

Energy Simulation

Tai Feng

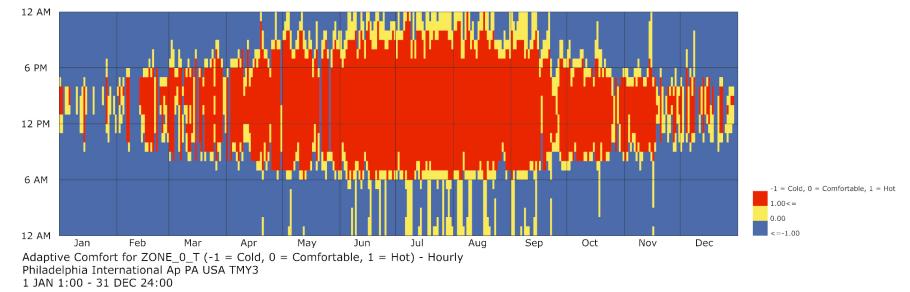
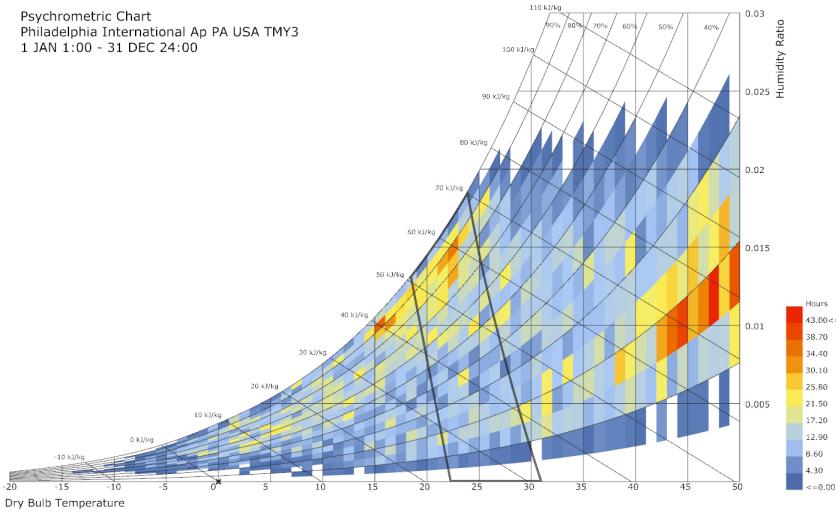
Initial Simulation

Thermal Comfort:12.82%

Hot:33.88%

Cold:53.3%

Psychrometric Chart
Philadelphia International Ap PA USA TMY3
1 JAN 1:00 - 31 DEC 24:00



The initial result shows 53.3%uncomfortable time is in winter. Also, In summer, most of time during the day is uncomfortable.

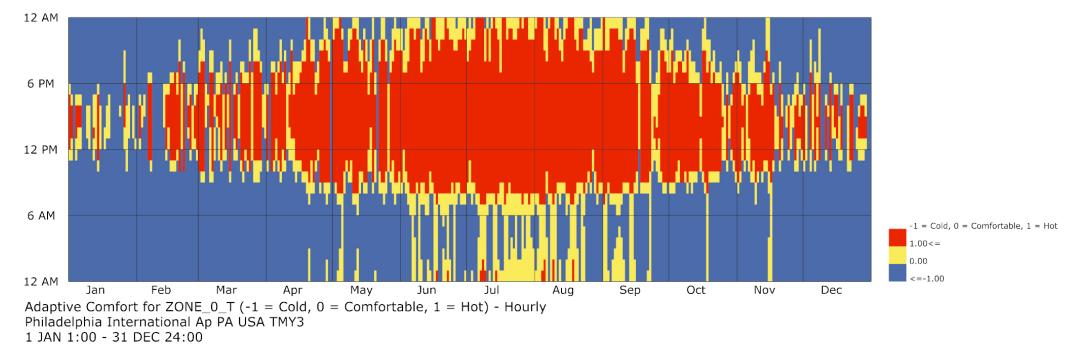
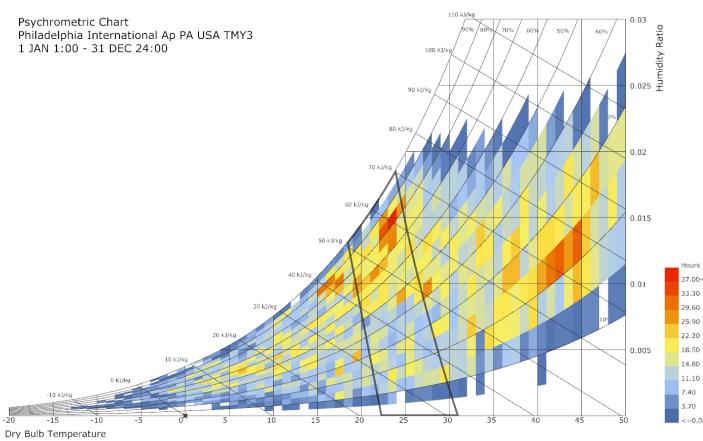
Step1 : Change the Window Ratio

