storage building. The Energy Usage Index (EUI), which is the total annual energy consumption of the building divided by its gross floor area, was calculated for the building. EUI for the Records Storage Building is 80.1 KBtu/sf-yr, which is much lower than Travis building (EUI=101) and the Supreme Court and Attorney Buildings (EUI=98) [5]. Appendix I provides the cooling and heating peak load components of each floor as well as the system monthly loads for the building.

Table 3.1 - Peak Loads For the Base Records Storage Building

Building	Cooling (MBtu/hr)	Heating (MBtu/hr)
Records Storage	1459	764

Table 3.2 - Total Energy Use For the Base Records Storage Building

Building	Cooling (MBtu)	Heating (MBtu)	Electrical Energy (MWH)	Total (MBtu)
Record Storage	894.0	1276.0	1273.8	6514.4

Figure 3.1 Distribution of Peak Cooling Load For the Base Records Storage Building (Total Loads = 121 Tons)

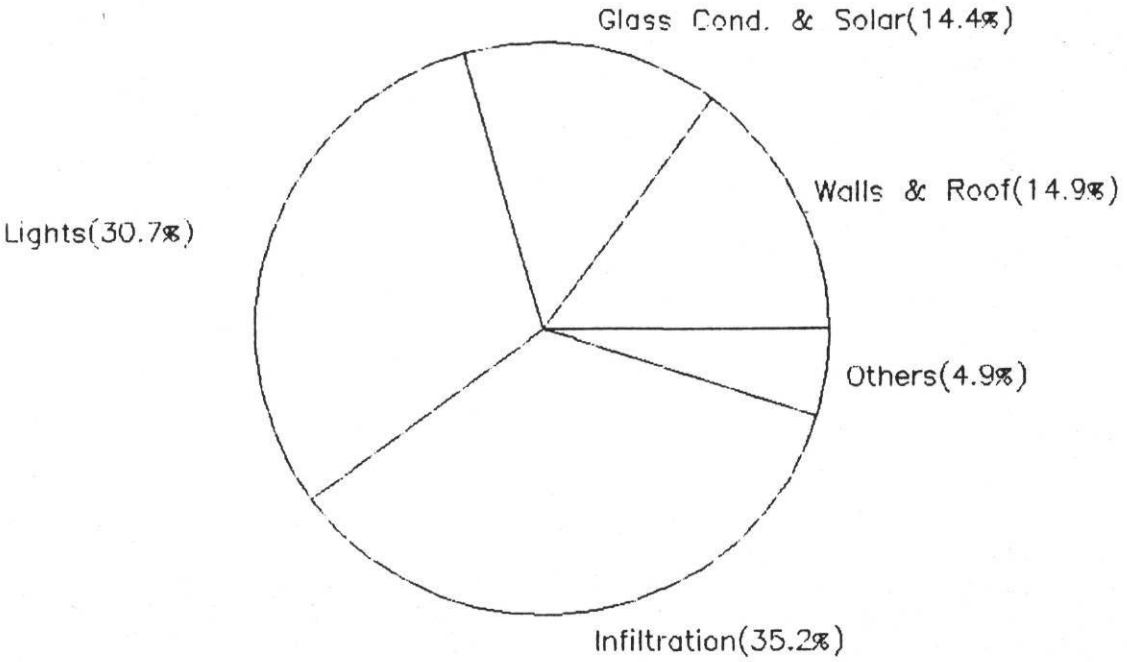
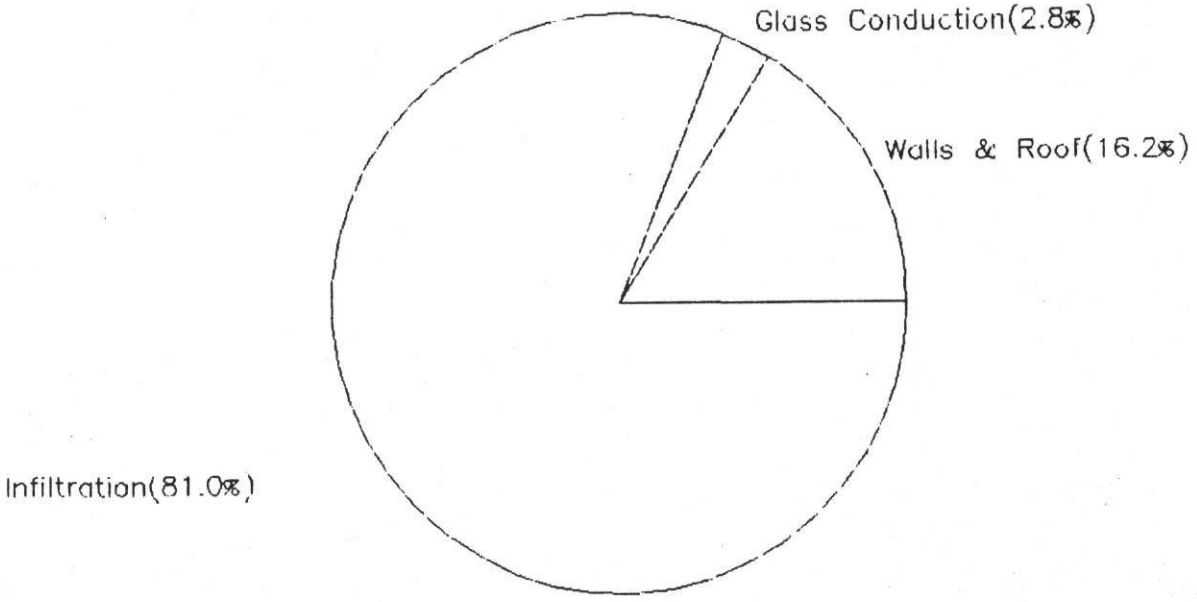


Figure 3.2 Distribution of Peak Heating Load For the Base Records Storage Building (Total Loads = 764 KBtu/h)



CHAPTER 4

RESULTS & ANALYSIS

Several different conservation strategies were considered for the addition Records Storage building. These strategies included redesigns of the buildings to the proposed ASHRAE standard 90.1p, increasing the wall and roof R-value, installing solar film on the windows and skylights, reducing the light level, and setting the indoor temperature back during summer. Appendix II provides the cooling and heating peak load components and the system monthly loads for the modified building with different conservation strategies.

SOLAR FILM

As proposed, the windows and skylights are double pane with a exterior lite tint and interior clear. The first option considered installing of solar film on the windows and skylights. All the external windows and skylights were assumed to be coated with a silver solar film having a 10% transmissivity and 51% reflectivity. The solar heat gain and solar conduction of the windows and the skylights during the peak loads were reduced. Table 4.1 shows the percent reduction of peak glass solar and glass conduction for cooling with the improved glass type. Figures 4.1 and 4.2 show the effect of solar film on the windows and skylights during the cooling and heating peak loads. Table 4.2 provides the total energy use for the base building and the building with improved windows and skylights. Hence, the reduction in total cooling energy use due to the improved glass on the base building is about 12.0%. The annual energy reduction is 8.4%. The calculated EUI for the modified building with solar film is 73.3 (Btu/sf-yr) which is a 8.5% reduction compared to

Table 4.1 - Comparison of Cooling Peak Loads (MBtu/hr)
Base Glass and Glass With Solar Film

Type	Glass Solar	Glass Conduction
Base	181	38
Solar Film	25	22
% Reduction	86	42

Figure 4.1 Distribution of Peak Cooling Load For the Building With Solar Film (Total Load = 107 Tons)

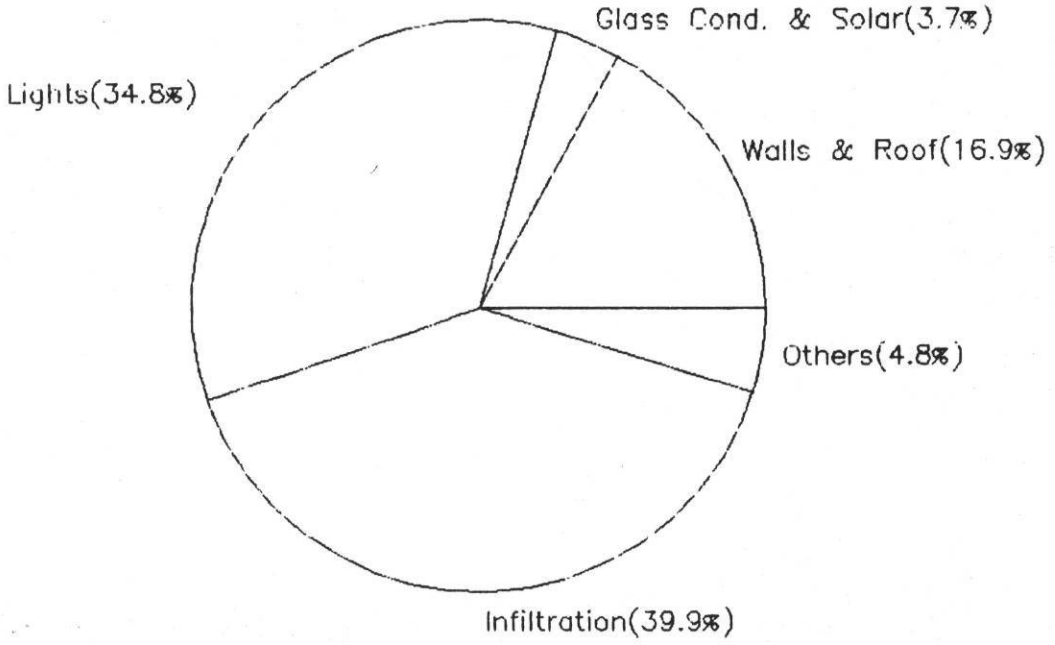


Figure 4.2 Distribution of peak Heating Load For the Building With Solar Film (Total Loads = 756 KBtu/h)

