
Technical Assignment Two

Building and Plant Energy Analysis Report



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Salisbury, CT

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1.0 Executive Summary

All mechanical option students in AE 481 class were assigned to write a technical assignment two report which consists of design load estimation and annual energy consumption and operating cost.

In the process of obtaining information about the design load estimation, eQuest software was used to run the energy simulation. All the building data was put into the program to run the simulation. Annual energy consumption was provided by the software and it was 1,148,300 kWh per year.

In second part of assignment discussed about annual energy consumption and operating cost. The program eQuest used \$0.09051/kWh for electricity in commercial buildings and \$0.99/liter for natural gas. Operating cost of the building was \$175,933.

According to the data, the cost to operate the building per square foot was \$1.72 / ft². It is not as expensive as other commercial buildings since the function of the building is gymnasium.

2.0 Design Load Estimation

2.1 eQuest Data

eQuest software was used in order to obtain the design load estimation.
Following data was entered.

Building type – gymnasium

Location set – Hartford, CT

Utility rate – electric, gas

Building area – 102,000 square feet

Building envelope construction – roof and wall R values

Area of exterior windows –

	Wall Gross Area(sf)	Glass Area(sf)
West	13865	3028.15
East	13865	1541.37
North	11718	3520.29
South	11718	0

Activity areas allocation –

Gymnasium 75 sf/person

Office 225 sf/person

Storage 450 sf/person

Corridor 150 sf/person

Lighting –

Gymnasium 1 W/sf

Corridor 0.6 W/sf

Office 1.3 W/sf

Storage 0.6 W/sf

Open and close hours – 7am to 6pm according to school schedule

HVAC system fans – supply fan 3.5 in wg

Utility bills – \$0.09051/kWh for commercial buildings from Northeast Utilities supplier
For rate of fuel cost, \$0.99 /liter and 1 liter can produce 30,489 BTU

2.2 Energy Consumption

Following graphs are electric consumption in kWh and gas consumption in Btu. Electric consumption data consists of area lighting, ventilation, pumps, and space cooling. Fuel consumption is only used for spacing heating and water heating.

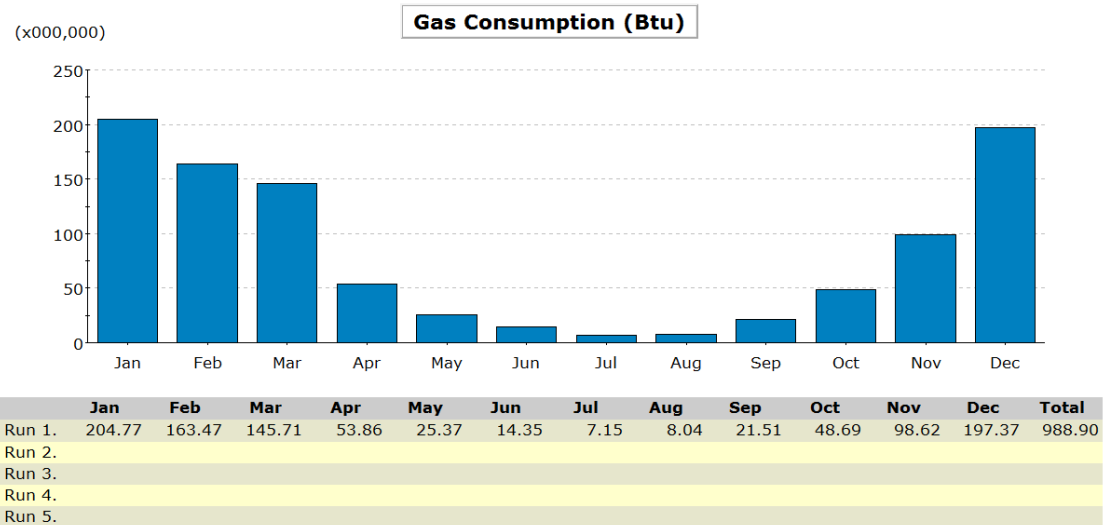
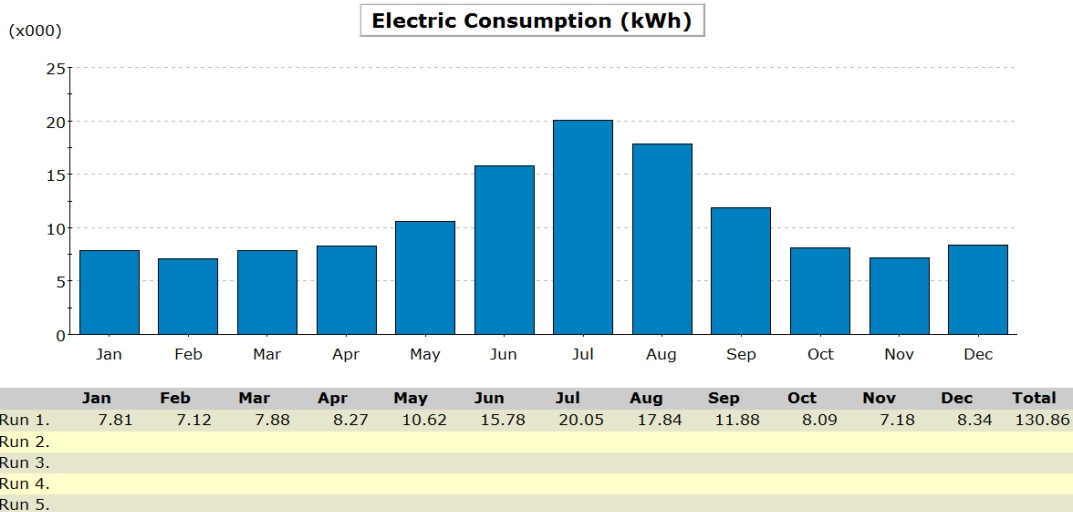


