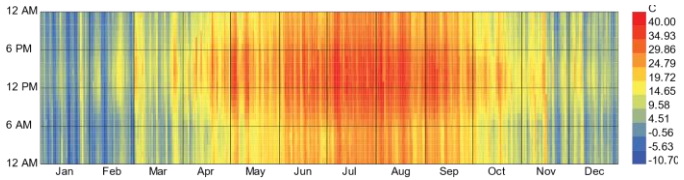
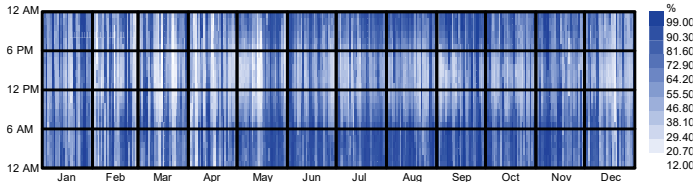
DRY BULB TEMPERATURE (C) Annual Hourly Data

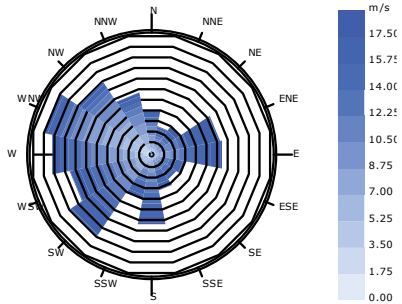


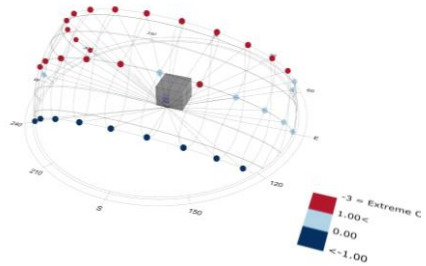
Philadelphia has extreme weather with hot summers ranging from 29-40C and winters ranging from -0 to -10 C. January is the coldest month and July is the hottest month.

RELATIVE HUMIDITY (%) Annual Hourly Data



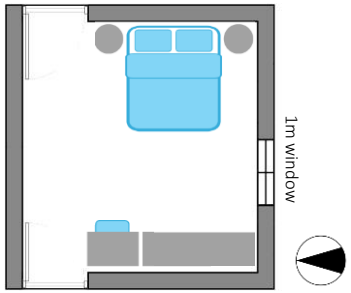
There is high relative humidity during the night in the summer and fall months with humidity reaching 99%.





Using the Sun-path diagram, the percentage of time comfortable is plotted. The percent of time comfortable in Philadelphia is 37.34%.

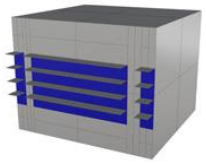
PLAN OF THE BEDROOM



Increasing the R-values increases the thermal resistance of the material. Hence the material or insulation has high conductivity wherein, it absorbs a lot of the heat and stores it. While the shading device restricts some of the direct heat through the glazing, the heat still enters through the walls.

Indoor airflow makes the space very comfortable especially in the summer because natural airflow makes the bedroom cooler when the windows are opened based on the temperature outside. During winter, the program is configured such that the windows are automatically open if the temperature outside is greater than inside.

Step 1. Shading Design



SIZE OF WINDOW: 3m; 0.25m
HORIZONTAL SHADING: 0.5m

Step 2. Natural Indoor Airflow

The simulation was set up such that in the summers, the windows would be opened if the temperature outside it greater than the inside. During winter, the windows will be opened if the temperature outside is more than the temperature inside.