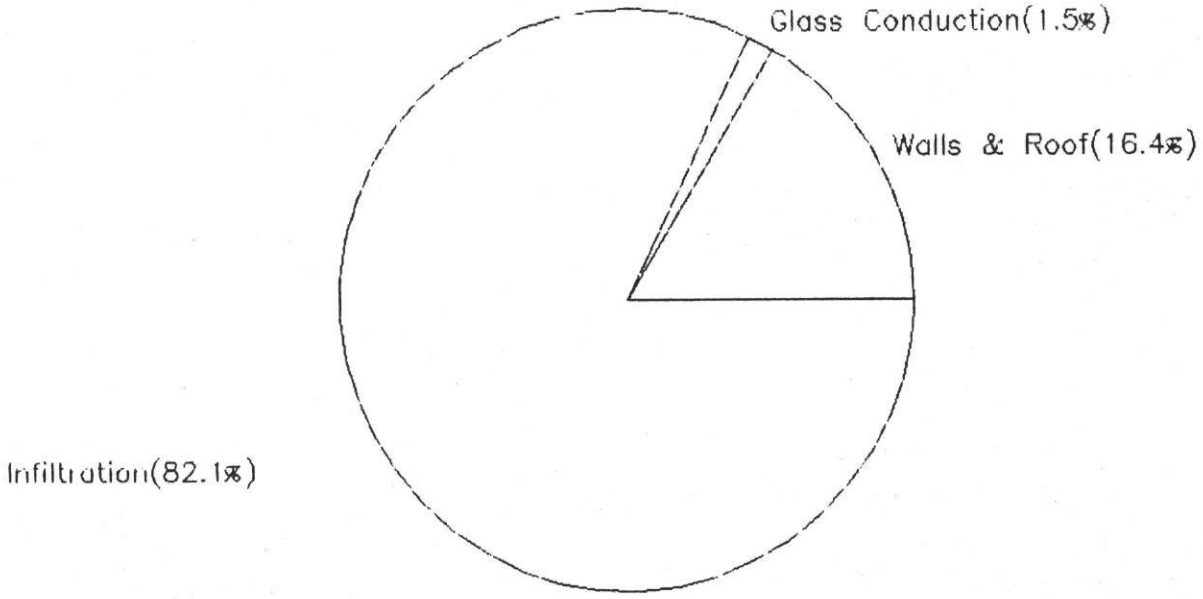


Table 4.2 - Comparison of Total Energy Use For Base Glass and Glass With Solar Film

Type	Cooling (MBtu)	Heating (MBtu)	Electrical Enrgy (MWH)	Total (MBtu)
Base	894	1276	1274	6514
Solar Film	787	1108	1193	5964
% Reduction	12.0	13.2	6.3	8.4

ASHRAE STANDARDS

ASHRAE has recently proposed a major update to the previously published studies on the non-residential buildings [2]. The update affects several major areas : (1) lighting levels and its controls, (2) control of equipment loads, and (3) HVAC systems.

Lighting and its Control

The major difference between the base building and that required with the proposed ASHRAE standards was in lighting level. The base building had 1.94 w/sf compared to 1.8 w/sf recommended by the standards. It was assumed the most efficient lamp/ballasting systems and luminaries would be installed in the base building. The ASHRAE Standards also recommend the replacement of any incandescent fixtures with fluorescent fixtures. For example, the fluorescent fixture with 2 lamps are required to have an efficacy of 68 lumens/watt (including ballast losses). The standards also call for automatic controls including occupancy sensors, light level sensors etc. These reduce the lighting level during unoccupied hours to those level needed for safety and security, and also adjust the lighting levels when adequate daylight is present. These controls would be useful in perimeter zones of the the buildings where there is abundant indirect solar insolation.

Control of Equipment Loads

The proposed standards specify that major heat generating equipment should, where practical, be located where it can balance other heat losses. For example, computer centers, mechanical room areas could be located in the north or northwest perimeter areas of building depending on the climate and prevailing wind directions.

HVAC Systems

The standards call for VAV systems in any office building. Systems serving areas with large internal loads (lighting, equipment, and people), especially interior zones with little or no exposure to weather, should be designed to take advantage of mild or cool weather conditions to reduce cooling energy. Economizer controls should be integrated with mechaincal cooling controls so that mechanical cooling in only operated when necessary, and the supply air is not over cooled to a temperature below the desired supply temperature. The system and controls should be designed so that economizer operation does not increase heating energy use. The supply air quantity should vary with sensible (i.e. VAV system). The recommended temperature controls during occupancy are 70 degree F heating and 75 degree F for cooling. It is assumed that VAV systems with an economizer cycle used in the buildings. Also, the standards call for temperature setbacks during week nights and weekends.

Figures 4.3 and 4.4 show the distribution of peak cooling and heating loads with the ASHRAE standards. The change in cooling peak loads for the Addition to Records Storage building and the building with ASHRAE standards are shown in Table 4.3. The change in cooling peak load is 6.1%. The reduction as compared to base is from the heat gain from lighting, since the lighting levels were reduced by 0.14 w/sf and increase the cooling temperature from 75 to 78 degree F. Three degree change on the design cooling temperature has a negligible effect on the building humidity ratio. The peak heating loads increased for the building with ASHRAE standards. The increase in heating load is due to lower lighting level recommended by the proposed ASHRAE standards.

Table 4.4 shows the total energy use for the building modified with ASHRAE standards. There is a reduction of 23.5% in electrical energy consumption due to the lower light level The largest reduction occures in heating loads with 49.7 percent due to lower design heating temperature. Due to the design cooling temperature increase from 75 to 78 degree F, there is a reduction of 21.2% in cooling load. Hence, the reduction in total energy use with ASHRAE standards on the base building is about 28.3%. The calculated EUI for the building with the ASHRAE standards is 57.4 (Btu/sf-yr) which is 28.3% less than the base building.

Figure 4.3 Distribution of Peak Cooling Load For the Building With ASHRAE Standards (Total Loads = 114 Tons)

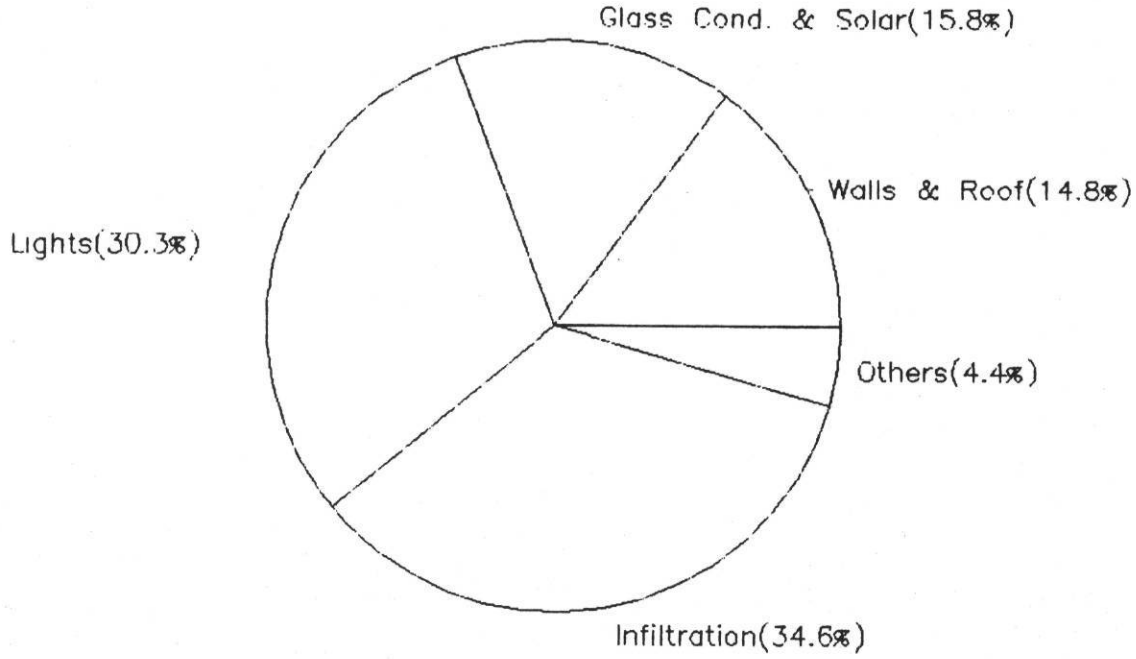


Figure 4.4 Distribution of Peak Heating Load For the Building With ASHRAE Standards (Total Loads = 874 Kbtu/h)

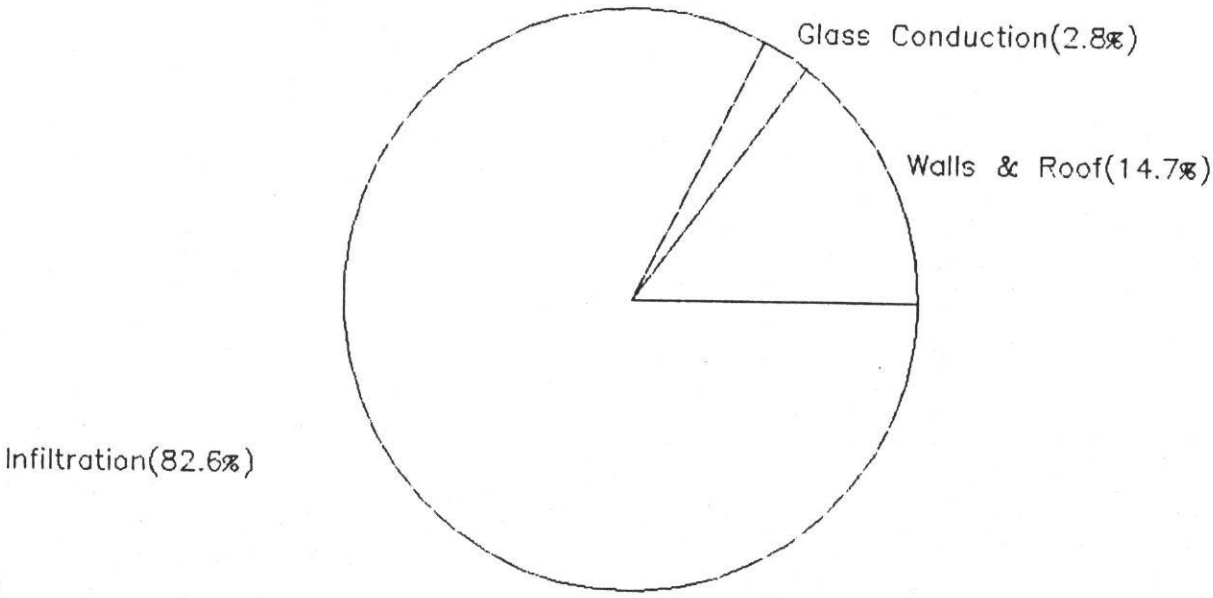


Table 4.3 - Comparison of Peak Loads
For The Addition to Records Storage Building
with Proposed ASHRAE Standards

Type	Cooling Load (KBtu/hr)	Heating Load (KBtu/hr)
Base	1459	764
ASHRAE Standards	1370	874
% Reduction	6.1	-14.4

Table 4.4 - Comparison of Total Energy Use For
the Base Building and Proposed ASHRAE Standards

Type	Cooling (MBtu)	Heating (MBtu)	Electrical Enrgy (MWH)	Total (MBtu)
Base	894	1276	1274	6514
ASHRAE Standards	704	642	974	4669
% Reduction	21.2	49.7	23.5	28.3

INCREASE R-VALUE OF WALLS & ROOF

To decrease the heat loss and heat gain during the winter and the summer from the building, the R-value of the walls and roof were increased to an average of R-44. The walls and roof insulation were increased by an averrage of 44% over the proposed design. Figures 4.5 and 4.6 show the distribution of total cooling and heating peak load components. The walls and roof conduction heat gain and heat loss in peak cooling and heating loads are 118.8 KBtu/hr and 90.2 KBtu/hr, this is a reduction of 45.1% and 52.6%, respectively compared to the base building. Table 4.5 shows the comparison of peak cooling and heating loads for the base building and the modified building with increase of R-19 insulation on the walls and roof. There is 10.1% reduction in heating compared to the base building. The reduction as compared to the base is from the decrease in heat loss through the walls and roof. This reduction is more significant in case of heating than cooling because the indoor-outdoor temperature difference is much greater in winter than summer.

