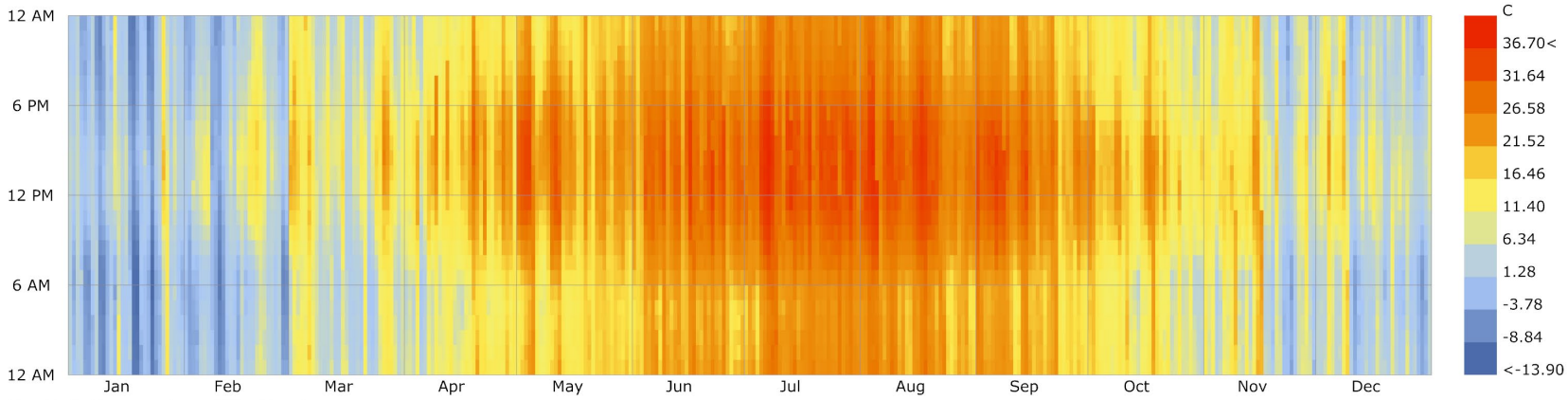
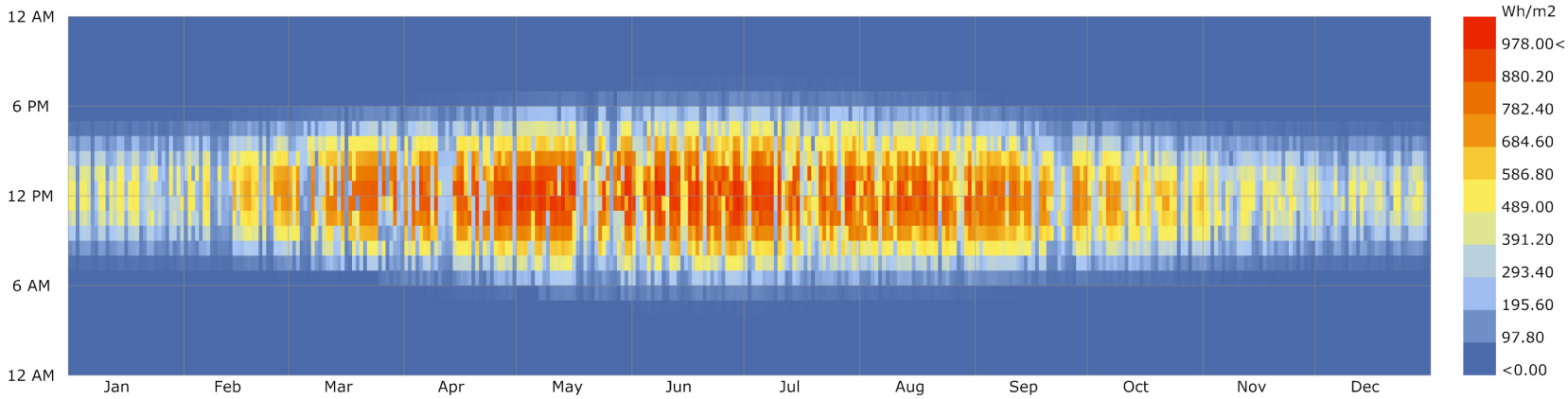
Philadelphia Weather



