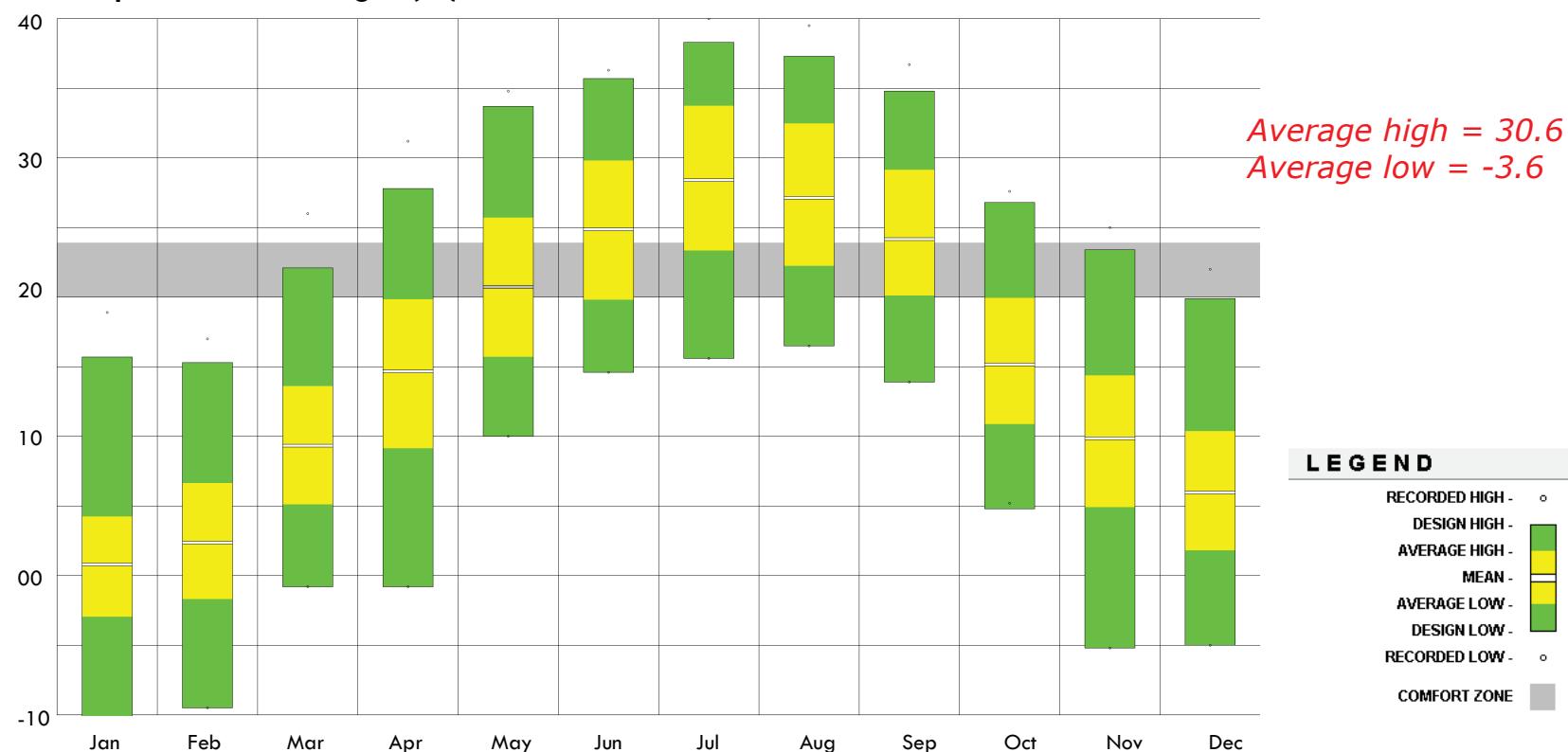


Adaptive Comfort for “Dream Room”