Min Indoor Temperature : 24C
Max Outdoor Temperature: 28C

Step 3. Zone Loads

Infiltration Rate: Tight building: 0.0001 m3/s per m2
No of people: 0.03 ppl/m2
Equipment Load: 4 W/m2
Lighting Density per Area: 8 W/m2

Step 4. Occupancy Schedule

Occupancy schedule: Mid Rise Apartment Light

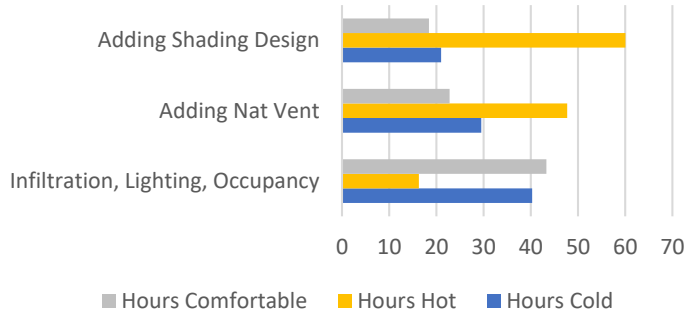
Although the occupants of the current bedroom are both working, the above schedule was selected for the sake of the analysis of the bedroom.

The schedule incorporates all days and all times of the year.

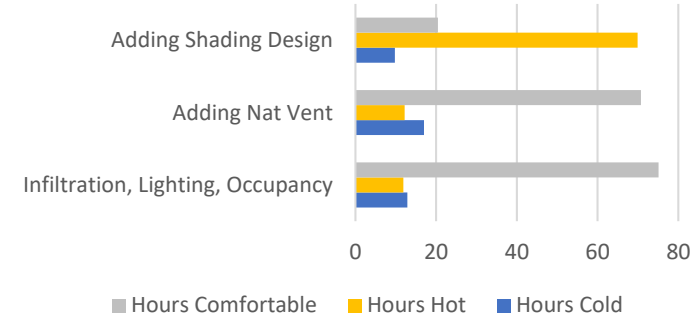
Step 5. Change of Materials

The materials were changed to increase the comfort of the bedroom.
Roof: Highly Insulated with R-value of 34.4
Wall: **Highly Insulated with** R-value of 34.4
Floor: **Highly Insulated with R-value of 34.4**
Glazing:
A four pane window with low-e coating was included in the simulations.
R-value of 1.9 & SGHC of 0.39

Low R-Values



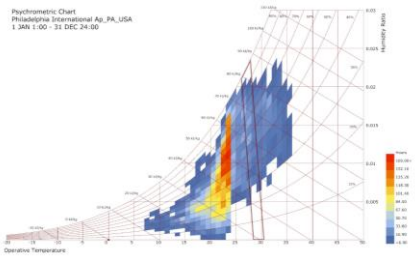
High R-Values

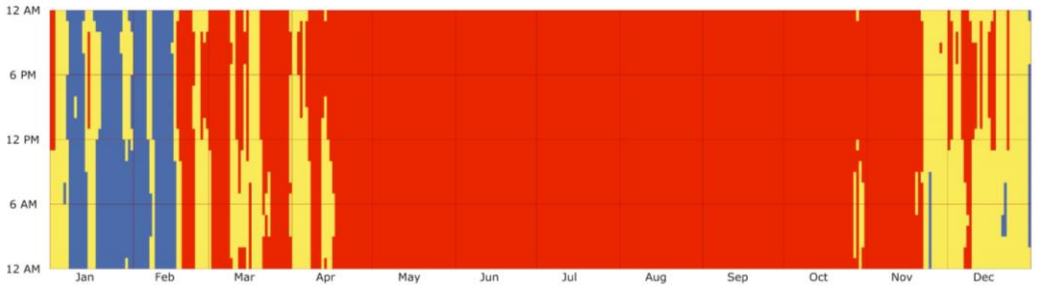


Reducing the infiltration means that during the summer, it doesn't add to the heat of the bedroom. The equipment in the bedroom was also modified to make sure there isn't too much heat in the bedroom.
Adding sensors in the bedroom based on occupancy schedule means that the light is only on when there isn't enough daylight. The summers mostly has enough daylight so the lighting heat is not generated. However during winters, more light is required hence lighting heat can help keep the room warm.

BASELINE ADAPTIVE COMFORT FOR BEDROOM

% Comfortable Hours: 17.06





PROPOSED DESIGN ADAPTIVE COMFORT

% Comfortable Hours: 80.37