Dry Bulb Temperature (C) - Hourly
Philadelphia International Ap_PA_USA
1 JAN 1:00 - 31 DEC 24:00

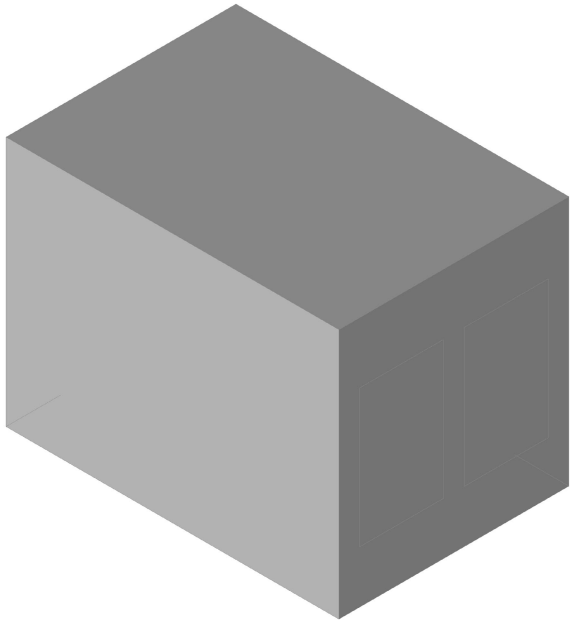


Global Horizontal Radiation (Wh/m2) - Hourly
Philadelphia International Ap_PA_USA
1 JAN 1:00 - 31 DEC 24:00

Philadelphia weather is highly variable with hot summers and cold winters. These issues are only exacerbated by the intensity of the sun in the summer and the low angle in the winter. An understanding of these changes are important when designing or looking at the energy and lighting demands for a space. With these high variations it is hard to make an truly passively maintained building. However, the following pages represent some of the changes possible to try and reduce the needed mechanical loads as much as possible.

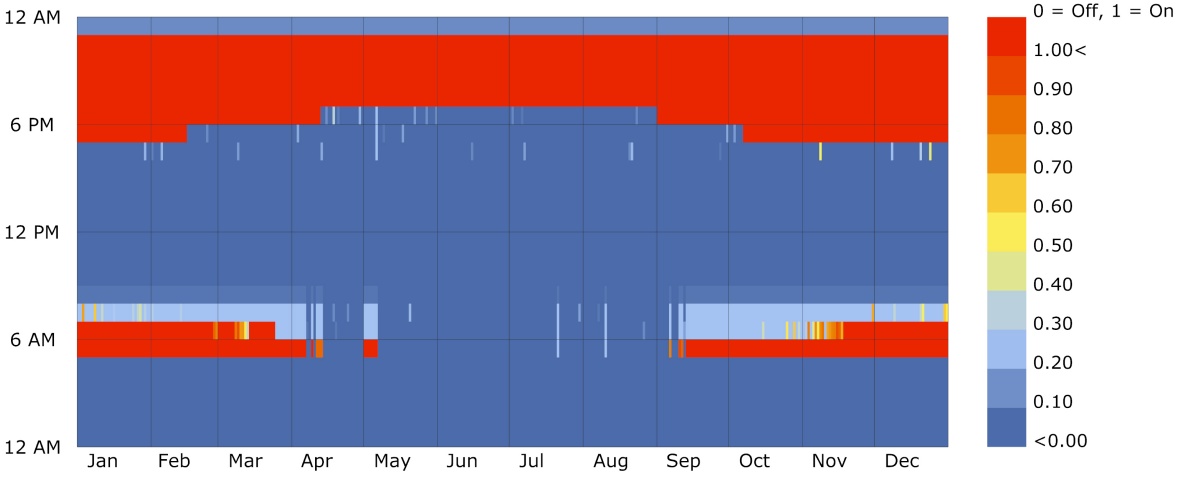
The following analysis has some shortfallings. First these are run for the hours a home is occupied. Since the home is mostly occupied at night, lighting will generally be needed despite the design. Additionally since the room is occupied when the sun is low and toward the East and west, the shading devices which would work to alieviate issues for 90% of the critical day, do not work as well at this time. Still, the following looks into proposals which take into account both heating and cooling loads and lighting.