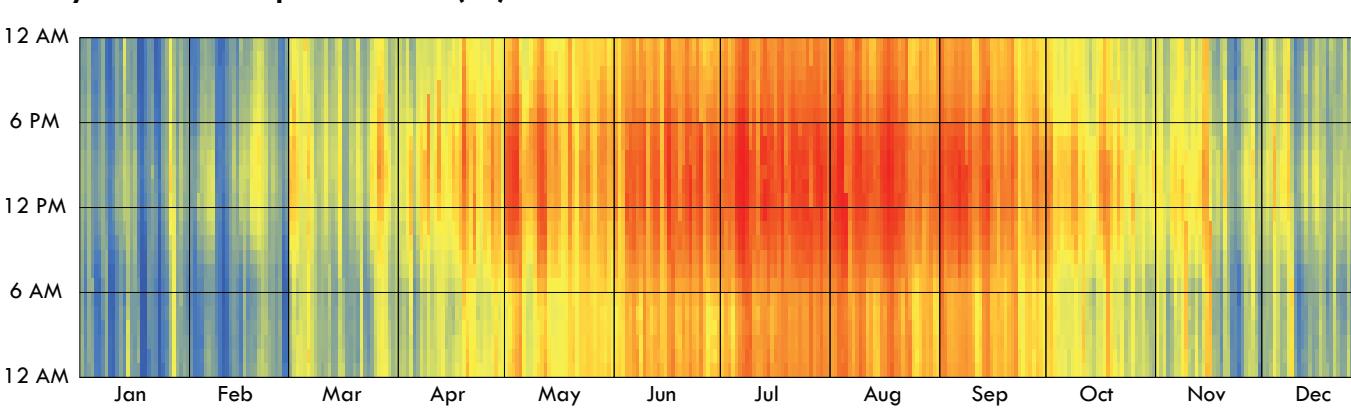
Philadelphia

110 N 34th Street

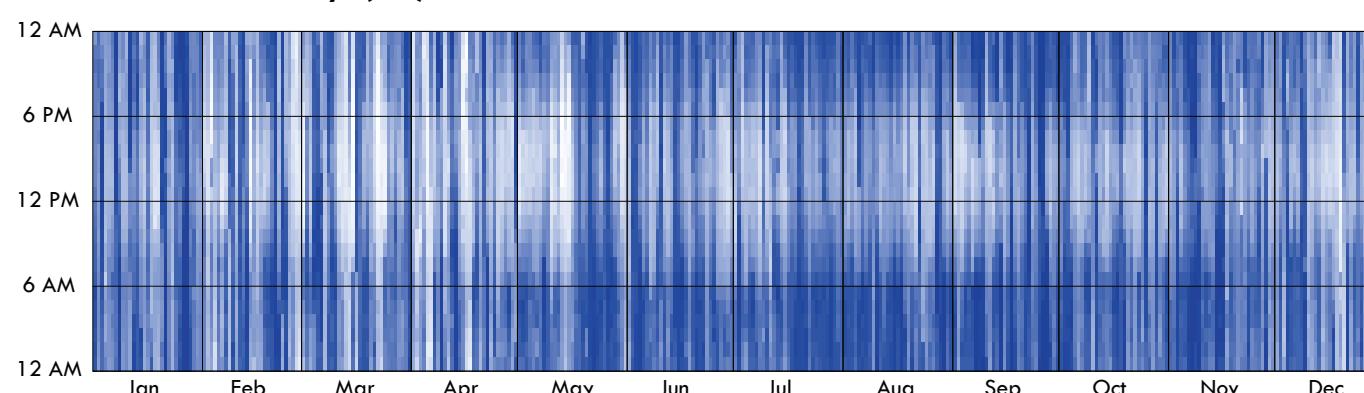
Temperature Range (C) MONTHLY Hourly Data



Dry Bulb Temperature (C) ANNUAL Hourly Data



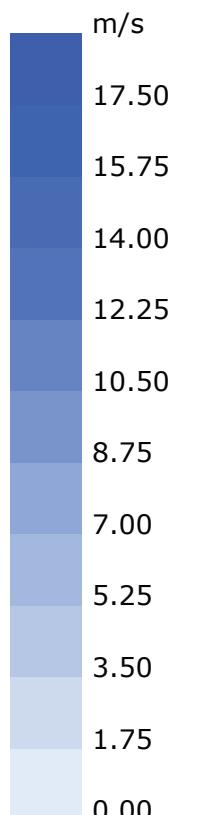
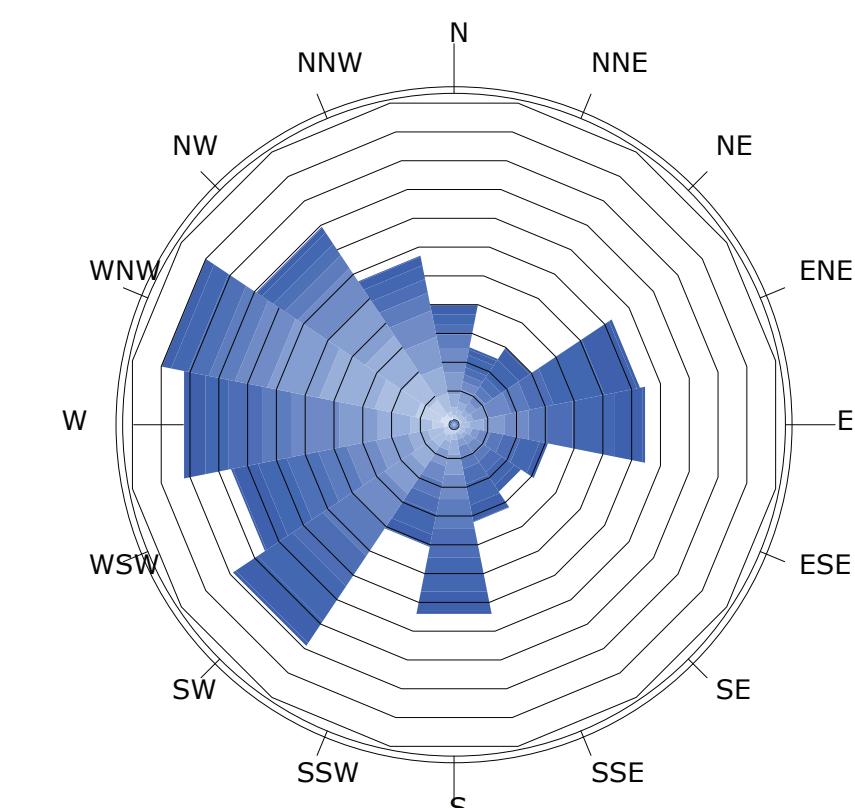
Relative Humidity (%) ANNUAL Hourly Data