Thermal Comfort:15.9%

Hot:33.09%

Cold:51.1%

Psychrometric Chart
Philadelphia International Ap PA USA TMY3
1 JAN 1:00 - 31 DEC 24:00



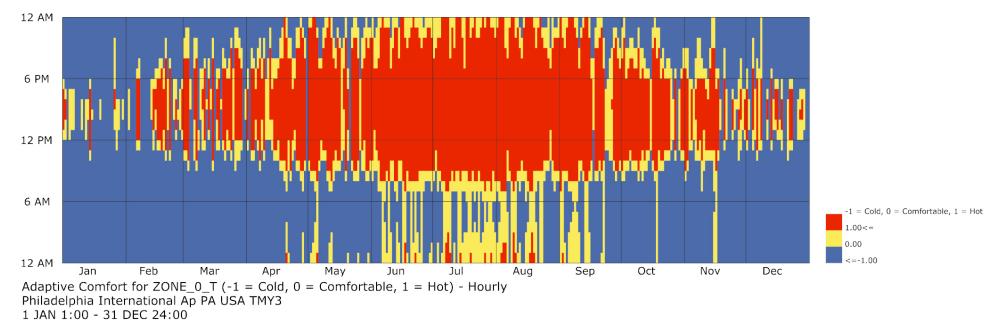
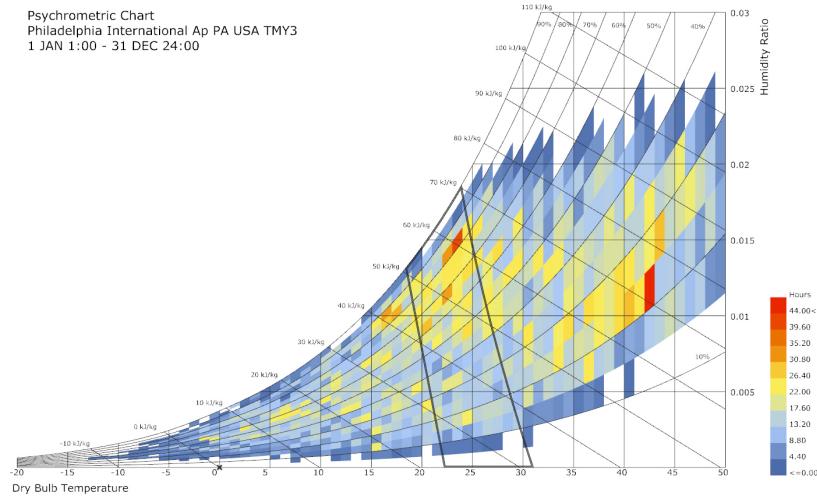
Because the result shows 53.3% of time is cold, which means we need to decrease the area of windows to preventing the room from losing too much heat in winter. So I changed the ratio of window.