Base Energy Balance and Comfort



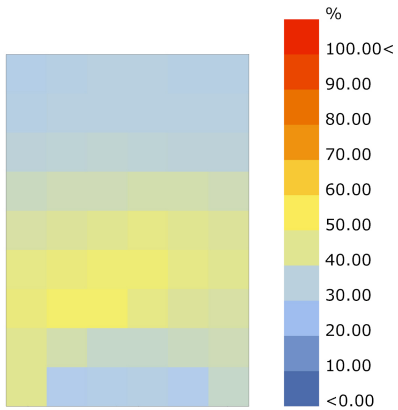
The graphs to the right show both the heating and cooling loads as well as the need for lighting. It is important to note that this is run mostly when the sun is in the east and west and lower in the sky or down. The cooling and, to an extend, the heating loads are clearly quite high in this room when comparted to the lighting loads. Additionally, despite the unusual hours, daylighting is not terrible and reaches decently deeply into the building.

Total load is 1881 kWh.

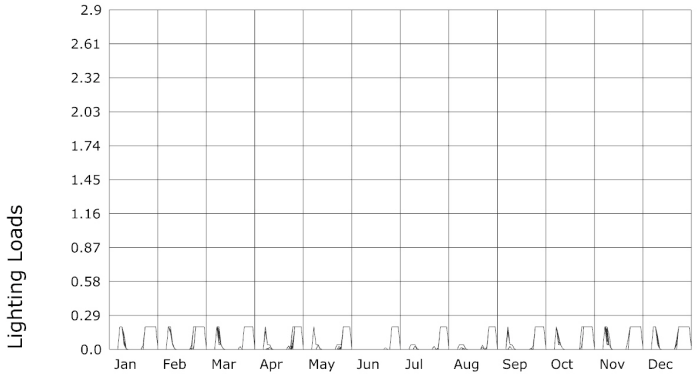


Lighting Switch Profile (0 = Off, 1 = On) - Hourly

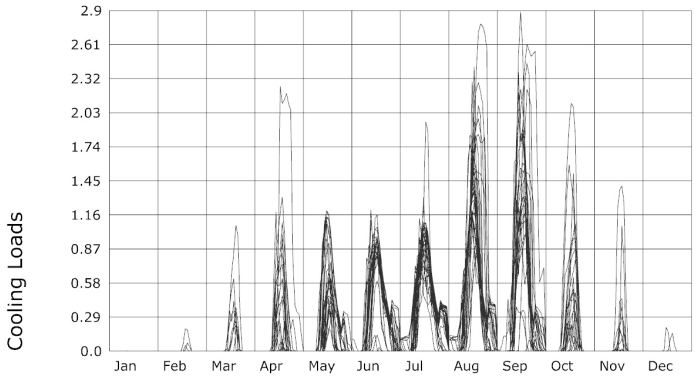
1 JAN 1:00 - 31 DEC 24:00



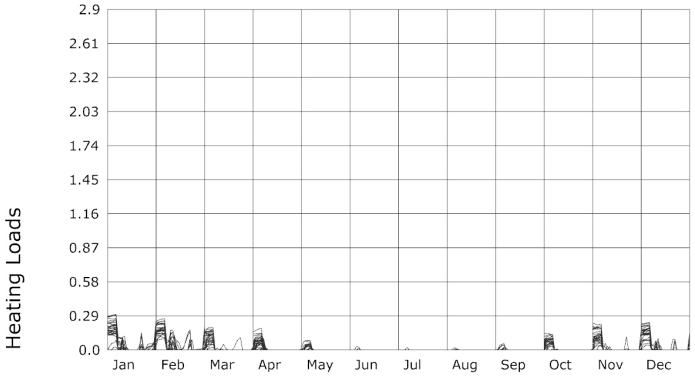
Annual Daylight Analysis



Lighting Load: 442 kWh

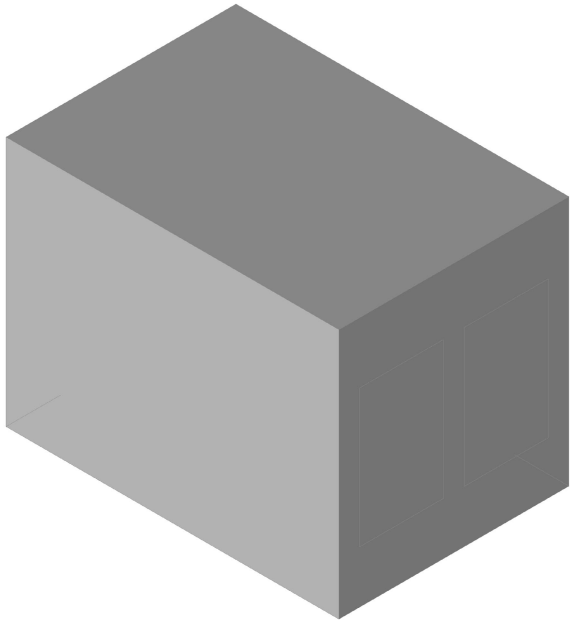


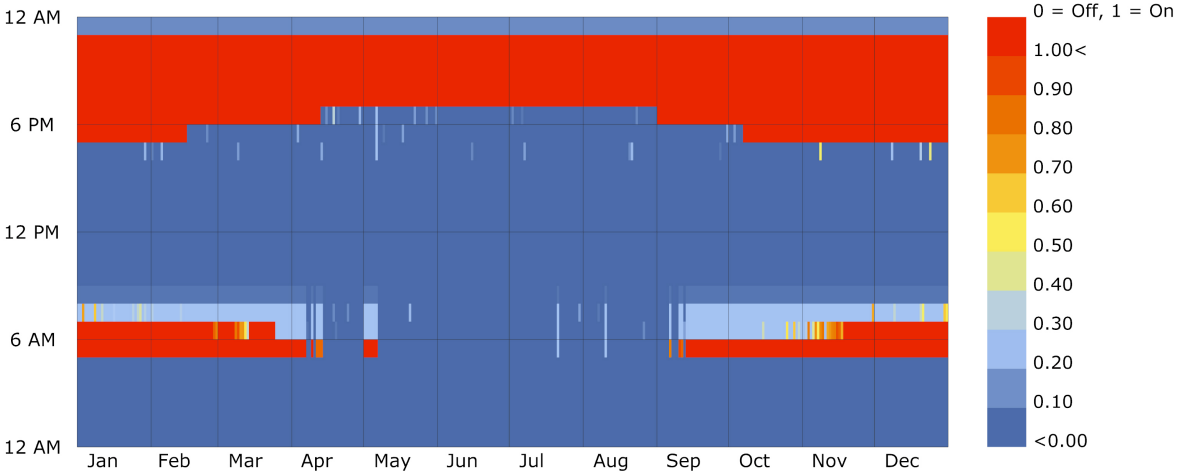
Cooling Load: 1297 kWh



Heating Load: 142 kWh

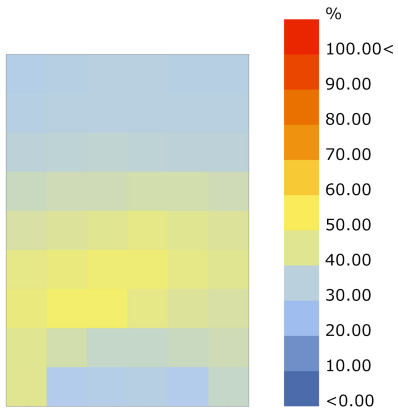
Energy Balance and Comfort with New materials