Weather in Philadelphia

- Summers are usually hot & muggy, falls & spring is generally mild and winters are cold.
- **January** is on average the **COOLEST** month
- **July** is on average the **HOTTEST** month

Main Prevailing winds:
SW & W



Wind Rose Diagram

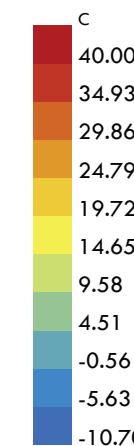
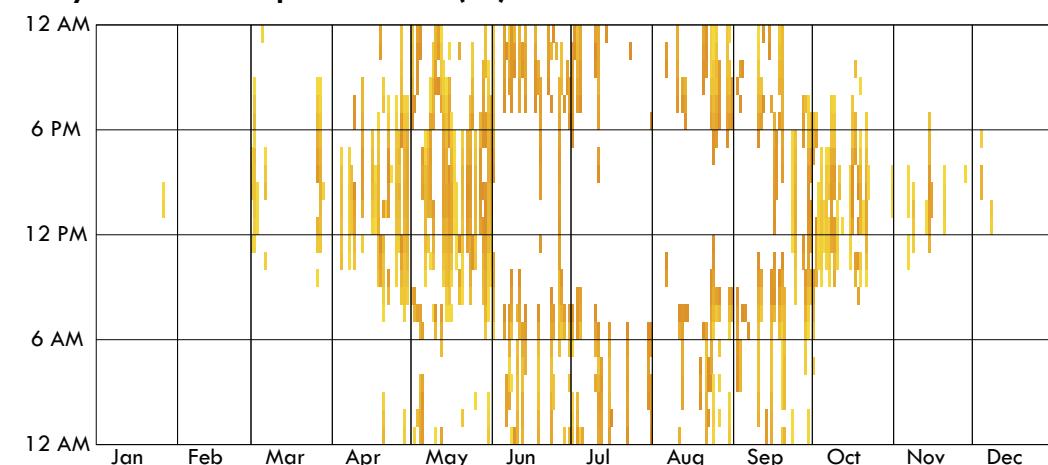
ANNUAL Hourly Data: Wind Speed (m/s)

Adaptive Comfort for “Dream Room”

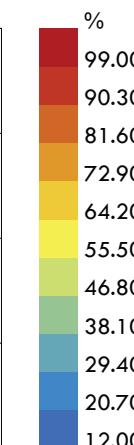
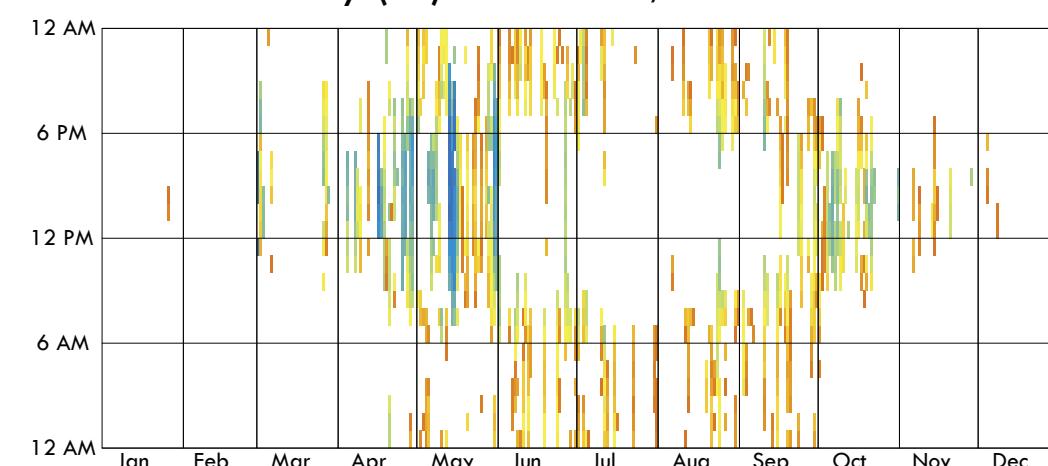
Philadelphia