Table shown below represents annual energy consumption of the lights and equipment electrical load

Lighting	262800	kWh
Misc. Equipment	196200	kWh
Ventilation	366500	kWh
Pumps	98600	kWh
Space Cooling	209500	kWh
Total	1,148,300	kWh
Total / 102000sf	11.10	watt/sf

2.3 Design Occupancy

Design occupancy from schedule was not provided by engineer. Design occupancy could be found from internet and used following data.

- Activity areas allocation –
- Gymnasium 75 sf/person
- Office 225 sf/person
- Storage 450 sf/person
- Corridor 150 sf/person

2.4 Design Dry-Bulb Temperature

Data of ASHRAE design indoor and outdoor condition for Hartford, CT was achieved from TRACE 700 weather library data. As we can see from data below, 99.6% winter design dry-bulb temperature is 2.9 °F. and 0.4% cooling design dry-bulb temperature is 91.3 °F.

The screenshot shows the ASHRAE Climatic Data software interface. The Region is set to United States, Subregion to North East, and Location to Hartford, Connecticut. The design month is July. The ASHRAE Climatic Data section shows Winter Design conditions: 99.6% and 99% dry bulb temperatures of 2.9 and 7.6 respectively. The Cooling Maximum DB / Mean Coincident WB section shows 0.4%, 1%, and 2% dry bulb temperatures of 91.3, 88.3, and 85.4 respectively. The Dehumid Maximum DB / Mean Coincident DB section shows 0.4%, 1%, and 2% dry bulb temperatures of 80.9, 79.2, and 77.9 respectively.

2.5 Design Load and Ventilation

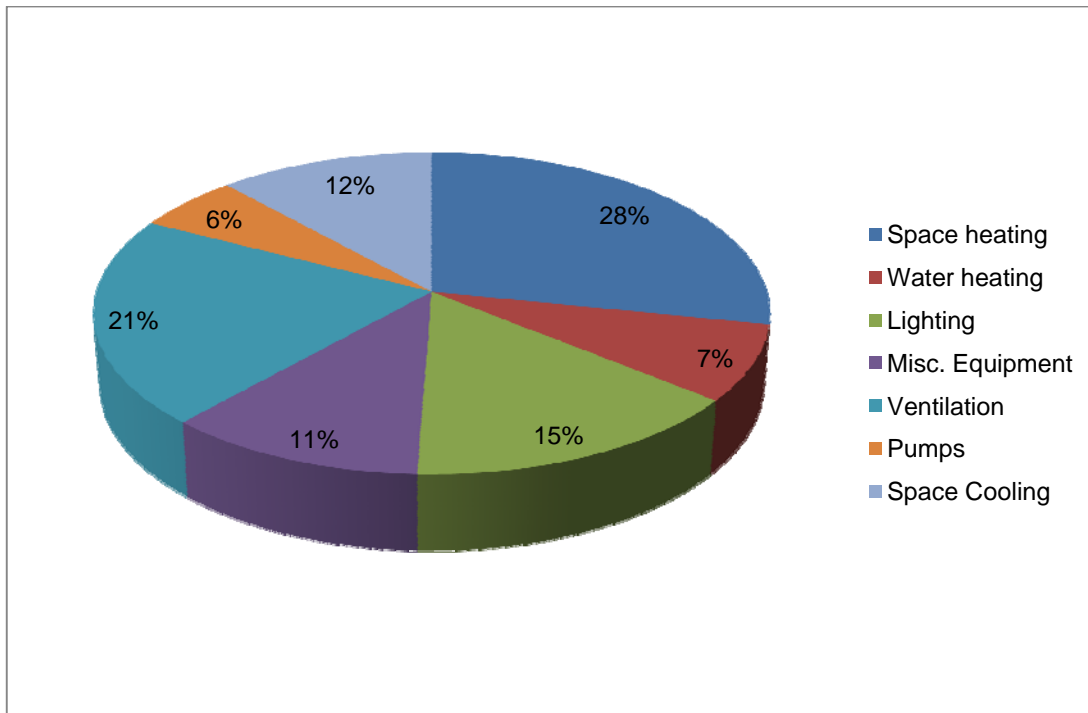
Designed load and ventilation indices were not provided by engineer but computed design load and ventilation was calculated.