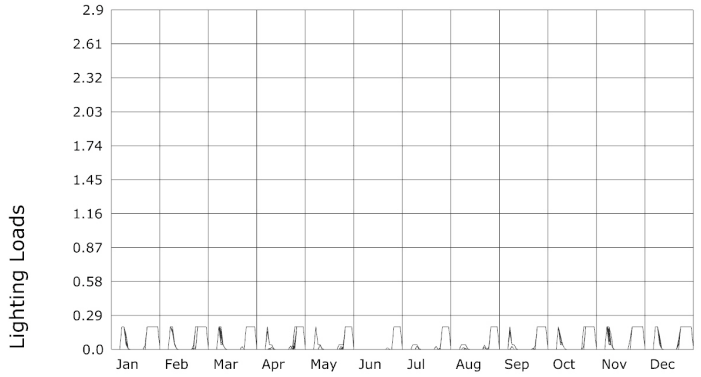


Lighting Switch Profile (0 = Off, 1 = On) - Hourly

1 JAN 1:00 - 31 DEC 24:00



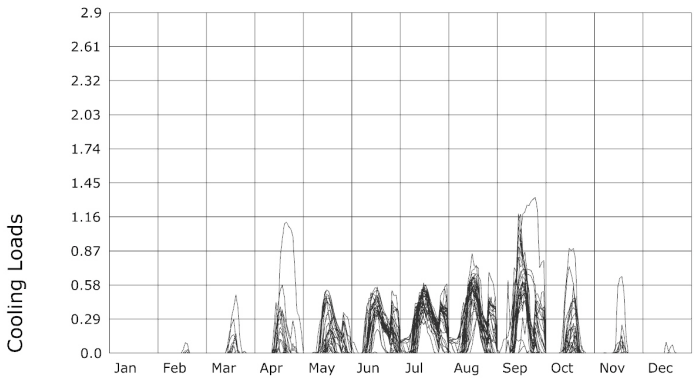
Annual Daylight Analysis



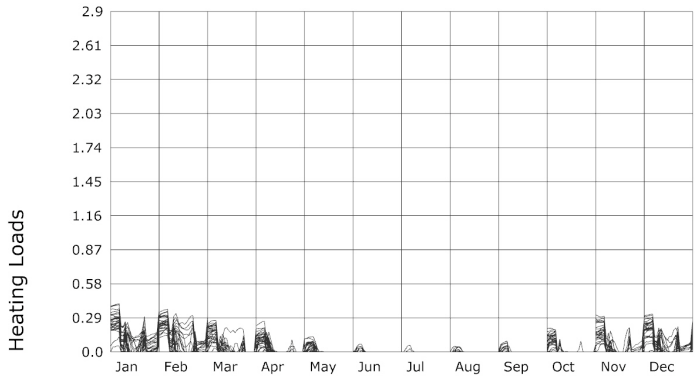
Lighting Load: 442 kWh

The graphs to the right show the changes which both the heating and cooling loads as well as the need for lighting. By changing the window to a uble paned, low-e, argon filled window unit and adding extra insulation to the exterior wall the cooling load drops drastically. However, with the reduced visual transmittance of the proposed window, the heating load has increased. Suprisingly, despite this reduce clarity, the need for lighting has not changed. This is perhaps due to the need for lighting being mostly dependent on the unusual hours.