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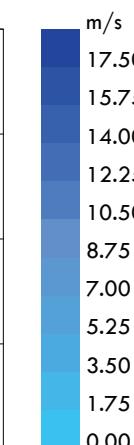
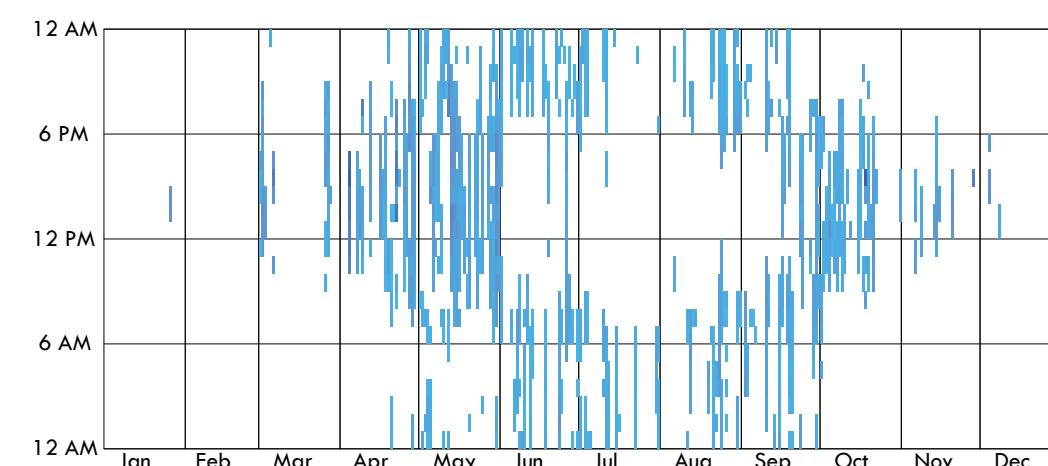
Dry Bulb Temperature (C) ANNUAL Hourly Data



Relative Humidity (%) ANNUAL Hourly Data



Wind Speed (m/s) ANNUAL Hourly Data

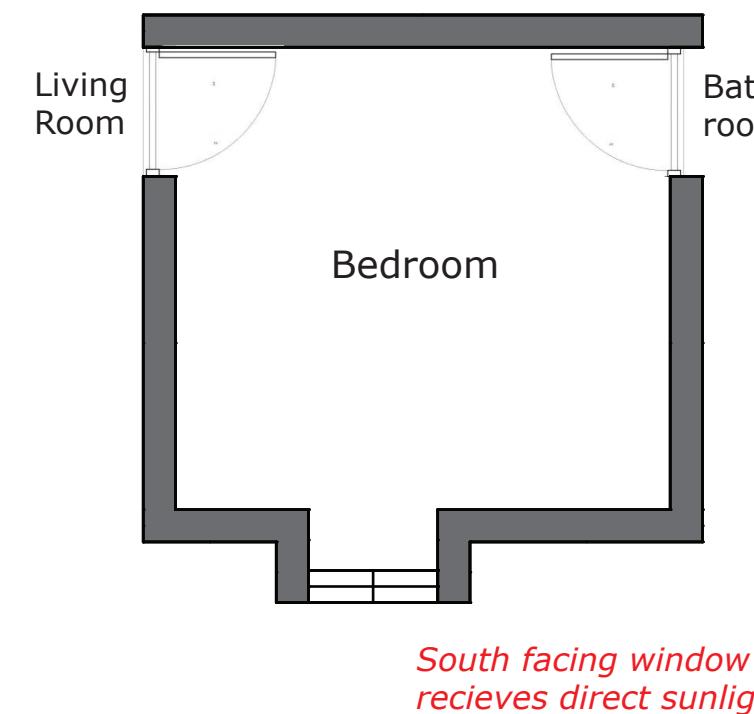


The graphs above indicate the following “IDEAL conditions”:

18 < Dry Bulb Temperature < 26;

Relative Humidity < 80;

Wind Speed > 2



Current problems of the dream room:

1. Thick insulated walls = less heat loss, comfortable in winter but very hot in the summer
2. South facing window provides lot of light in the summer during the day
3. Room does not achieve natural ventilation.

