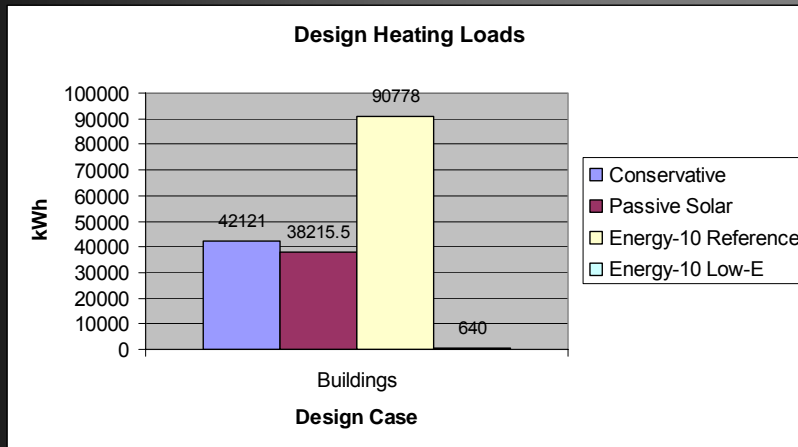


| F. Heating Load Calculations                                       |  |        |        |
|--|--|--------|--------|
| Net daily heat transmission coefficient (NLC), Btu/F-day           |  |        | 252413 |
| Total daily heat transmission coefficient (TLC), Btu/F-day         |  |        | 278126 |
|  |  | Btu/h  | kW     |
| Design heating load (qH = (UA)tot x Δt) - conservative assumptions |  | 394012 | 115.4  |
| Design heating load (qH = (UA)net x Δt) - passive solar building   |  | 357586 | 104.7  |

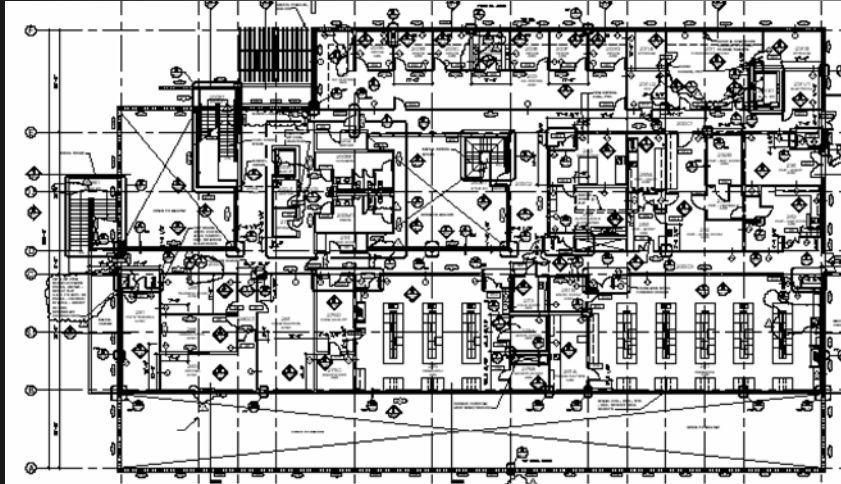
115.4 kW x 365 days = **42, 121 kWh**      104.7 kW x 365 days = **38,215.5 kWh**

|                                 |  |                        |
|---------------------------------|--|------------------------|
| Results:                        | (Energy cost: 0.400 \$/Therm, 0.054 \$/kWh, 2.470 \$/kW) |                        |
| Simulation dates                | 01-Jan to 31-Dec   | 01-Jan to 31-Dec       |
| Simulation status, Thermal/DL   | valid/NA   | valid/valid            |
| Energy use, kBtu                | 1093629  | 249575                 |
| Energy cost,                    | \$21271  | 5089                   |
| Saved by daylighting, kWh       | NA   | 0                      |
| Total Electric, kWh             | 320496   | 73140                  |
| Internal/External lights, kWh   | 0/0  | 0/0                    |
| <b>Heating/Cooling/Fan, kWh</b> | <b>90778/192458/37260</b>                                | <b>640/61594/10906</b> |
| Elec. Res./Heat Pump, kWh       | 90337/441  | 634/6                  |
| Hot water/Other, kWh            | 0/0  | 0/0                    |
| Peak Electric, kW               | 195.4  | 52.3                   |
| Fuel, hw/heat/total, kBtu       | 0/0/0  | 0/0/0                  |
| Emissions, CO2/SO2/NOx, lbs     | 430747/2532/1314   | 98300/578/300          |

Comparing spreadsheet heating load to Energy-10 simulation. There is a large difference between the spreadsheet calculations and the Energy-10 calculations. This may be a possible error on my part, however the cases can still be examined as to their relationship with one another. The passive solar case has a slightly smaller heating load than the conservative building. This is possibly due to the gains from the solar solar collecting south windows.



Graphic comparison. According to the spreadsheet calculations, the passive solar building demand less heating. This proves to be better than the conventional building, but not by much. This clearly shows that the passive solar and low energy case outperform the conventional building and the reference case. Design criteria could be change to further exaggerate this difference. One of the main discrepancies, possibly lies in that the building was modeled in Energy-10 with the south windows in full shade, which lowers heat gain as increases need for mechanical heating. The spreadsheet calculations did not consider this.



The passive solar method did achieve a reduced heating load. So this does seem like a possible solution to reduce the building's heating load. It would need to be taken further to have a greater impact. However, it's decrease could be further improved by adding more thermal mass to counter heat losses through the large south collector area.

## c h a n g e s   i n   d e s i g n   c r i t e r i a

1. move north facing windows to south
2. lower north window u-value
3. reduce infiltration on north side
4. reduce number of windows on north side
5. reduce winter shading on south side
6. reduction in ventilation load

| Building Component   |        | UA<br>Btu/h-F |
|--|--------|---------------|
| Ventilation  |        | 7331          |
| Design heating load ( $qH = (UA)_{tot} \times \Delta t$ ) - conservative assumptions | 394012 | 115.4         |
| Ventilation  |        | 3500          |
| Design heating load ( $qH = (UA)_{tot} \times \Delta t$ ) - conservative assumptions | 263745 | 77.2          |

By moving north facing windows to the south, you reduce the infiltration and heat loss on that façade. This also allows an increase in heat gain on the south façade. Since the results show that heat is needed, this would be advantages. By lowering the u-value on the north windows, the heat loss can be reduced. The south windows, however, would be left alone, so they can still allow heat gain into the building. Also, by reducing infiltration on the north side, the heat loss is also reduced. By allowing winter sun to come into the south collector area, the passive solar example would improve dramatically. The ventilation load is highest load in spreadsheet, a reduction would greatly reduce heat loads. Reducing ventilation load coefficient by half, reduces total heating load by one-third. This would be a huge reduction in the heating system.

## maximum hourly rate of fuel consumption

|   | Btu/h  | kW    |
|---|--------|-------|
| Design heating load ( $q_H = (UA)_{tot} \times \Delta t$ ) - conservative assumptions | 394012 | 115.4 |

fuel oil  $\rightarrow 394,012 / (141,000 \times .75) = 3.73 \text{ gal/h}$

natural gas  $\rightarrow 394,012 / (1052 \times .75) = 499.38 \text{ cfh}$

electricity  $\rightarrow 394,012 / (3413 \times 1) = 115.44 \text{ kW}$

When a building falls below its balance point, it will require heating. These maximum hourly rates of fuel consumption were calculated as maximum hourly heat loss divided by the product of heat value and efficiency. (as per MEEB)