Total Load is 1396.
Initial Load Reduced by 26%

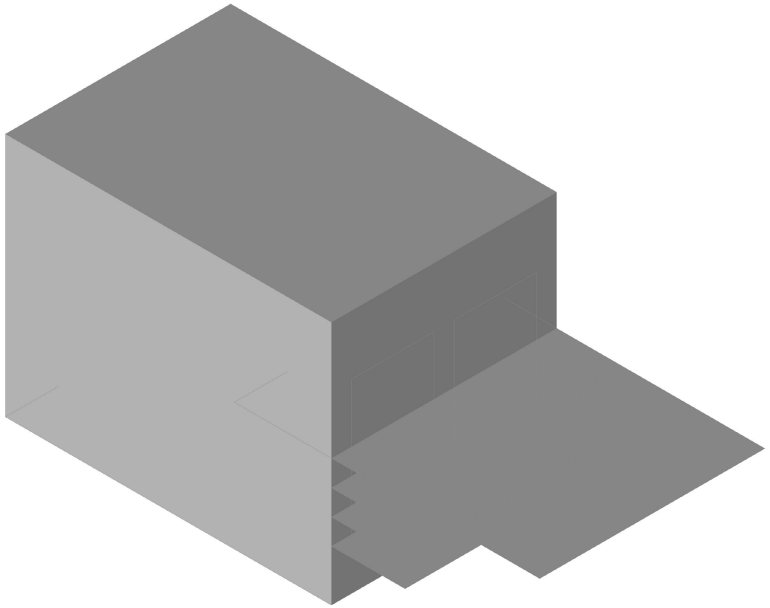


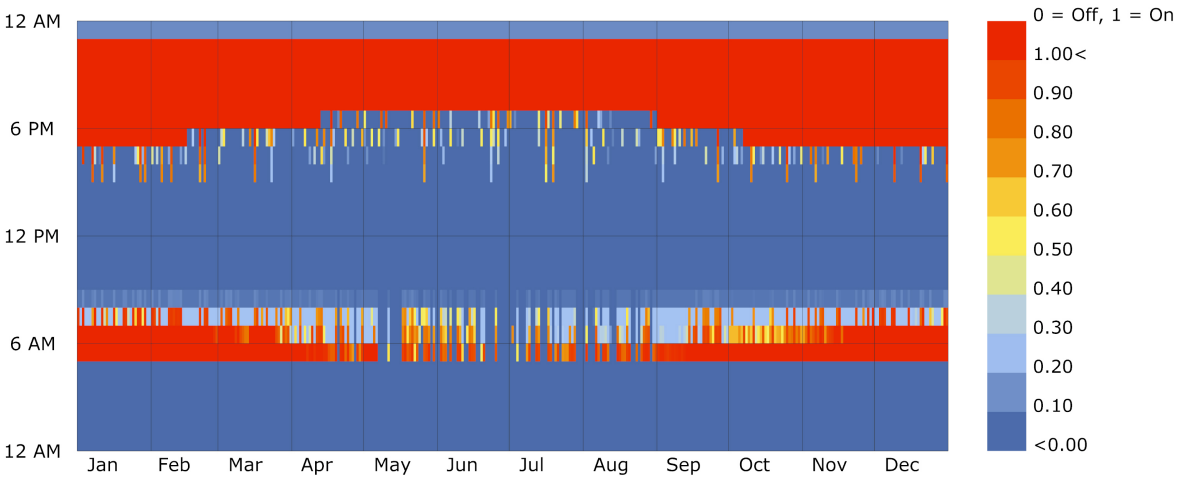
Cooling Load: 660 kWh



Heating Load: 294 kWh

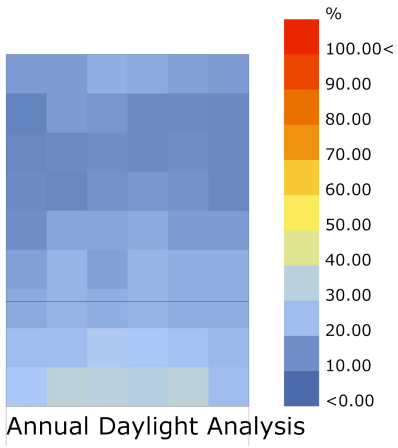
Energy Balance and Comfort with Light Shelf and Shading





Lighting Switch Profile (0 = Off, 1 = On) - Hourly

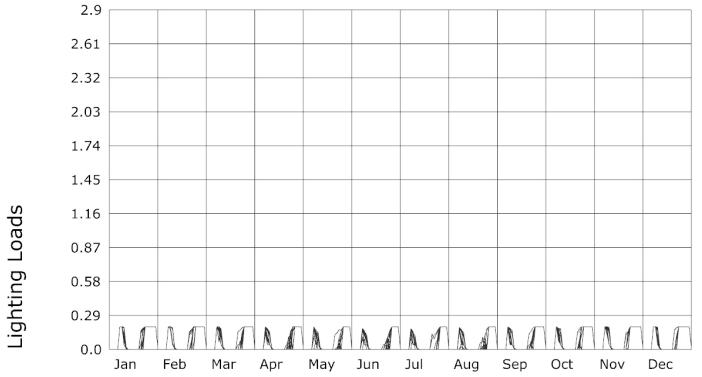
1 JAN 1:00 - 31 DEC 24:00



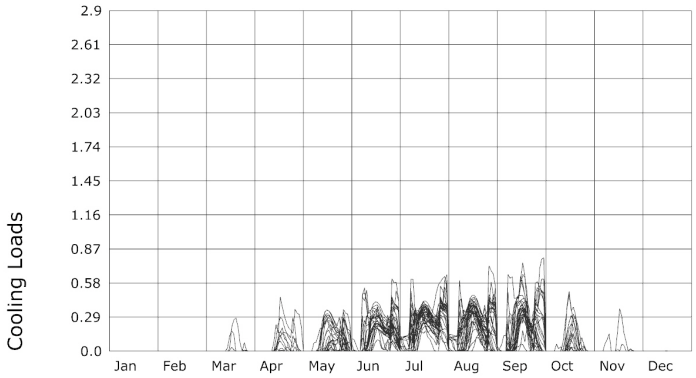
Annual Daylight Analysis

The graphs to the right show the changes if a light shelf and shading devices were also added to this building. Unsuprisingly this reduces both the amount of daylight coming in as well as the cooling load. Additionally, due to the blocking of the small amount of daylight available, the electric lighting load has increased. Despite the higher need for artificial lighting, the total load needed for this proposal is lower than the previous.