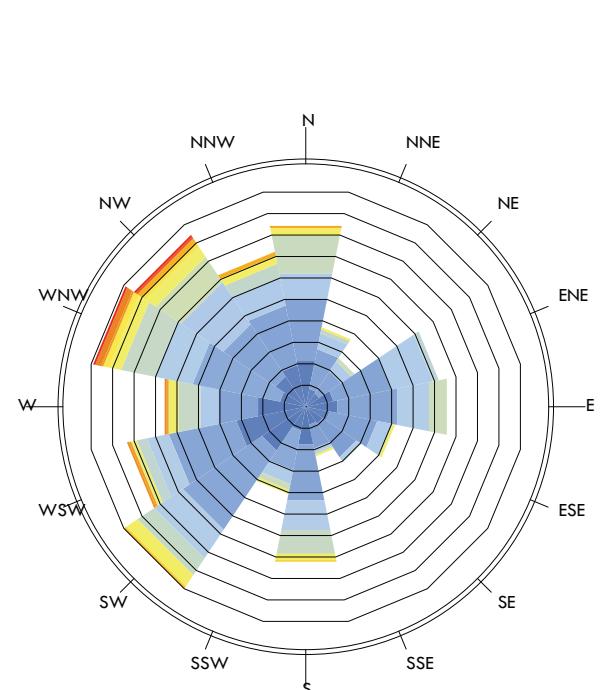
Design Strategy

1. A passive design overhang should be introduced above the window to fully shade in summer. This will make sure sunlight enters the bedroom only in the winter.
2. It's also important to make sure that no heavy equipment is running in the bedroom to reduce the amount of internal gains in the summer (to lower the balance point temperature)

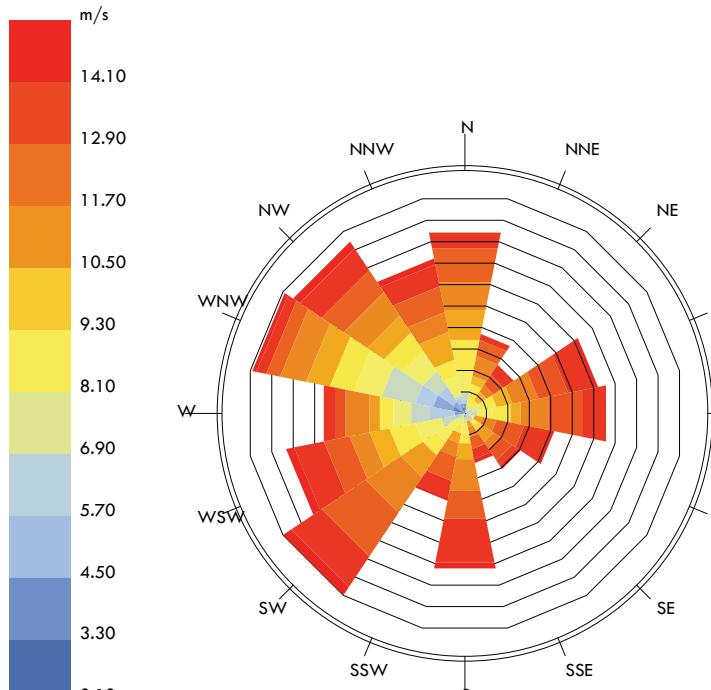
Adaptive Comfort for “Dream Room”

Each closed polyline shows frequency of 1.0%. = 90 hours.

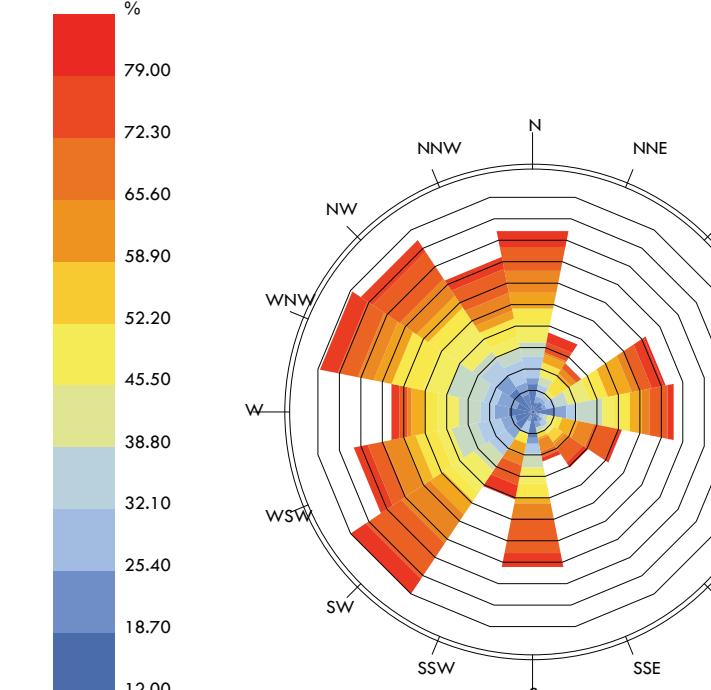
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Wind Speed (m/s)