Step 2 : Change the Window Ratio

Thermal Comfort:16.59%

Hot:31.78%

Cold:51.63%



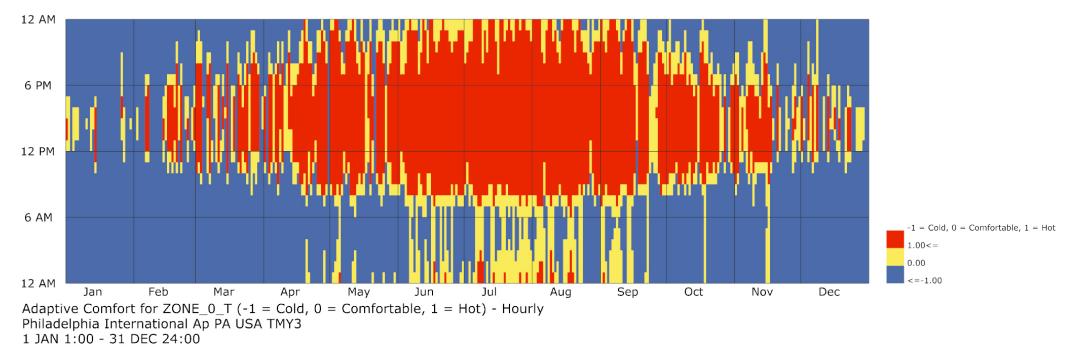
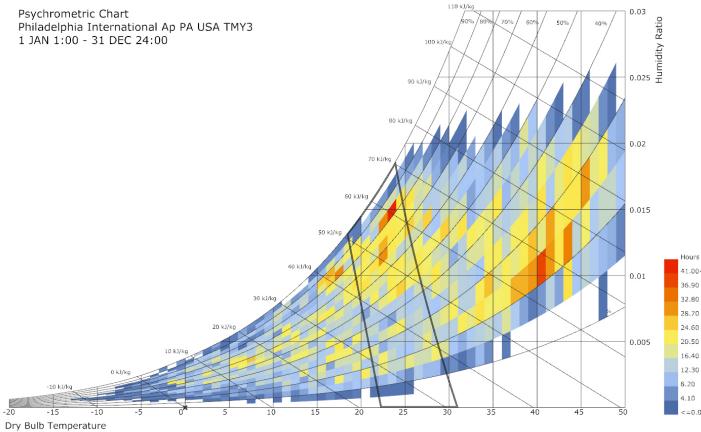
Because the result of Step1 shows the ratio of HOT did not change much, the reason could be the window at south and north side absorbed too much heat in summer, so I changed the window ratio at south and north side.

Step3 : Change the Orientation

Thermal Comfort:16.26%

Hot:32%

Cold:51.75%



When only changing the orientation for 30, 60 and 90 degree, the result didn't change much, the reason could be construction or blinds.

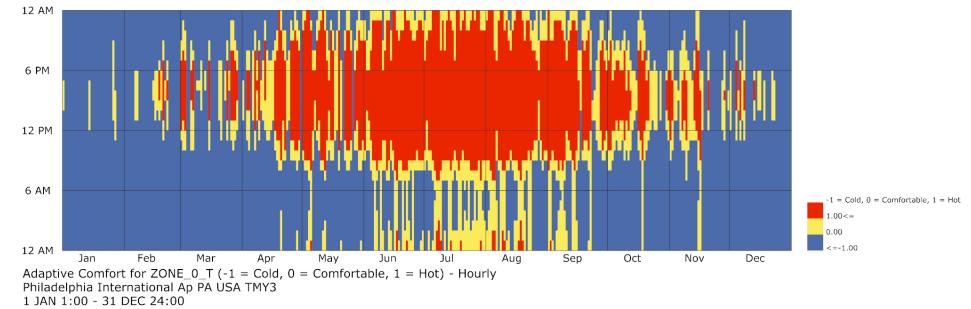
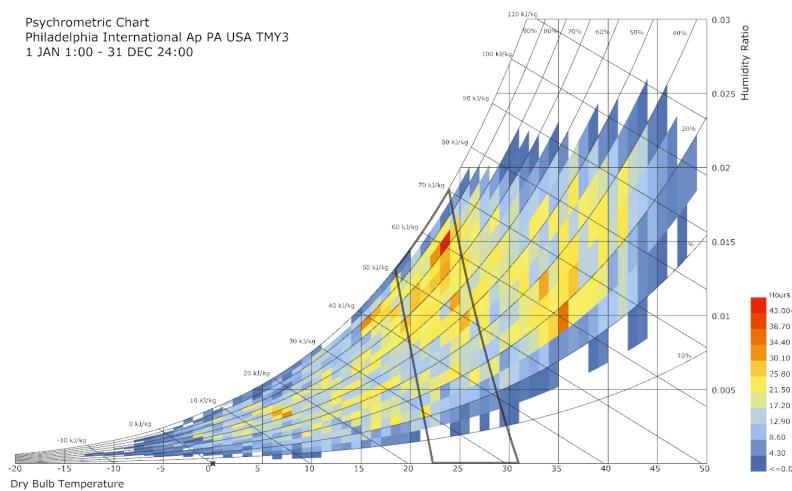
Step 4 : Add Blinds