Table 4.5 - Comparison of Peak Loads For the Base Building with the Building with Additional Insulation (R-19) On the Walls and Roof

Type	Cooling Load (KBtu/hr)	Heating Load (KBtu/hr)
Base	1459	764
Increase R-value	1361	687
% Reduction	6.8	10.1

Table 4.6 shows the total energy use for the building modified with increased walls and roof R-values. The reduction in total energy use with the modified building to the base building is about 3.3%. The calculated EUI for the building with increased walls and roof R-value is 77.45 (Btu/sf-yr) which is 3.3% less than the base building.

Figure 4.5 Distribution of Peak Cooling Load For Increased the Insulation on the Walls and Roof (Total Loads = 113 Tons)

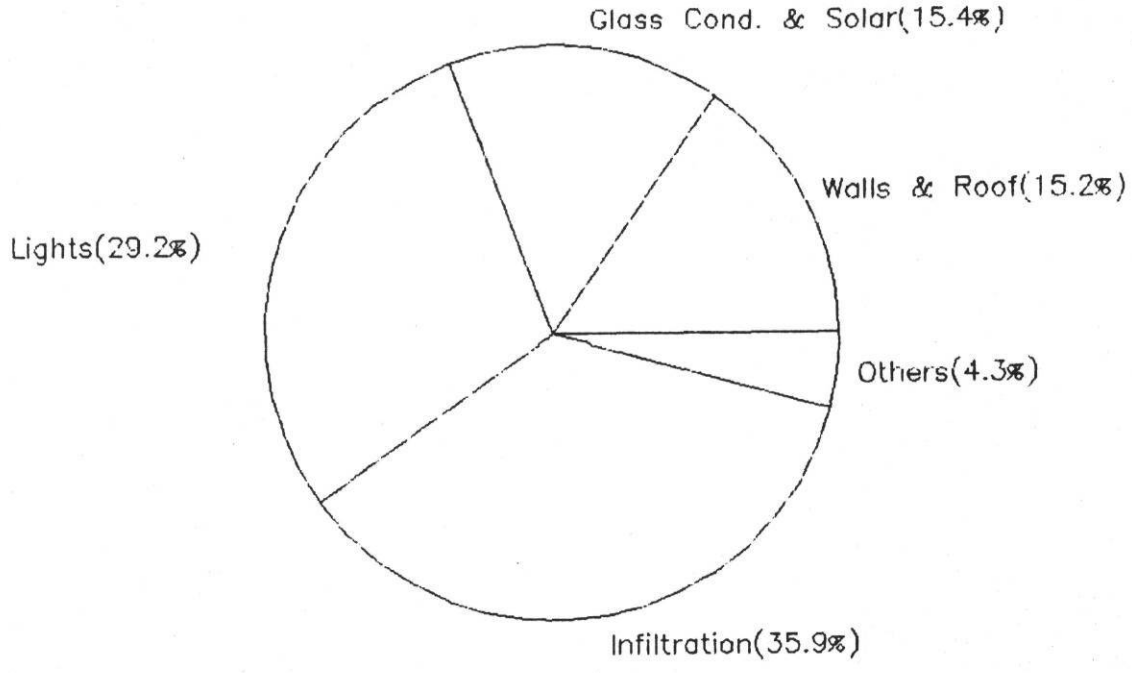


Figure 4.6 Distribution of Peak Heating Load For Increased the Insulation on the Walls and Roof (Total Loads = 687 KBtu/h)

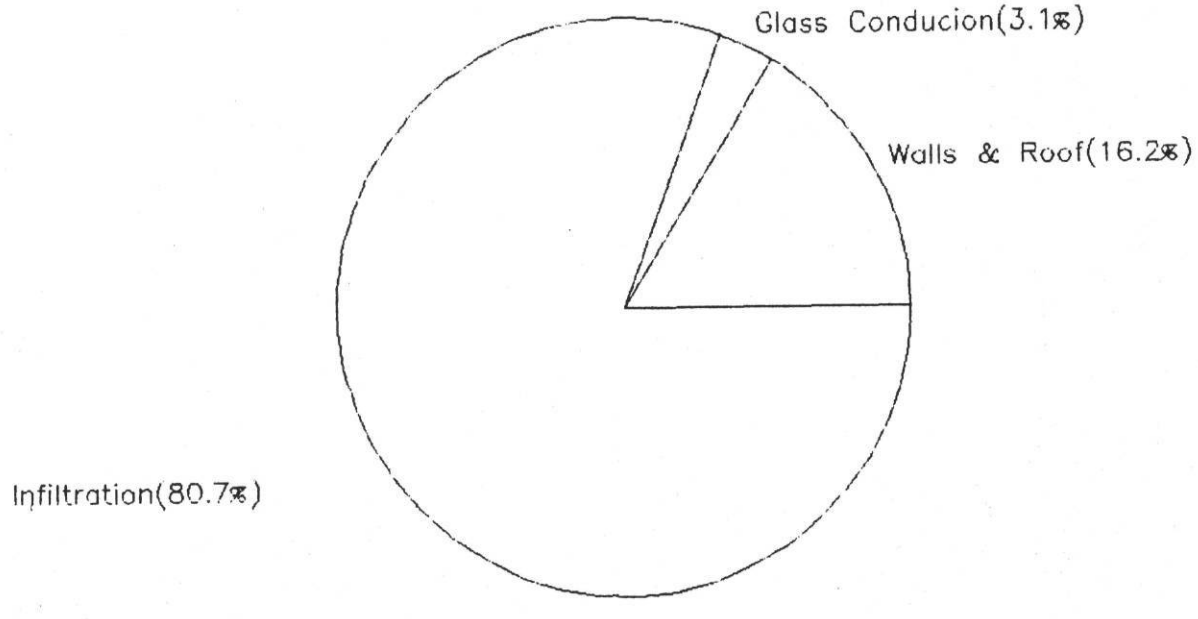


Table 4.6 - Comparison of Total Energy Use For the Base Building and the Building modified with Additional Insulation (R-19) to the Walls & roof

Type	Cooling (MBtu)	Heating (MBtu)	Electrical Enrgy (MWH)	Total (MBtu)
Base	894	1276	1274	6514
Increase R-value	861	1261	1225	6301
% Reduction	3.7	0.2	3.8	3.3

REDUCE THE LIGHT LEVEL

The peak lighting levels were estimated to be 1.94 w/sf from the number of fixtures in each zone using the floor plans. The lighting level was reduced by 0.14 w/sf. Figures 4.7 and 4.8 show the distribution of total cooling and heating peak loads. As shown in Table 4.7, there is a 7.3% reduction in peak cooling load due to lowering the light level from 1.94 w/sf to 1.8 w/sf.

Table 4.7 - Comparison of Cooling Peak Load (KBtu/h) Base Lighting 1.94 w/sf With Lighting 1.8 w/sf

Type	Light
1.94 w/sf	449
1.8 w/sf	416
% Reduction	7.3

Figure 4.7 Distribution of Peak Cooling Load For Reducing the Light Level to 1.8 w/sf (Total Load = 119 Tons)

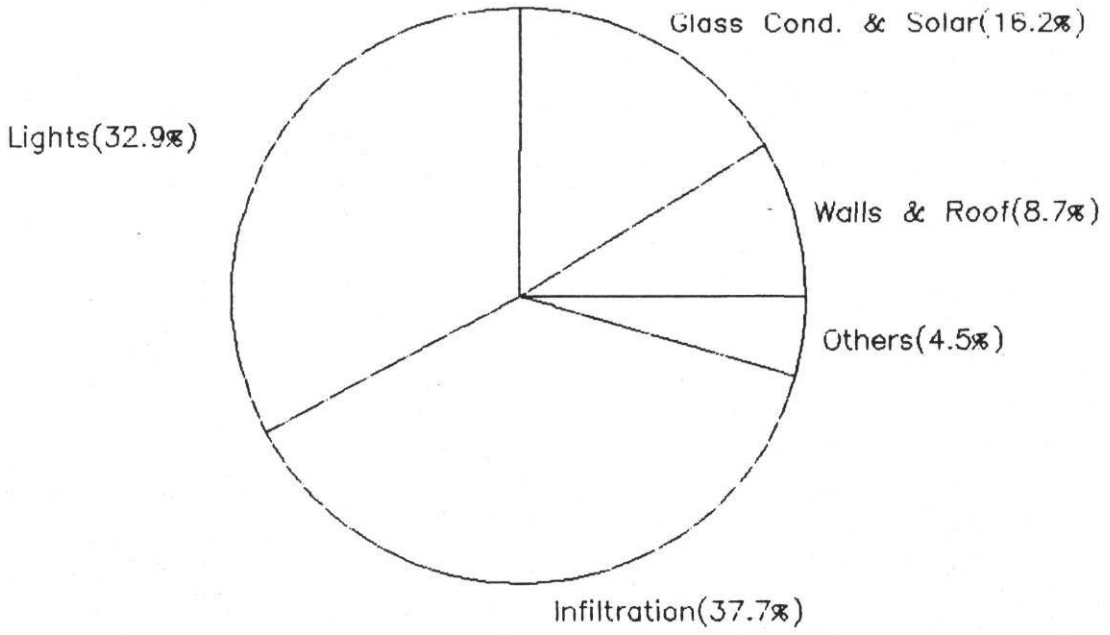


Figure 4.8 Distribution of Peak Heating Load For Reducing the Light Level to 1.8 w/sf (Total Load = 792 KBtu/h)