Relative Humidity (%)



Dry Bulb Temperature (C)

Conditional Selection Applied for the above Wind Rose Diagrams:

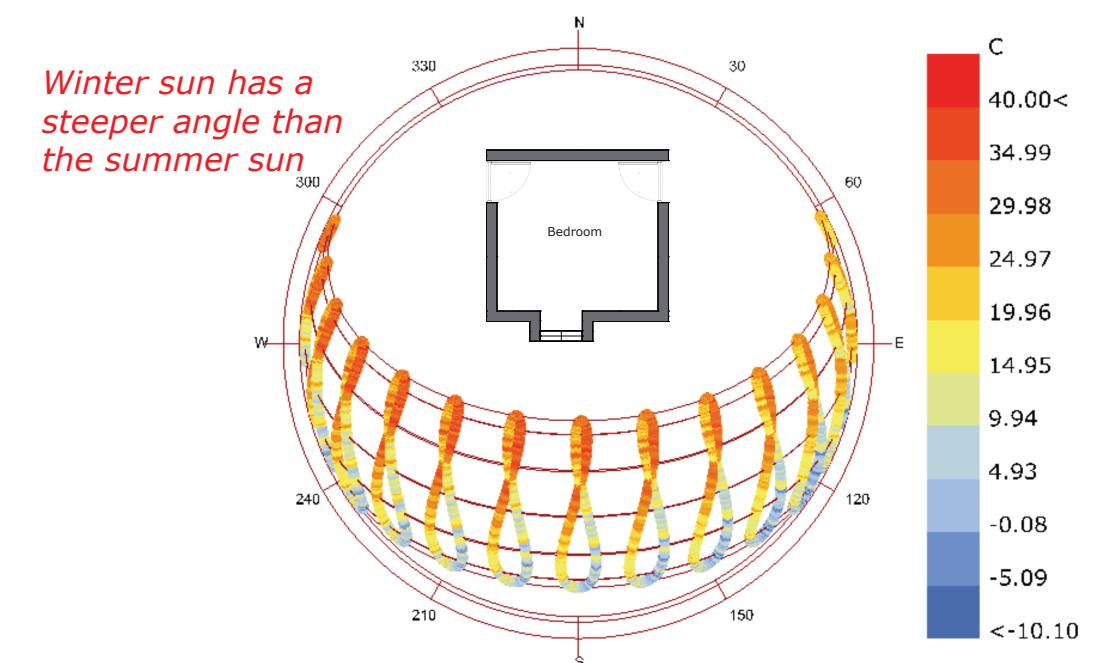
*18 < Dry Bulb Temperature < 26
and Relative Humidity < 80
and Wind Speed > 2
1079.0 hours of total 8760.0 hours (12.32%).*

Design Strategy

2. Because the bedroom is receiving direct sunlight from the south, it is suggested to use sheer curtains when some sunlight is needed and black-out curtains when sunlight is not required.
3. Operable windows are required in the SW or NW direction, to assist in cross ventilation and flush out the heat. Another option is to introduce a small ventilator opposite the window which provides some air movement. Ceiling fan can also make the bedroom cooler.