	Cooling (sf/ton)	Supply Air (cfm/sf)	Ventilation Air (cfm/sf)
Computed	560 sf/ton	0.955 cfm/sf	0.347 cfm/sf

2.6 Annual Energy Consumption

Annual energy consumption for Flood Athletic Center is shown below.

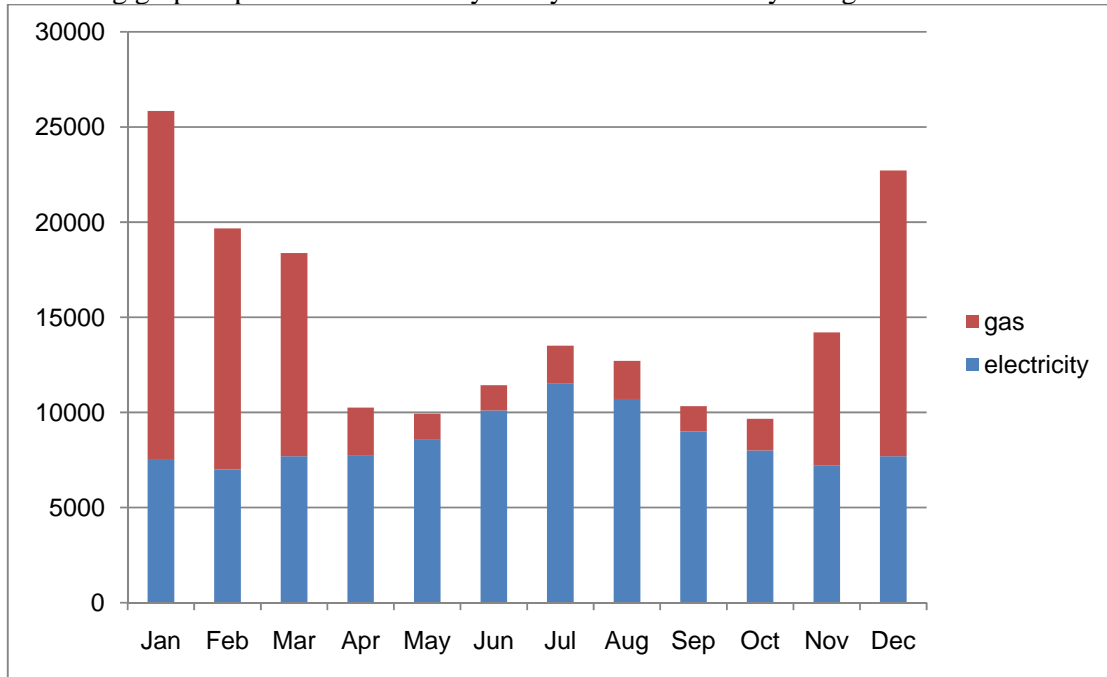
Space heating	498,200	kWh
Water heating	134,812	kWh
Lighting	260,000	kWh
Misc. Equipment	195,000	kWh
Ventilation	370,000	kWh
Pumps	100,000	kWh
Space Cooling	207,000	kWh



3.0 Annual Energy Consumption and Operating Costs

3.1 Annual Cost Breakdown

Following graph represents the monthly utility bill for electricity and gas.



The annual cost for utility bill is \$175,933 according to the data from eQuest.
The annual cost per square foot to operate the building is $\$175,933/102,000 \text{ ft}^2 = \$1.72 / \text{ft}^2$.

3.2 Contact with Design Engineer.

With the contact with building design engineer, prescriptive method was applied for an energy analysis. The office of Michael Rosenfeld Inc. has used ComCheck software to analyze the load on the building. But since ComCheck does not calculate the cost regarding equipments in the building results could not be compared. They have mentioned that the building is not design for LEED but used ASHRAE compliance.

Flood Athletic Center does not have actual utility bills/data since the building will be completed on December.

3.3 Annual Emission

Emission is important fact in the building. Table below shows how much emission the building will have.

	For Delivered Electricity	Total Emission
CO ₂	1.57 lb / kWh	2771068.84 lb
NO _x	0.00276 lb / kWh	48714.3312 lb
SO _x	0.00836 lb / kWh	14755.50032 lb
Total kWh in the building	1765012 kWh	