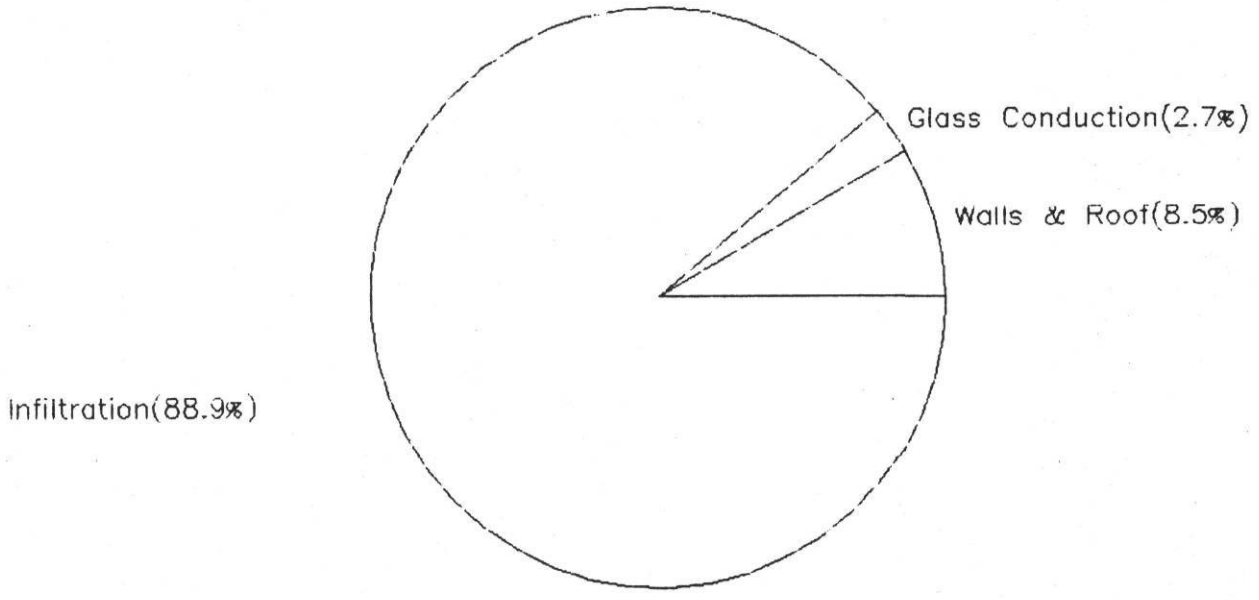


Table 4.8 shows the total energy use for the building modified with the lighting level at 1.8 w/sf. The reduction in cooling load and electrical energy use for the lights are 3.4% and 4.4%, respectively compared to the base building. The total energy use is reduced by 4.1%. The calculated EUI for the building with light level 1.8 w/sf is 76.8 (Btu/sf-yr) which is 4.12% less than the base building.

Table 4.8 - Comparison of Total Energy Use For Base Light Level and 1.8 w/sf Light Level

Type	Cooling (MBtu)	Heating (MBtu)	Electrical Enrgy (MWH)	Total (MBtu)
Base	894	1276	1274	6514
1.8 w/sf	863	1231	1218	6249
% Reduction	3.4	3.6	4.4	4.1

CHANGE INDOOR TEMPERATURE

As mentioned earlier, the temperature assumed for cooling and heating was 75 degree F during the days, the nights, weekends and holidays. This temperature was specified by state purchasing personal. By setting temperature to 78 degree F during the summer, there would be a reduction in cooling loads. Figure 4.9 shows the distribution of total peak cooling load. As shown in Table 4.9, there is 8% reduction in peak cooling loads due to changing the inside temperature from 75 F to 78 degree F. The three degree change on the design cooling temperature has a negligible effect on the buiding humidity ratio.

Table 4.10 shows the total energy use for the building with temperature set to 78 F. Due to the three degree change in the design cooling temperature, the reduction in cooling load and electrical energy use for the modified building are 20.5% and 11.2%, respectively, compared to the base building. The total energy use is reduced by 13.5%. The calculated EUI for the building with temperature to 78 degree F was 69.2 (KBtu/sf-yr) which is 13.6% less than the base building.

Figure 4.9 Distribution of Peak Cooling Load For a Temperature Setting of 78 Degree F (Total Load = 117 Tons)

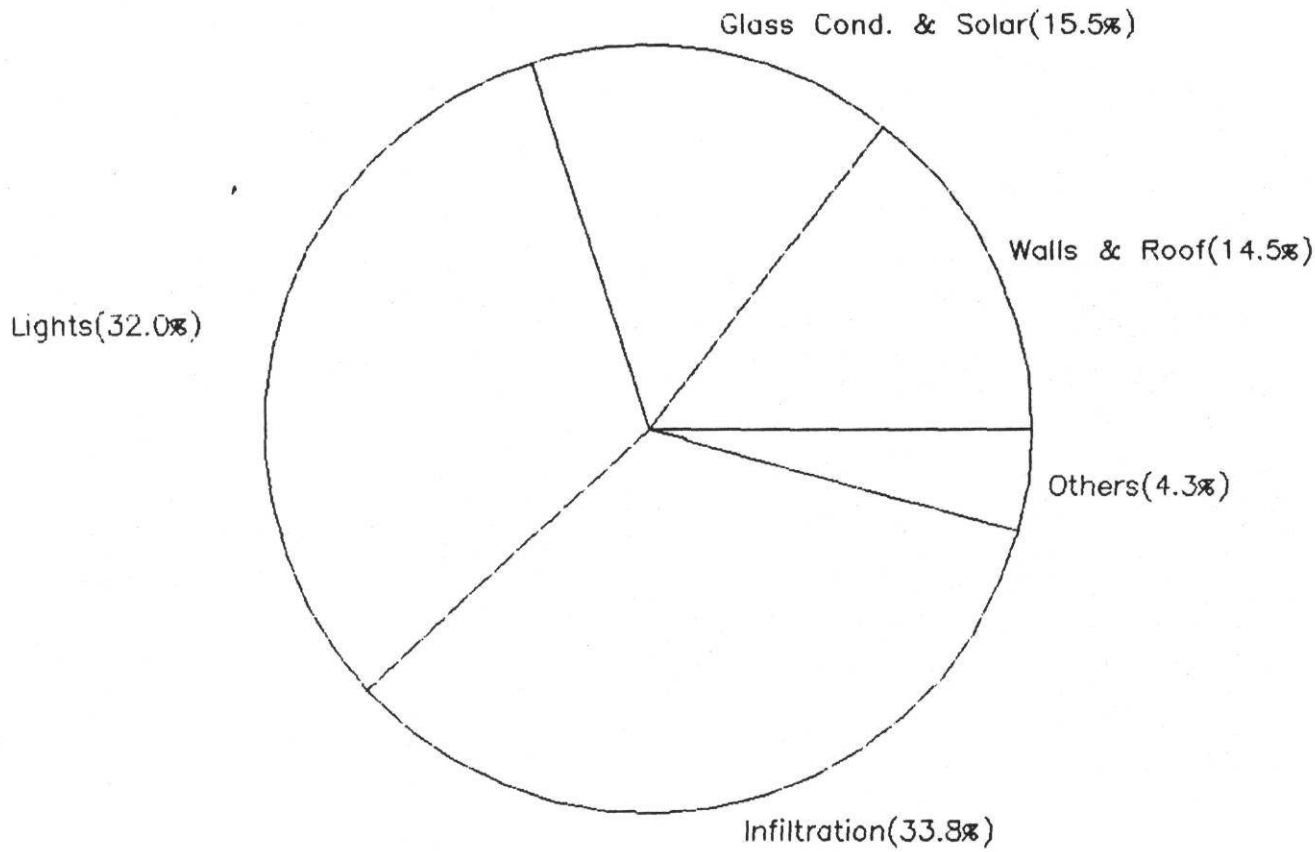


Table 4.9 - Comparison of Cooling Peak Load Temperature settings of 75 F and 78 F (KBtu/hr)

TYPE	Cooling Load
75 F	1459
78 F	1403
% Reduction	3.8

Table 4.10 - Comparison of Total Energy Use For Temperature Settings of 75 F and 75 F

Type	Cooling (MBtu)	Electrical Enrgy (MWH)	Total (MBtu)
75 F	894	1274	6514
78 F	711	1131	5635
% Reduction	20.5	11.2	13.5

CHAPTER 5

CONCLUSIONS & RECOMMENDATIONS

The current proposal for the addition to Records Storage building reflects improvements in energy use over buildings built several years ago. Some of the options analyzed for reducing the building energy use included : using glass with high reflectivity and low 'U' value, reducing the lighting levels, increasing the R-value of walls and roof, and temperature setback. These options will not only reduce the peak loads but also reduce the total energy use of the building. Table 5.1 shows EUI for different options as well as cumulative option. The proposed ASHRAE standards appears to reduce energy use of this building. Further studies must be done to evaluate the economics of an energy code for the new state buildings.

Table 5.1 - EUI's For The Addition To Records Storage Building (KBtu/sf-yr)

Options	EUI	%Reduction
Base Case	80.1	----
Increase Walls & Roof Insulation	77.4	3.4
Reduce the Light Level to 1.8 w/sf	76.8	4.1
Solar Film On the Windows & Skylight	73.3	8.5
Temperature Setting to 78 F (summer)	69.2	13.6
ASHRAE Standards	57.4	28.3
Cumulative Option	52.4	34.6

REFERENCES

[1] "Energy Conservation Procedures for HVAC," By Walter & Associates Consulting Engineers, Public Utilities Commission of Texas, Austin, TX, 1984.

[2] "Energy Efficient Design of New Non-Residential Buildings and New High-Rise Residential Buildings", ANSI/ASHRAE/IES 90.1P, public review draft june 10, 1985, The American Society of Heating, Refrigerating, and Air-Conditioning Inc. (ASHRAE), 1791 Tullie Circle NE, Atlanta, GA 30329.

[3] Handbook of Fundamentals, ASHRAE 1791 Tullie Circle, N.E., Atlanta, GA. 30329.

[4] DOE-2, Reference Manual, Version 2.1B, Lawrence Berkeley Laboratory, University of California, Berkeley, CA. 94720, January 1983.

[5] "Analysis of Energy Use and Energy Conservation Options For the Travis Building" by Srinivas Katipamula, Dennis O'Neal, and Mohsen Farzad, Texas Public Utility Commission, Austin, TX, 1986.