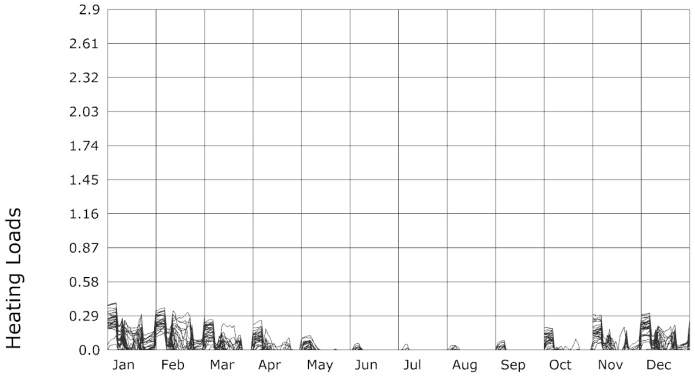
Total Load is 1315 kWh
Initial Load reduced by 30%



Lighting Load: 505 kWh

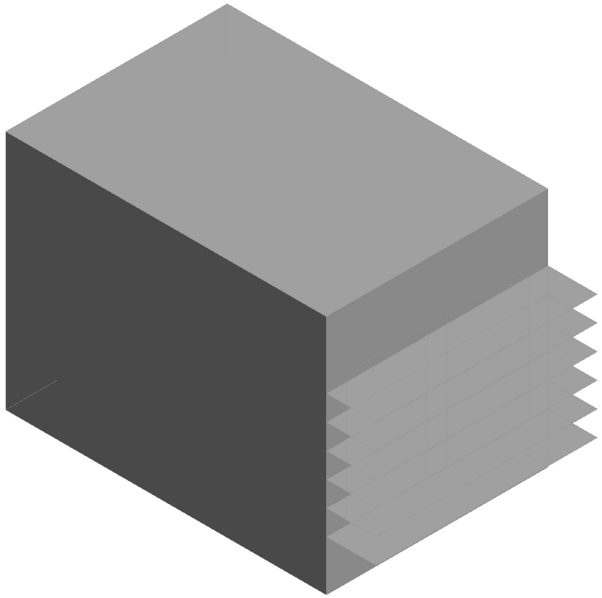


Cooling Load: 522 kWh



Heating Load: 288 kWh

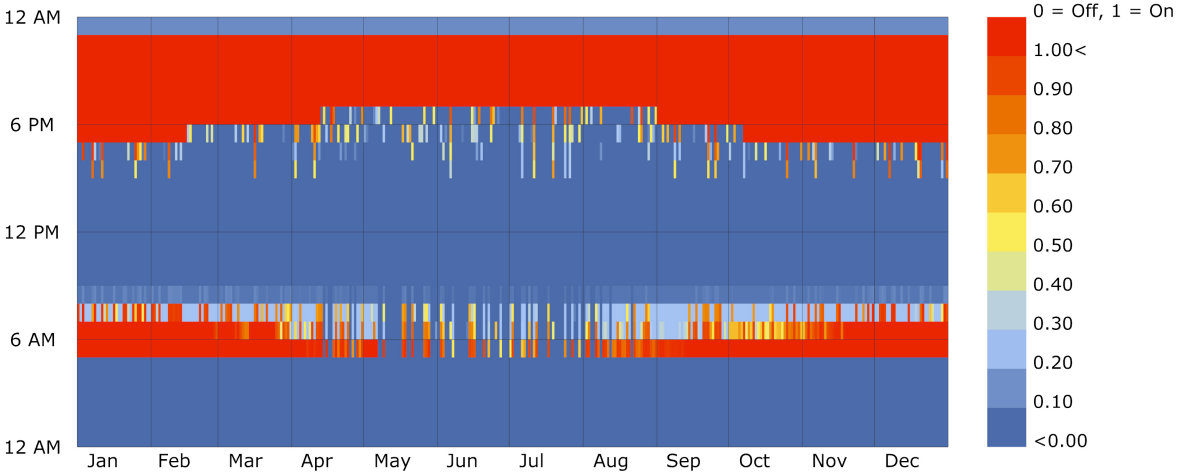
Energy Balance and Comfort with Shading



This propsoal of simple shading devices further lowers the total load for the room. As expected, the cooling load has decreased with less daylight coming in. Additionally less light is reaching into the room. However. with the switch being located near the winow (which is the most occupied area), the need for electric lighting has decreased.