Design Strategy

5. Trees can be planted outside the bedroom to keep the space cool in the summer.

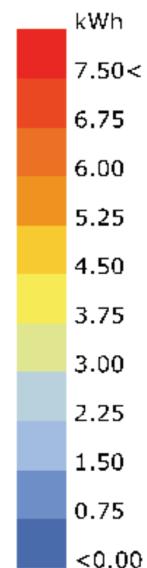
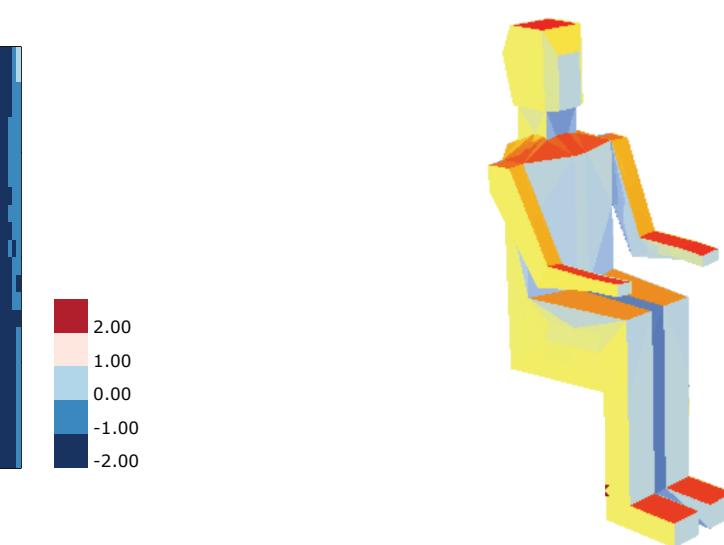
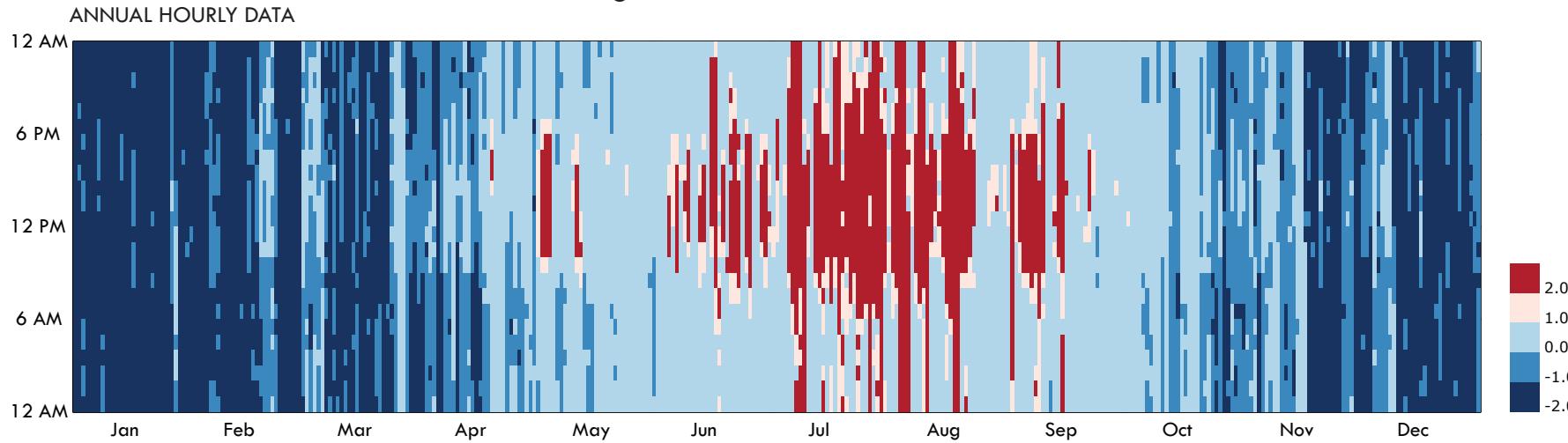


Sun Path Diagram (C) ANNUAL Hourly Data

Comparison of Outdoor Comfort

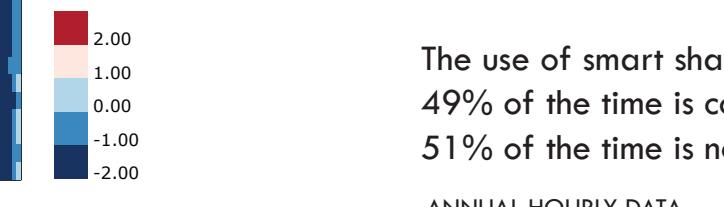
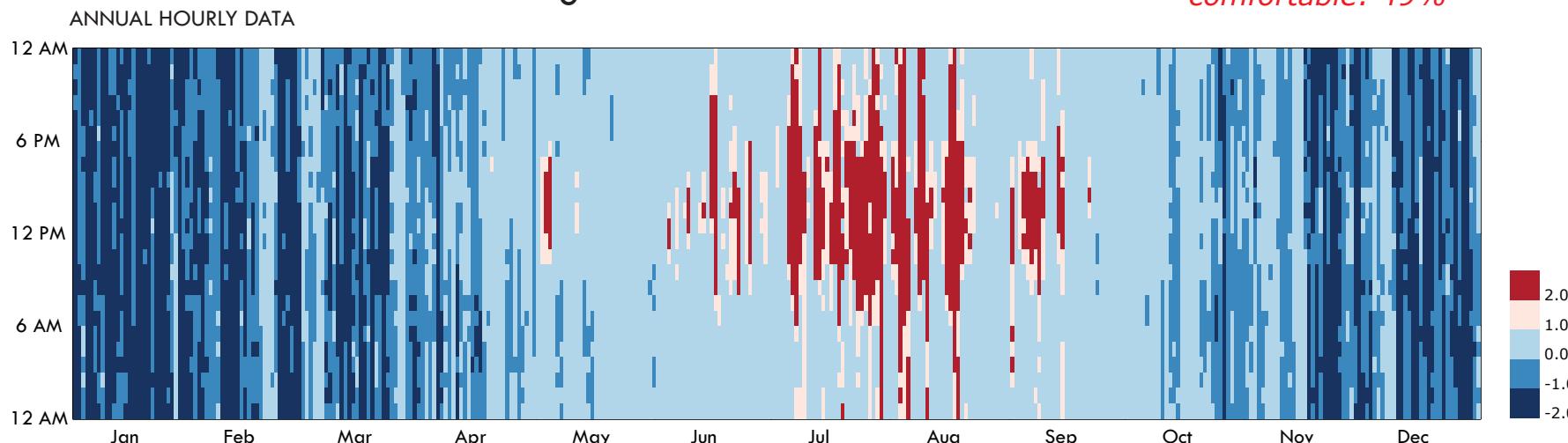
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Outdoor Comfort without shading