APPENDIX I

REPORT- LS-C BUILDING PEAK LOAD COMPONENTS

*** BUILDING ***

FLOOR AREA	81362	SQFT	7559	SQMT
VOLUME	2431065	CUFT	68848	CUMT

	COOLING LOAD		HEATING LOAD	
TIME	AUG 11 4PM		JAN 18 10AM	
DRY-BULB TEMP	104F	40C	31F	-1C
WET-BULB TEMP	75F	24C	29F	-2C

	SENSIBLE (KBTU/H)	SENSIBLE (KW)	LATENT (KBTU/H)	LATENT (KW)	SENSIBLE (KBTU/H)	SENSIBLE (KW)
WALLS	44.573	13.054	0.000	0.000	-47.373	-13.874
ROOFS	173.099	50.696	0.000	0.000	-142.953	-41.867
GLASS CONDUCTION	38.423	11.253	0.000	0.000	-33.083	-9.689
GLASS SOLAR	181.500	53.157	0.000	0.000	8.371	2.452
DOOR	4.953	1.450	0.000	0.000	-5.468	-1.601
INTERNAL SURFACES	0.000	0.000	0.000	0.000	0.000	0.000
UNDERGROUND SURFACES	0.000	0.000	0.000	0.000	0.000	0.000
OCCUPANTS TO SPACE	3.090	0.905	2.260	0.662	0.798	0.234
LIGHT TO SPACE	448.777	131.436	0.000	0.000	363.500	106.460
EQUIPMENT TO SPACE	49.573	14.519	0.000	0.000	41.397	12.124
PROCESS TO SPACE	0.000	0.000	0.000	0.000	0.000	0.000
INFILTRATION	353.108	103.416	160.193	46.917	-949.998	-278.230
TOTAL	1297.095	379.887	162.453	47.578	-764.807	-223.993
TOTAL LOAD	1459.548 KBTU/H		427.465 KW		-764.807 KBTU/H	-223.993 KW
TOTAL LOAD / AREA	17.94BTU/H.SQFT		56.552 W /SQMT		9.400BTU/H.SQFT	29.633 W /SQMT

NOTE 1)THE ABOVE LOADS EXCLUDE OUTSIDE VENTILATION AIR LOADS
2)TIMES GIVEN IN STANDARD TIME FOR THE LOCATION IN CONSIDERATION

REPORT- LS-D BUILDING MONTHLY LOADS SUMMARY

	COOLING						HEATING						ELEC	
MONTH	COOLING ENERGY (MBTU)	TIME OF MAX DY	HR	DRY-BULB TEMP	WET-BULB TEMP	MAXIMUM COOLING LOAD (KBTU/HR)	HEATING ENERGY (MBTU)	TIME OF MAX DY	HR	DRY-BULB TEMP	WET-BULB TEMP	MAXIMUM HEATING LOAD (KBTU/HR)	ELEC-TRICAL ENERGY (KWH)	MAXIMUM ELEC LOAD (KW)
JAN	77.66138	6	14	83.F	62.F	777.615	-27.718	18	10	31.F	29.F	-764.806	53994.	157.519
FEB	90.31822	27	14	80.F	63.F	744.330	-14.068	21	8	35.F	29.F	-684.379	48812.	157.519
MAR	150.70055	27	15	81.F	58.F	866.672	-13.602	1	9	27.F	24.F	-712.926	56669.	157.519
APR	210.15941	6	16	89.F	61.F	1078.281	-0.046	18	8	55.F	46.F	-20.550	51821.	157.519
MAY	273.40259	11	15	99.F	77.F	1274.265	-0.006	15	7	57.F	51.F	-6.423	55332.	157.519
JUN	313.60107	12	15	94.F	75.F	1214.090	0.000					0.000	54496.	157.519
JUL	328.25220	10	15	93.F	75.F	1141.926	0.000					0.000	52657.	157.519
AUG	340.39697	11	15	104.F	75.F	1297.095	0.000					0.000	56669.	157.519
SEP	270.15283	13	14	93.F	77.F	1069.206	0.000					0.000	51821.	157.519
OCT	209.04872	2	13	91.F	76.F	1025.138	-0.936	27	9	53.F	43.F	-211.793	53994.	157.519
NOV	115.08876	7	15	82.F	63.F	805.261	-11.624	14	9	45.F	34.F	-476.741	51821.	157.519
DEC	85.74321	14	15	81.F	64.F	708.503	-20.650	18	8	28.F	23.F	-701.806	52657.	157.519
TOTAL	2464.525						-88.649						640741.	
MAX						1297.095						-764.806		157.5

REPORT- SS-A SYSTEM MONTHLY LOADS SUMMARY FOR FLOOR-G

	COOLING						HEATING						ELEC	
MONTH	COOLING ENERGY (MBTU)	TIME OF DY	TIME MAX HR	DRY-BULB TEMP	WET-BULB TEMP	MAXIMUM COOLING LOAD (KBTU/HR)	HEATING ENERGY (MBTU)	TIME OF DY	TIME MAX HR	DRY-BULB TEMP	WET-BULB TEMP	MAXIMUM HEATING LOAD (KBTU/HR)	ELEC-TRICAL ENERGY (KWH)	MAXIMUM ELEC LOAD (KW)
JAN	8.13458	2	14	75.F	60.F	1765.764	-284.332	10	15	65.F	45.F	-5280.645	133548.	397.288
FEB	11.82712	27	12	75.F	63.F	1860.343	-153.205	3	13	72.F	54.F	-2806.825	117497.	397.288
MAR	36.38519	27	15	81.F	58.F	1267.041	-246.346	4	15	66.F	45.F	-5529.273	120561.	397.288
APR	131.32455	1	15	77.F	55.F	1869.370	-119.406	17	15	74.F	53.F	-5129.203	78399.	397.288
MAY	284.62329	11	16	99.F	77.F	2490.764	-37.310	2	19	74.F	55.F	-3797.319	85389.	397.287
JUN	448.70142	12	16	94.F	75.F	2345.609	-1.851	1	13	74.F	59.F	-1129.184	89285.	397.282
JUL	504.78809	31	16	99.F	75.F	2462.912	0.000	5	6	74.F	71.F	-0.015	87049.	397.286
AUG	535.90039	11	16	104.F	75.F	2618.942	0.000	16	6	74.F	72.F	-0.015	93884.	397.287
SEP	346.52197	8	14	88.F	79.F	2270.503	0.000	8	9	73.F	72.F	-0.015	79165.	397.287
OCT	165.96468	2	14	91.F	76.F	2027.687	-46.099	24	14	74.F	54.F	-4354.215	80140.	397.288
NOV	39.30495	22	15	75.F	60.F	1865.979	-177.014	21	15	65.F	46.F	-4656.094	111708.	397.288
DEC	6.94581	14	15	81.F	64.F	982.772	-184.285	2	14	67.F	48.F	-3908.943	124739.	397.288
TOTAL	2520.287						-1249.714						1200822.	
MAX						2618.942						-5529.273		397.3

REPORT- SS-A SYSTEM MONTHLY LOADS SUMMARY FOR FLOOR-1

	COOLING						HEATING						ELEC	
MONTH	COOLING ENERGY (MBTU)	TIME OF MAX DY	HR	DRY-BULB TEMP	WET-BULB TEMP	MAXIMUM COOLING LOAD (KBTU/HR)	HEATING ENERGY (MBTU)	TIME OF MAX DY	HR	DRY-BULB TEMP	WET-BULB TEMP	MAXIMUM HEATING LOAD (KBTU/HR)	ELEC-TRICAL ENERGY (KWH)	MAXIMUM ELEC LOAD (KW)
JAN	0.76483	6	16	82.F	62.F	67.860	-8.829	3	15	70.F	50.F	-172.055	5341.	21.799
FEB	1.13932	3	17	76.F	57.F	75.813	-6.322	3	14	74.F	55.F	-176.985	3925.	21.799
MAR	3.25715	27	12	76.F	57.F	88.486	-11.270	20	19	73.F	50.F	-271.411	5080.	21.799
APR	9.61026	6	10	78.F	57.F	91.785	-7.005	17	15	74.F	53.F	-249.633	5637.	21.799
MAY	18.35825	12	16	97.F	73.F	100.055	-2.480	2	19	74.F	55.F	-181.401	6808.	21.799
JUN	28.43097	26	8	75.F	69.F	111.545	-0.153	1	13	74.F	59.F	-73.091	7554.	21.799
JUL	31.53273	31	17	98.F	75.F	104.795	0.000					0.000	7521.	21.799
AUG	33.03151	14	17	101.F	76.F	106.648	0.000					0.000	7956.	21.799
SEP	22.58606	18	9	75.F	71.F	109.362	0.000					0.000	6656.	21.799
OCT	11.33894	3	12	87.F	76.F	101.127	-3.142	24	14	74.F	54.F	-215.007	5627.	21.799
NOV	3.34830	8	17	82.F	64.F	84.252	-6.036	13	17	72.F	56.F	-131.370	4457.	21.799
DEC	0.67297	11	15	76.F	63.F	72.882	-8.980	20	15	64.F	48.F	-152.364	5940.	21.799
TOTAL	164.063						-54.210						72446.	
MAX						111.545						-271.411		21.8

APPENDIX II

REPORT- LS-C BUILDING PEAK LOAD COMPONENTS

*** BUILDING ***

FLOOR AREA	81362 SQFT	7559 SQMT
VOLUME	2431065 CUFT	68848 CUMT

	COOLING LOAD		HEATING LOAD	
TIME	AUG 11 4PM		JAN 18 10AM	
DRY-BULB TEMP	104F	40C	31F	-1C
WET-BULB TEMP	75F	24C	29F	-2C

	SENSIBLE (KBTU/H)	SENSIBLE (KW)	LATENT (KBTU/H)	LATENT (KW)	SENSIBLE (KBTU/H)	SENSIBLE (KW)
WALLS	44.573	13.054	0.000	0.000	-47.373	-13.874
ROOFS	173.099	50.696	0.000	0.000	-142.953	-41.867
GLASS CONDUCTION	22.392	6.558	0.000	0.000	-17.824	-5.220
GLASS SOLAR	25.057	7.338	0.000	0.000	1.406	0.412
DOOR	4.953	1.450	0.000	0.000	-5.468	-1.601
INTERNAL SURFACES	0.000	0.000	0.000	0.000	0.000	0.000
UNDERGROUND SURFACES	0.000	0.000	0.000	0.000	0.000	0.000
OCCUPANTS TO SPACE	3.090	0.905	2.260	0.662	0.798	0.234
LIGHT TO SPACE	448.777	131.436	0.000	0.000	363.500	106.460
EQUIPMENT TO SPACE	49.573	14.519	0.000	0.000	41.397	12.124
PROCESS TO SPACE	0.000	0.000	0.000	0.000	0.000	0.000
INFILTRATION	353.108	103.416	160.193	46.917	-949.998	-278.230
TOTAL	1124.621	329.373	162.453	47.578	-756.513	-221.564
TOTAL LOAD	1287.073 KBTU/H		376.951 KW		-756.513 KBTU/H	-221.564 KW
TOTAL LOAD / AREA	15.82BTU/H.SQFT		49.869 W /SQMT		9.298BTU/H.SQFT	29.312 W /SQMT

NOTE 1)THE ABOVE LOADS EXCLUDE OUTSIDE VENTILATION AIR LOADS
2)TIMES GIVEN IN STANDARD TIME FOR THE LOCATION IN CONSIDERATION