Overall for the current situation and use of the room this option seems like the best option.

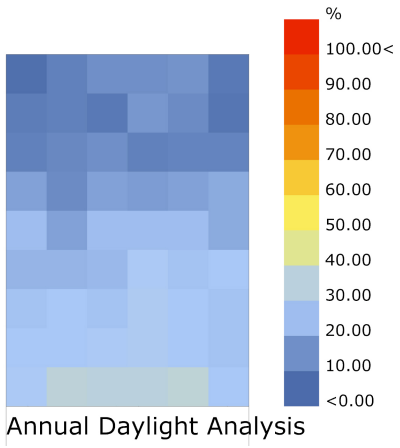
Total Load is 1267 kWh
Initial Load reduced by 33%



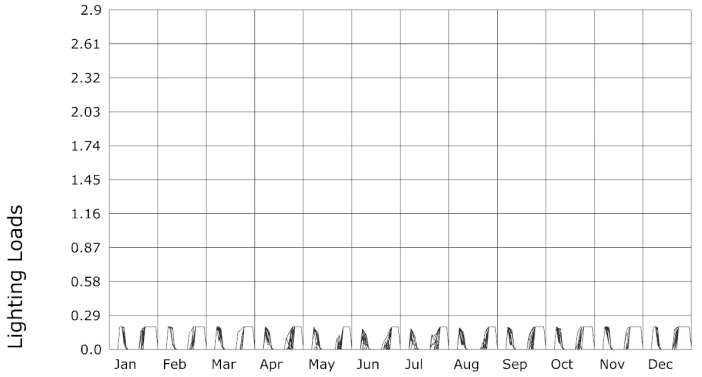
Lighting Switch Profile (0 = Off, 1 = On) - Hourly

1 JAN 1:00 - 31 DEC 24:00

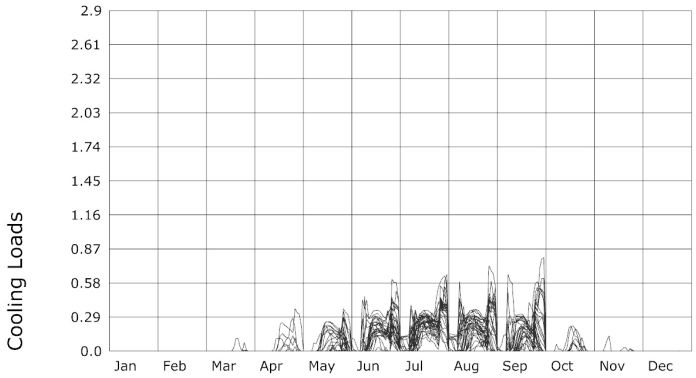
Full on: 25%



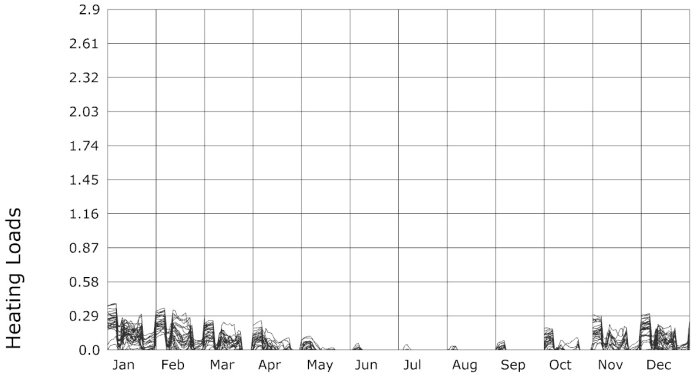
Annual Daylight Analysis



Lighting Load: 500 kWh



Cooling Load: 426 kWh



Heating Load: 341 kWh