Thermal Comfort:17.32%

Hot:24.9%

Cold:57.79%

Psychrometric Chart
Philadelphia International Ap PA USA TMY3
1 JAN 1:00 - 31 DEC 24:00



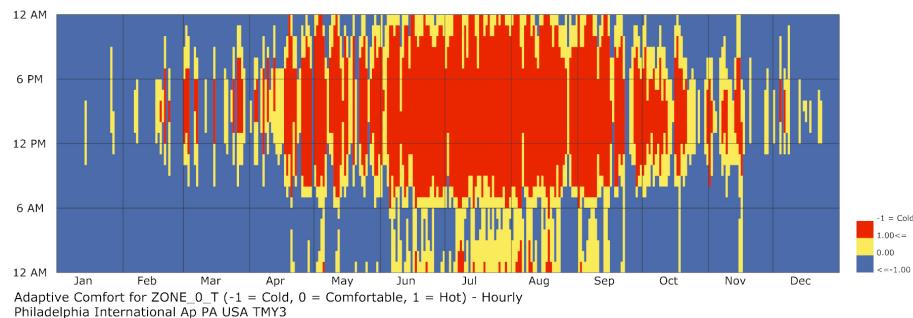
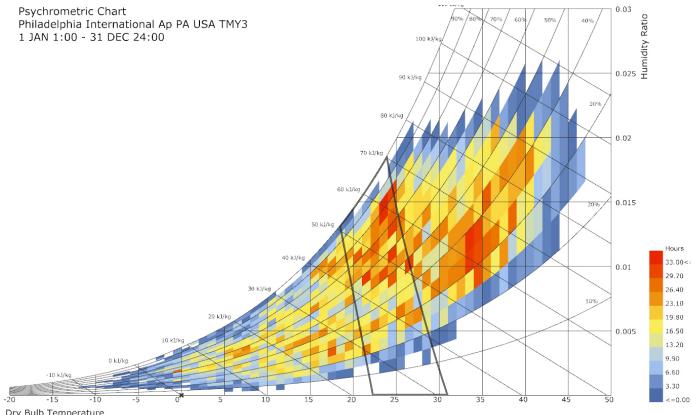
When adding the blinds, the comfort value increased, and the ratio of hot time decreased while that of Cold increased, the reason could be the blinds cut off the sunlight but prevent it from absorbing heat in winter.

Step5 : Change the Construction

Thermal Comfort:18.46%

Hot:26.35%

Cold:55.19%



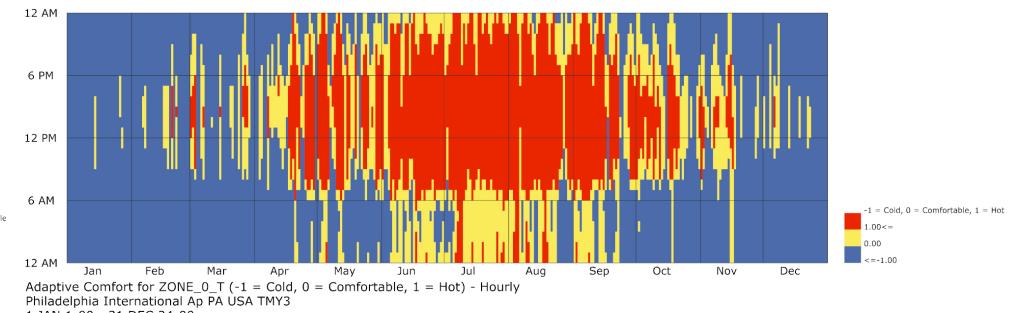
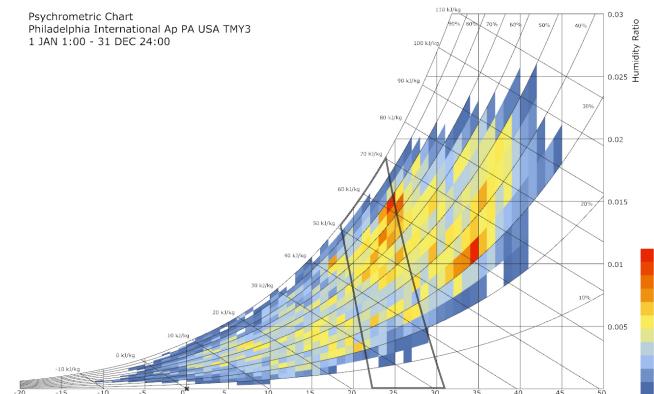
Exterior wall: R14.8