REPORT- SS-A SYSTEM MONTHLY LOADS SUMMARY FOR FLOOR-G

	COOLING						HEATING					ELEC	
MONTH	COOLING ENERGY (MBTU)	TIME OF DY	TIME MAX HR	DRY-BULB TEMP	WET-BULB TEMP	MAXIMUM COOLING LOAD (KBTU/HR)	HEATING ENERGY (MBTU)	TIME OF DY	TIME MAX HR	DRY-BULB TEMP	WET-BULB TEMP	MAXIMUM HEATING LOAD (KBTU/HR)	ELEC-TRICAL ENERGY (KWH)	MAXIMUM ELEC LOAD (KW)
JAN	14.04403	6	12	79.F	60.F	1789.895	-242.701	10	15	65.F	45.F	-4591.605	124144.	364.152
FEB	11.76606	3	15	76.F	56.F	1755.428	-132.780	8	12	67.F	52.F	-1742.202	108847.	364.152
MAR	27.67110	27	16	81.F	59.F	973.069	-205.258	4	15	66.F	45.F	-4732.227	112302.	364.152
APR	112.94130	4	13	76.F	54.F	1751.851	-107.107	17	15	74.F	53.F	-4463.699	75527.	364.152
MAY	243.86360	11	16	99.F	77.F	2234.864	-30.322	2	19	74.F	55.F	-3102.904	78877.	364.150
JUN	394.33130	12	16	94.F	75.F	2068.898	-1.543	1	13	74.F	59.F	-912.558	83204.	364.148
JUL	443.37622	31	16	99.F	75.F	2099.470	0.000	5	6	74.F	71.F	-0.013	80664.	364.143
AUG	478.07202	11	16	104.F	75.F	2332.878	0.000	25	14	74.F	71.F	-0.013	87821.	364.152
SEP	311.04590	8	14	88.F	79.F	2168.586	0.000	8	6	73.F	72.F	-0.012	75178.	364.149
OCT	142.72708	2	14	91.F	76.F	1870.667	-44.543	24	14	74.F	54.F	-3732.788	78986.	364.152
NOV	35.48775	6	12	77.F	69.F	1794.696	-156.198	21	15	65.F	46.F	-4050.739	103749.	364.152
DEC	7.60792	11	15	76.F	63.F	1769.540	-163.188	2	15	70.F	50.F	-3721.189	116047.	364.152
TOTAL	2222.789						-1083.510						1125031.	
MAX						2332.878						-4732.227		364.2

REPORT- SS-A SYSTEM MONTHLY LOADS SUMMARY FOR FLOOR-1

	COOLING						HEATING						ELEC	
MONTH	COOLING ENERGY (MBTU)	TIME OF DY	TIME MAX HR	DRY-BULB TEMP	WET-BULB TEMP	MAXIMUM COOLING LOAD (KBTU/HR)	HEATING ENERGY (MBTU)	TIME OF DY	TIME MAX HR	DRY-BULB TEMP	WET-BULB TEMP	MAXIMUM HEATING LOAD (KBTU/HR)	ELEC-TRICAL ENERGY (KWH)	MAXIMUM ELEC LOAD (KW)
JAN	0.68890	6	16	82.F	62.F	62.048	-8.040	3	15	70.F	50.F	-153.366	5075.	20.155
FEB	0.99771	3	17	76.F	57.F	65.722	-5.683	3	14	74.F	55.F	-149.753	3838.	20.155
MAR	2.61266	29	15	78.F	67.F	75.314	-10 207	11	14	71.F	47.F	-197.805	5280.	20.155
APR	8.14373	7	15	88.F	66.F	78.766	-5.861	17	15	74.F	53.F	-213.341	5296.	20.155
MAY	15.47540	12	16	97.F	73.F	87.521	-1.957	2	19	74.F	55.F	-151.647	6231.	20.155
JUN	23.81027	16	14	77.F	76.F	96.045	-0.115	1	13	74.F	59.F	-56.192	6739.	20.155
JUL	26.76962	7	10	81.F	75.F	88.542	0.000					0.000	6837.	20.155
AUG	28.30293	28	8	75.F	73.F	91.071	0.000					0.000	7296.	20.155
SEP	19.23535	8	12	81.F	77.F	94.412	0.000					0.000	6101.	20.155
OCT	9.73194	3	11	84.F	76.F	89.623	-2.728	24	14	74.F	54.F	-180.945	5351.	20.155
NOV	3.00016	13	15	77.F	59.F	74.299	-5.472	13	17	72.F	56.F	-113.844	4347.	20.155
DEC	0.66084	14	15	81.F	64.F	65.840	-8.088	18	9	28.F	23.F	-137.166	5624.	20.155
TOTAL	139.420						-48.143						67986.	
MAX						96.045						-213.341		20.2

REPORT- LS-C BUILDING PEAK LOAD COMPONENTS

*** BUILDING ***

FLOOR AREA	81362 SQFT	7559 SQMT
VOLUME	2431065 CUFT	68848 CUMT

	COOLING LOAD		HEATING LOAD	
TIME	AUG 11 4PM		JAN 30 9AM	
DRY-BULB TEMP	104F	40C	36F	2C
WET-BULB TEMP	75F	24C	31F	-1C

	SENSIBLE (KBTU/H)	SENSIBLE (KW)	LATENT (KBTU/H)	LATENT (KW)	SENSIBLE (KBTU/H)	SENSIBLE (KW)
WALLS	25.437	7.450	0.000	0.000	-22.894	-6.705
ROOFS	93.462	27.373	0.000	0.000	-67.378	-19.733
GLASS CONDUCTION	38.423	11.253	0.000	0.000	-28.557	-8.364
GLASS SOLAR	181.500	53.157	0.000	0.000	6.155	1.803
DOOR	4.953	1.450	0.000	0.000	-4.697	-1.376
INTERNAL SURFACES	0.000	0.000	0.000	0.000	0.000	0.000
UNDERGROUND SURFACES	0.000	0.000	0.000	0.000	0.000	0.000
OCCUPANTS TO SPACE	3.090	0.905	2.260	0.662	0.740	0.217
LIGHT TO SPACE	448.777	131.436	0.000	0.000	335.517	98.264
EQUIPMENT TO SPACE	49.573	14.519	0.000	0.000	39.133	11.461
PROCESS TO SPACE	0.000	0.000	0.000	0.000	0.000	0.000
INFILTRATION	353.108	103.416	160.193	46.917	-945.151	-276.811
TOTAL	1198.322	350.958	162.453	47.578	-687.132	-201.244
TOTAL LOAD	1360.774 KBTU/H		398.537 KW		-687.132 KBTU/H	-201.244 KW
TOTAL LOAD / AREA	16.72BTU/H.SQFT		52.725 W /SQMT		8.445BTU/H.SQFT	26.624 W /SQMT

NOTE 1)THE ABOVE LOADS EXCLUDE OUTSIDE VENTILATION AIR LOADS
2)TIMES GIVEN IN STANDARD TIME FOR THE LOCATION IN CONSIDERATION

REPORT- SS-A SYSTEM MONTHLY LOADS SUMMARY FOR FLOOR-G

	COOLING						HEATING						ELEC	
MONTH	COOLING ENERGY (MBTU)	TIME OF MAX DY	TIME OF MAX HR	DRY-BULB TEMP	WET-BULB TEMP	MAXIMUM COOLING LOAD (KBTU/HR)	HEATING ENERGY (MBTU)	TIME OF MAX DY	TIME OF MAX HR	DRY-BULB TEMP	WET-BULB TEMP	MAXIMUM HEATING LOAD (KBTU/HR)	ELEC-TRICAL ENERGY (KWH)	MAXIMUM ELEC LOAD (KW)
JAN	8.47937	2	14	75.F	60.F	1752.013	-263.916	10	15	65.F	45.F	-4945.277	125324.	377.775
FEB	11.12790	19	15	75.F	66.F	1614.329	-150.211	6	16	63.F	49.F	-1958.583	109841.	377.775
MAR	39.57166	27	15	81.F	58.F	1261.991	-254.134	4	15	66.F	45.F	-5146.027	112376.	377.775
APR	131.73683	6	17	89.F	61.F	1922.294	-119.472	17	15	74.F	53.F	-4823.766	77402.	377.775
MAY	273.13062	10	16	95.F	77.F	2416.616	-36.759	2	19	74.F	55.F	-3464.399	84283.	377.774
JUN	431.30273	12	16	94.F	75.F	2244.400	-1.821	1	13	74.F	59.F	-1077.323	88002.	377.772
JUL	478.64795	31	16	99.F	75.F	2267.895	0.000	13	7	74.F	71.F	-0.014	84685.	377.772
AUG	507.94019	11	16	104.F	75.F	2467.276	0.000	27	13	71.F	70.F	-0.012	91118.	377.773
SEP	332.57544	8	14	88.F	79.F	2213.101	0.000	27	14	73.F	63.F	-0.014	78034.	377.775
OCT	161.72180	2	14	91.F	76.F	1975.161	-46.891	24	14	74.F	54.F	-4061.484	78429.	377.775
NOV	39.68138	22	15	75.F	60.F	1793.440	-174.479	21	15	65.F	46.F	-4376.988	106021.	377.775
DEC	7.10986	14	15	81.F	64.F	981.696	-185.332	2	14	67.F	48.F	-3664.303	118725.	377.775
TOTAL	2422.890						-1232.876						1153702.	
MAX						2467.276						-5146.027		377.8

REPORT- SS-A SYSTEM MONTHLY LOADS SUMMARY FOR FLOOR-1

	COOLING					HEATING					ELEC	
MONTH	COOLING ENERGY (MBTU)	TIME OF MAX DY	TIME OF MAX HR	DRY-BULB TEMP	WET-BULB TEMP	MAXIMUM COOLING LOAD (KBTU/HR)	HEATING ENERGY (MBTU)	TIME OF MAX DY	TIME OF MAX HR	DRY-BULB TEMP	WET-BULB TEMP	MAXIMUM HEATING LOAD (KBTU/HR)	ELEC-TRICAL ENERGY (KWH)	MAXIMUM ELEC LOAD (KW)
JAN	0.85194	6	15	82.F	62.F	80.034	-9.510	3	15	70.F	50.F	-183.775	5337.	21.396
FEB	1.23125	28	16	77.F	64.F	78.163	-6.847	3	14	74.F	55.F	-172.837	4009.	21.396
MAR	3.29739	29	15	78.F	67.F	88.776	-11.984	11	14	71.F	47.F	-284.256	5210.	21.396
APR	10.07658	21	16	86.F	71.F	89.036	-7.152	17	15	74.F	53.F	-242.575	5835.	21.396
MAY	18.15199	12	16	97.F	73.F	97.382	-2.572	2	19	74.F	55.F	-178.435	6874.	21.396
JUN	27.86507	26	16	91.F	70.F	100.310	-0.155	1	13	74.F	59.F	-72.662	7510.	21.396
JUL	30.66617	31	16	99.F	75.F	101.666	0.000					0.000	7383.	21.396
AUG	32.31458	14	17	101.F	76.F	103.244	0.000					0.000	7906.	21.396
SEP	22.33098	1	11	85.F	76.F	100.943	0.000					0.000	6699.	21.396
OCT	11.68471	3	12	87.F	76.F	100.233	-3.314	24	14	74.F	54.F	-209.286	5864.	21.396
NOV	3.53801	8	17	82.F	64.F	82.272	-6.560	13	17	72.F	56.F	-132.254	4603.	21.396
DEC	0.74335	5	15	75.F	68.F	78.417	-6.059	10	15	74.F	56.F	-131.209	4358.	21.396
TOTAL	162.743						-54.146						71526.	
MAX						103.244						-284.256		21.4

REPORT- LS-C BUILDING PEAK LOAD COMPONENTS

*** BUILDING ***

FLOOR AREA	81362	SQFT	7559	SQMT
VOLUME	2431065	CUFT	68848	CUMT

	COOLING LOAD		HEATING LOAD	
TIME	AUG 11 4PM		JAN 18 10AM	
DRY-BULB TEMP	104F	40C	31F	-1C
WET-BULB TEMP	75F	24C	29F	-2C

	SENSIBLE (KBTU/H)	SENSIBLE (KW)	LATENT (KBTU/H)	LATENT (KW)	SENSIBLE (KBTU/H)	SENSIBLE (KW)
WALLS	44.573	13.054	0.000	0.000	-52.740	-15.446
ROOFS	173.099	50.696	0.000	0.000	-142.953	-41.867
GLASS CONDUCTION	38.423	11.253	0.000	0.000	-37.015	-10.841
GLASS SOLAR	181.500	53.157	0.000	0.000	9.417	2.758
DOOR	4.953	1.450	0.000	0.000	-5.468	-1.601
INTERNAL SURFACES	0.000	0.000	0.000	0.000	0.000	0.000
UNDERGROUND SURFACES	0.000	0.000	0.000	0.000	0.000	0.000
OCCUPANTS TO SPACE	3.090	0.905	2.260	0.662	2.711	0.794
LIGHT TO SPACE	416.391	121.951	0.000	0.000	360.519	105.587
EQUIPMENT TO SPACE	49.573	14.519	0.000	0.000	44.251	12.960
PROCESS TO SPACE	0.000	0.000	0.000	0.000	0.000	0.000
INFILTRATION	353.108	103.416	160.193	46.917	-970.954	-284.368
TOTAL	1264.709	370.402	162.453	47.578	-792.231	-232.025
TOTAL LOAD	1427.162 KBTU/H		417.980 KW		-792.231 KBTU/H	-232.025 KW
TOTAL LOAD / AREA	17.54BTU/H.SQFT		55.297 W /SQMT		9.737BTU/H.SQFT	30.696 W /SQMT

NOTE 1)THE ABOVE LOADS EXCLUDE OUTSIDE VENTILATION AIR LOADS
2)TIMES GIVEN IN STANDARD TIME FOR THE LOCATION IN CONSIDERATION

VARIABLE AIR VOLUME HEAT PUMP SYSTEMS STATE PROJECT, REDUCED LIGHT TO 1.8 DOE-2.1B 10/ 20/ 86 - W SDL RUN 1

REPORT- SS-A SYSTEM MONTHLY LOADS SUMMARY FOR FLOOR-G

	COOLING						HEATING						ELEC	
MONTH	COOLING ENERGY (MBTU)	TIME OF DY	TIME MAX HR	DRY-BULB TEMP	WET-BULB TEMP	MAXIMUM COOLING LOAD (KBTU/HR)	HEATING ENERGY (MBTU)	TIME OF DY	TIME MAX HR	DRY-BULB TEMP	WET-BULB TEMP	MAXIMUM HEATING LOAD (KBTU/HR)	ELEC-TRICAL ENERGY (KWH)	MAXIMUM ELEC LOAD (KW)
JAN	12.01629	27	14	75.F	67.F	1896.067	-272.835	10	15	65.F	45.F	-5134.859	129438.	381.589
FEB	10.96214	27	12	75.F	63.F	1798.062	-146.785	3	13	72.F	54.F	-2740.184	113498.	381.589
MAR	34.19469	27	15	81.F	58.F	1212.156	-236.564	4	15	66.F	45.F	-5381.613	115879.	381.589
APR	122.43974	1	15	77.F	55.F	1809.020	-119.465	17	15	74.F	53.F	-4973.586	75699.	381.589
MAY	274.25317	11	16	99.F	77.F	2463.404	-35.727	2	19	74.F	55.F	-3679.345	80175.	381.587
JUN	434.21704	12	16	94.F	75.F	2274.825	-1.731	1	13	74.F	59.F	-1067.391	83994.	381.582
JUL	489.04199	31	16	99.F	75.F	2411.875	0.000	5	7	73.F	70.F	-0.015	81982.	381.581
AUG	519.54370	11	16	104.F	75.F	2570.490	0.000	27	11	74.F	73.F	-0.015	88484.	381.586
SEP	334.91870	8	14	88.F	79.F	2215.575	0.000	27	18	73.F	64.F	-0.015	74452.	381.585
OCT	158.42824	2	14	91.F	76.F	1966.945	-44.987	24	14	74.F	54.F	-4216.551	76844.	381.589
NOV	35.43889	6	12	77.F	69.F	1971.897	-170.308	21	15	65.F	46.F	-4526.961	108019.	381.589
DEC	7.56231	11	15	76.F	63.F	1940.504	-175.757	2	14	67.F	48.F	-3797.056	120986.	381.589
TOTAL	2432.877						-1204.019						1149090.	
MAX						2570.490						-5381.613		381.6

REPORT- SS-A SYSTEM MONTHLY LOADS SUMMARY FOR FLOOR-1

	COOLING						HEATING					ELEC	
MONTH	COOLING ENERGY (MBTU)	TIME OF MAX DY	HR	DRY-BULB TEMP	WET-BULB TEMP	MAXIMUM COOLING LOAD (KBTU/HR)	HEATING ENERGY (MBTU)	TIME OF MAX DY	HR	DRY-BULB TEMP	WET-BULB TEMP	MAXIMUM HEATING LOAD (KBTU/HR)	ELEC-TRICAL ENERGY (KWH)	MAXIMUM ELEC LOAD (KW)
JAN	0.70412	6	16	82.F	62.F	63.358	-8.243	3	15	70.F	50.F	-159.084	5029.	20.713
FEB	0.93559	3	17	76.F	57.F	72.591	-6.408	3	14	74.F	55.F	-168.798	4153.	20.713
MAR	2.99167	27	12	76.F	57.F	84.748	-11.433	11	14	71.F	47.F	-253.467	5199.	20.713
APR	9.12437	6	10	78.F	57.F	88.844	-6.646	17	15	74.F	53.F	-239.438	5291.	20.713
MAY	17.54887	12	16	97.F	73.F	96.405	-2.344	2	19	74.F	55.F	-173.623	6402.	20.713
JUN	27.36719	26	8	75.F	69.F	106.143	-0.143	1	13	74.F	59.F	-68.768	7156.	20.713
JUL	30.40933	31	17	98.F	75.F	100.990	0.000					0.000	7146.	20.713
AUG	31.76843	14	17	101.F	76.F	102.870	0.000					0.000	7530.	20.713
SEP	21.59451	8	14	88.F	79.F	108.333	0.000					0.000	6250.	20.713
OCT	10.76416	3	12	87.F	76.F	95.086	-2.950	24	14	74.F	54.F	-205.724	5255.	20.713
NOV	3.10383	8	17	82.F	64.F	81.160	-5.621	13	17	72.F	56.F	-124.460	4140.	20.713
DEC	0.62804	11	15	76.F	63.F	65.983	-8.468	20	15	64.F	48.F	-145.678	5606.	20.713
TOTAL	156.931						-52.248						69135.	
MAX						108.333						-253.467		20.7

REPORT- LS-C BUILDING PEAK LOAD COMPONENTS

*** BUILDING ***

FLOOR AREA	81362	SQFT	7559	SQMT
VOLUME	2431065	CUFT	68848	CUMT

	COOLING LOAD		HEATING LOAD	
TIME	AUG 11 4PM		JAN 30 9AM	
DRY-BULB TEMP	104F	40C	36F	2C
WET-BULB TEMP	75F	24C	31F	-1C

	SENSIBLE (KBTU/H)	SENSIBLE (KW)	LATENT (KBTU/H)	LATENT (KW)	SENSIBLE (KBTU/H)	SENSIBLE (KW)
WALLS	40.752	11.935	0.000	0.000	-48.640	-14.245
ROOFS	162.645	47.635	0.000	0.000	-135.486	-39.681
GLASS CONDUCTION	35.832	10.494	0.000	0.000	-34.547	-10.118
GLASS SOLAR	181.500	53.157	0.000	0.000	7.581	2.220
DOOR	4.575	1.340	0.000	0.000	-5.095	-1.492
INTERNAL SURFACES	0.000	0.000	0.000	0.000	0.000	0.000
UNDERGROUND SURFACES	0.000	0.000	0.000	0.000	0.000	0.000
OCCUPANTS TO SPACE	2.742	0.803	2.596	0.760	2.233	0.654
LIGHT TO SPACE	416.391	121.951	0.000	0.000	332.765	97.459
EQUIPMENT TO SPACE	49.573	14.519	0.000	0.000	41.831	12.251
PROCESS TO SPACE	0.000	0.000	0.000	0.000	0.000	0.000
INFILTRATION	314.814	92.201	159.300	46.655	-1034.507	-302.981
TOTAL	1208.825	354.035	161.895	47.415	-873.865	-255.933
TOTAL LOAD	1370.720 KBTU/H		401.450 KW		-873.865 KBTU/H	-255.933 KW
TOTAL LOAD / AREA	16.85BTU/H.SQFT		53.110 W /SQMT		10.740BTU/H.SQFT	33.859 W /SQMT

NOTE 1)THE ABOVE LOADS EXCLUDE OUTSIDE VENTILATION AIR LOADS
2)TIMES GIVEN IN STANDARD TIME FOR THE LOCATION IN CONSIDERATION