Exterior window: R1.9, SHGC 0.39

Thermal Comfort:20.16%

Hot:26.26%

Cold:53.58%



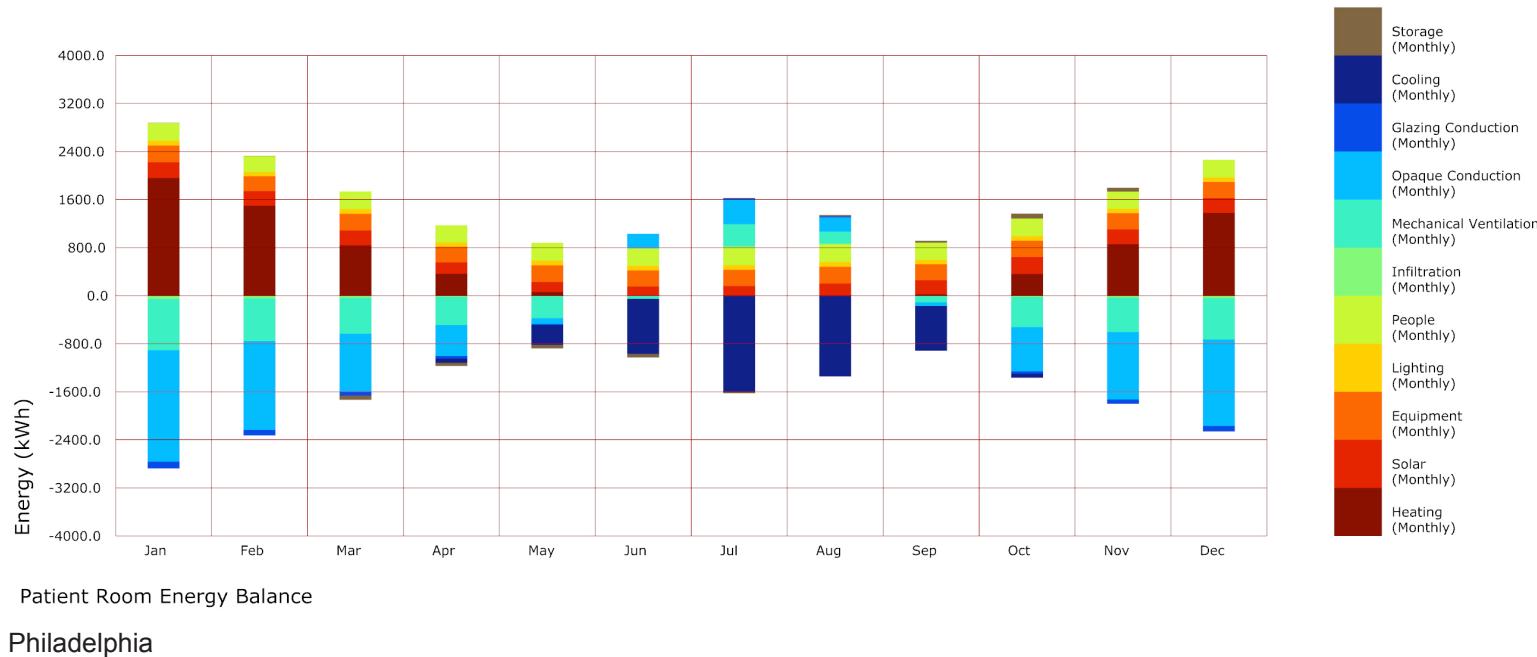
Exterior wall: R34.4

Exterior window: R1.9, SHGC 0.39

Exterior roof: R34.4

By chaning the construction of exterior wall and exterior window, the idea is try to keep the heat during the winter and night

Uncomfortable Source Identification



From this chart we can conclude that from Oct to March which means winter, the energy consumption is higher than that in summer. The main energy flow consists of 3 parts which is the Heating, Mechanical Ventilation and Opaque Conduction.

Based on the results, we can identify that the main uncomfortable source is from the low temperature and humidity in winter, which makes wall keep losing its heat and energy is used to generate heat and ventilate. Also, the main uncomfortable source is from the high temperature in summer and the main energy flow is from the cooling process.