REPORT- SS-A SYSTEM MONTHLY LOADS SUMMARY FOR FLOOR-G

	COOLING						HEATING						ELEC	
MONTH	COOLING ENERGY (MBTU)	TIME OF DY	TIME MAX HR	DRY-BULB TEMP	WET-BULB TEMP	MAXIMUM COOLING LOAD (KBTU/HR)	HEATING ENERGY (MBTU)	TIME OF DY	TIME MAX HR	DRY-BULB TEMP	WET-BULB TEMP	MAXIMUM HEATING LOAD (KBTU/HR)	ELEC-TRICAL ENERGY (KWH)	MAXIMUM ELEC LOAD (KW)
JAN	2.47056	6	16	82.F	62.F	520.222	-142.284	12	15	61.F	42.F	-3226.765	85262.	283.336
FEB	3.01940	28	19	84.F	80.F	1154.460	-79.938	20	12	49.F	38.F	-1889.852	70018.	283.336
MAR	23.55457	27	15	81.F	58.F	1235.093	-113.625	6	13	55.F	40.F	-2702.327	73812.	283.336
APR	83.82761	6	17	89.F	61.F	1531.969	-35.853	17	12	70.F	50.F	-1915.938	67284.	283.335
MAY	220.90999	8	13	90.F	79.F	2113.143	-11.300	2	12	69.F	53.F	-1147.463	76227.	283.335
JUN	363.61597	19	13	88.F	76.F	1995.124	-0.461	1	11	70.F	58.F	-267.124	83179.	283.335
JUL	429.03320	31	16	99.F	75.F	1968.168	0.000					0.000	79890.	283.335
AUG	445.94824	11	16	104.F	75.F	2073.381	0.000	31	6	69.F	66.F	-0.004	87887.	283.335
SEP	285.00732	8	14	88.F	79.F	2051.660	-0.002	27	8	62.F	58.F	-2.337	72872.	283.335
OCT	121.10011	2	14	91.F	76.F	2003.765	-27.211	24	12	70.F	53.F	-1258.523	66237.	283.334
NOV	20.74608	8	15	87.F	65.F	1085.347	-108.429	14	13	52.F	38.F	-2940.339	72631.	283.336
DEC	2.28476	14	15	81.F	64.F	843.961	-105.258	2	13	65.F	47.F	-2171.437	81456.	283.336
TOTAL	2001.401						-624.267						916626.	
MAX						2113.143						-3226.765		283.3

REPORT- SS-A SYSTEM MONTHLY LOADS SUMMARY FOR FLOOR-1

	COOLING						HEATING					ELEC	
MONTH	COOLING ENERGY (MBTU)	TIME OF MAX DY	TIME OF MAX HR	DRY-BULB TEMP	WET-BULB TEMP	MAXIMUM COOLING LOAD (KBTU/HR)	HEATING ENERGY (MBTU)	TIME OF MAX DY	TIME OF MAX HR	DRY-BULB TEMP	WET-BULB TEMP	MAXIMUM HEATING LOAD (KBTU/HR)	ELEC-TRICAL ENERGY (KWH)	MAXIMUM ELEC LOAD (KW)
JAN	0.33656	6	14	83.F	62.F	57.782	-7.090	3	15	70.F	50.F	-124.878	3761.	16.292
FEB	0.42131	28	19	84.F	80.F	60.447	-5.233	3	12	69.F	53.F	-69.976	3502.	16.292
MAR	1.61945	29	16	79.F	66.F	70.398	-7.863	11	15	70.F	47.F	-142.683	4435.	16.292
APR	5.68653	26	12	79.F	65.F	74.665	-3.548	17	12	70.F	50.F	-158.379	4925.	16.292
MAY	12.54852	8	13	90.F	79.F	83.098	-1.045	2	12	69.F	53.F	-96.996	5449.	16.292
JUN	19.78262	26	15	91.F	70.F	82.508	-0.065	1	11	70.F	58.F	-30.565	5734.	16.292
JUL	23.09789	31	17	98.F	75.F	83.920	0.000					0.000	5576.	16.292
AUG	23.50606	14	17	101.F	76.F	85.895	0.000					0.000	6009.	16.292
SEP	16.35400	8	14	88.F	79.F	87.803	0.000					0.000	5262.	16.292
OCT	7.74623	8	11	80.F	72.F	82.911	-2.270	24	12	70.F	53.F	-112.221	4968.	16.292
NOV	1.73733	8	17	82.F	64.F	67.775	-5.163	13	18	69.F	54.F	-79.812	3984.	16.292
DEC	0.18847	14	15	81.F	64.F	65.415	-4.742	27	15	68.F	52.F	-60.617	3778.	16.292
TOTAL	113.016						-37.013						57371.	
MAX						87.803						-158.379		16.3

REPORT- LS-C BUILDING PEAK LOAD COMPONENTS

*** BUILDING ***

FLOOR AREA	81362 SQFT	7559 SQMT
VOLUME	2431065 CUFT	68848 CUMT

	COOLING LOAD		HEATING LOAD	
TIME	AUG 11 4PM		JAN 30 9AM	
DRY-BULB TEMP	104F	40C	36F	2C
WET-BULB TEMP	75F	24C	31F	-1C

	SENSIBLE (KBTU/H)	SENSIBLE (KW)	LATENT (KBTU/H)	LATENT (KW)	SENSIBLE (KBTU/H)	SENSIBLE (KW)
WALLS	40.752	11.935	0.000	0.000	-48.640	-14.245
ROOFS	162.645	47.635	0.000	0.000	-135.486	-39.681
GLASS CONDUCTION	35.832	10.494	0.000	0.000	-34.547	-10.118
GLASS SOLAR	181.500	53.157	0.000	0.000	7.581	2.220
DOOR	4.575	1.340	0.000	0.000	-5.095	-1.492
INTERNAL SURFACES	0.000	0.000	0.000	0.000	0.000	0.000
UNDERGROUND SURFACES	0.000	0.000	0.000	0.000	0.000	0.000
OCCUPANTS TO SPACE	2.742	0.803	2.596	0.760	2.233	0.654
LIGHT TO SPACE	448.777	131.436	0.000	0.000	358.646	105.039
EQUIPMENT TO SPACE	49.573	14.519	0.000	0.000	41.831	12.251
PROCESS TO SPACE	0.000	0.000	0.000	0.000	0.000	0.000
INFILTRATION	314.814	92.201	159.300	46.655	-1034.507	-302.981
TOTAL	1241.211	363.520	161.895	47.415	-847.984	-248.353

TOTAL LOAD	1403.106 KBTU/H		410.935	KW	-847.984 KBTU/H	-248.353 KW
TOTAL LOAD / AREA	17.25BTU/H.SQFT	54.365	W /SQMT		10.422BTU/H.SQFT	32.856 W /SQMT

NOTE 1)THE ABOVE LOADS EXCLUDE OUTSIDE VENTILATION AIR LOADS
2)TIMES GIVEN IN STANDARD TIME FOR THE LOCATION IN CONSIDERATION

REPORT- SS-A SYSTEM MONTHLY LOADS SUMMARY FOR FLOOR-G

	COOLING						HEATING						ELEC	
MONTH	COOLING ENERGY (MBTU)	TIME OF MAX DY	TIME OF MAX HR	DRY-BULB TEMP	WET-BULB TEMP	MAXIMUM COOLING LOAD (KBTU/HR)	HEATING ENERGY (MBTU)	TIME OF MAX DY	TIME OF MAX HR	DRY-BULB TEMP	WET-BULB TEMP	MAXIMUM HEATING LOAD (KBTU/HR)	ELECTRICAL ENERGY (KWH)	MAXIMUM ELEC LOAD (KW)
JAN	2.28550	6	16	82.F	62.F	494.127	-219.994	3	15	70.F	50.F	-3804.113	107497.	317.960
FEB	3.18780	28	19	84.F	80.F	1111.384	-125.385	3	12	69.F	53.F	-1594.070	95581.	317.960
MAR	21.81783	27	14	80.F	59.F	1271.790	-206.143	24	12	75.F	49.F	-5654.281	101382.	317.960
APR	80.06250	6	17	89.F	61.F	1467.234	-91.286	17	15	74.F	53.F	-3641.235	75260.	317.960
MAY	224.79466	11	16	99.F	77.F	2197.413	-51.400	15	17	75.F	56.F	-3097.963	80078.	317.960
JUN	366.74756	12	16	94.F	75.F	2064.290	-2.507	1	13	74.F	59.F	-1047.260	86230.	317.959
JUL	432.91333	31	16	99.F	75.F	2158.660	0.000					0.000	82147.	317.958
AUG	450.12207	11	16	104.F	75.F	2281.422	0.000	23	6	75.F	70.F	-0.010	90897.	317.960
SEP	288.20068	8	14	88.F	79.F	2077.610	0.000	7	6	74.F	73.F	-0.009	75850.	317.959
OCT	121.00304	2	14	91.F	76.F	2018.160	-53.611	24	18	75.F	54.F	-3581.459	76897.	317.960
NOV	21.44357	8	15	87.F	65.F	1125.612	-147.037	21	15	65.F	46.F	-3381.540	95055.	317.960
DEC	2.40364	14	15	81.F	64.F	887.041	-143.168	2	15	70.F	50.F	-2996.173	101181.	317.960
TOTAL	2014.864						-1040.395						1067855.	
MAX						2281.422						-5654.281		318.0

REPORT- SS-A SYSTEM MONTHLY LOADS SUMMARY FOR FLOOR-1

	COOLING						HEATING						ELEC	
MONTH	COOLING ENERGY (MBTU)	TIME OF MAX DY	TIME OF MAX HR	DRY-BULB TEMP	WET-BULB TEMP	MAXIMUM COOLING LOAD (KBTU/HR)	HEATING ENERGY (MBTU)	TIME OF MAX DY	TIME OF MAX HR	DRY-BULB TEMP	WET-BULB TEMP	MAXIMUM HEATING LOAD (KBTU/HR)	ELEC-TRICAL ENERGY (KWH)	MAXIMUM ELEC LOAD (KW)
JAN	0.37405	6	16	82.F	62.F	64.425	-8.381	3	15	70.F	50.F	-135.523	4709.	17.215
FEB	0.42589	28	19	84.F	80.F	63.087	-6.333	3	14	74.F	55.F	-122.332	3757.	17.215
MAR	1.59453	29	16	79.F	66.F	71.512	-11.255	24	12	75.F	49.F	-247.123	4738.	17.215
APR	5.83442	26	15	83.F	67.F	76.856	-6.281	17	15	74.F	53.F	-171.218	5219.	17.215
MAY	13.06589	30	10	78.F	74.F	135.271	-3.204	15	17	75.F	56.F	-134.405	5771.	17.215
JUN	21.05911	16	16	78.F	76.F	182.475	-0.219	1	13	74.F	59.F	-61.320	6059.	17.215
JUL	24.44931	6	12	78.F	75.F	156.333	0.000					0.000	5883.	17.215
AUG	24.80069	26	14	78.F	75.F	143.791	0.000					0.000	6339.	17.215
SEP	17.38177	8	11	78.F	75.F	157.896	0.000					0.000	5561.	17.215
OCT	8.33027	13	11	78.F	76.F	161.668	-3.868	24	18	75.F	54.F	-159.754	5273.	17.215
NOV	1.77808	8	17	82.F	64.F	70.350	-6.503	13	16	74.F	57.F	-110.361	4260.	17.215
DEC	0.19505	14	15	81.F	64.F	70.376	-7.238	18	8	28.F	23.F	-108.396	5008.	17.215
TOTAL	119.281						-53.275						62559.	
MAX						182.475						-247.123		17.2