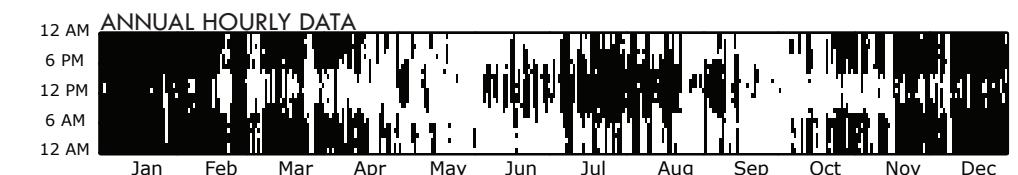


During the hottest month of July, the average person sitting down receives solar radiation ranging from .75 to 7.50 kWh

Outdoor Comfort with shading



The use of smart shading (removing solar radiation) gives:
49% of the time is comfortable (white)
51% of the time is not comfortable (black)



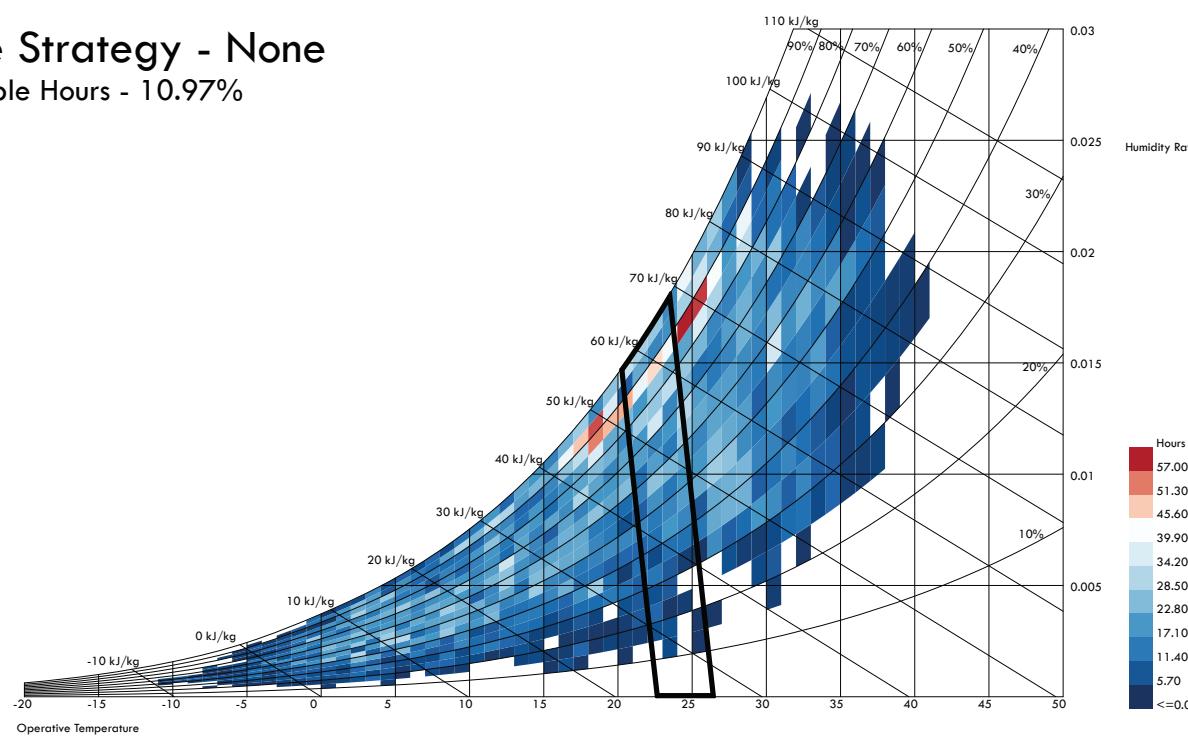
Outdoor Comfort (-3 = Extreme Cold | -2 = Cold | -1 = Cool | 0 = Comfort | 1 = Warm | 2 = Hot | 3 = Extreme Heat) - Hourly

Adding shading to a space in Philadelphia increases the percent of time comfortable by 10%. The amount of heat also substantially decreases in all seasons. While this might be beneficial in the summer, it raises the question of how valuable shading can be in winter season.

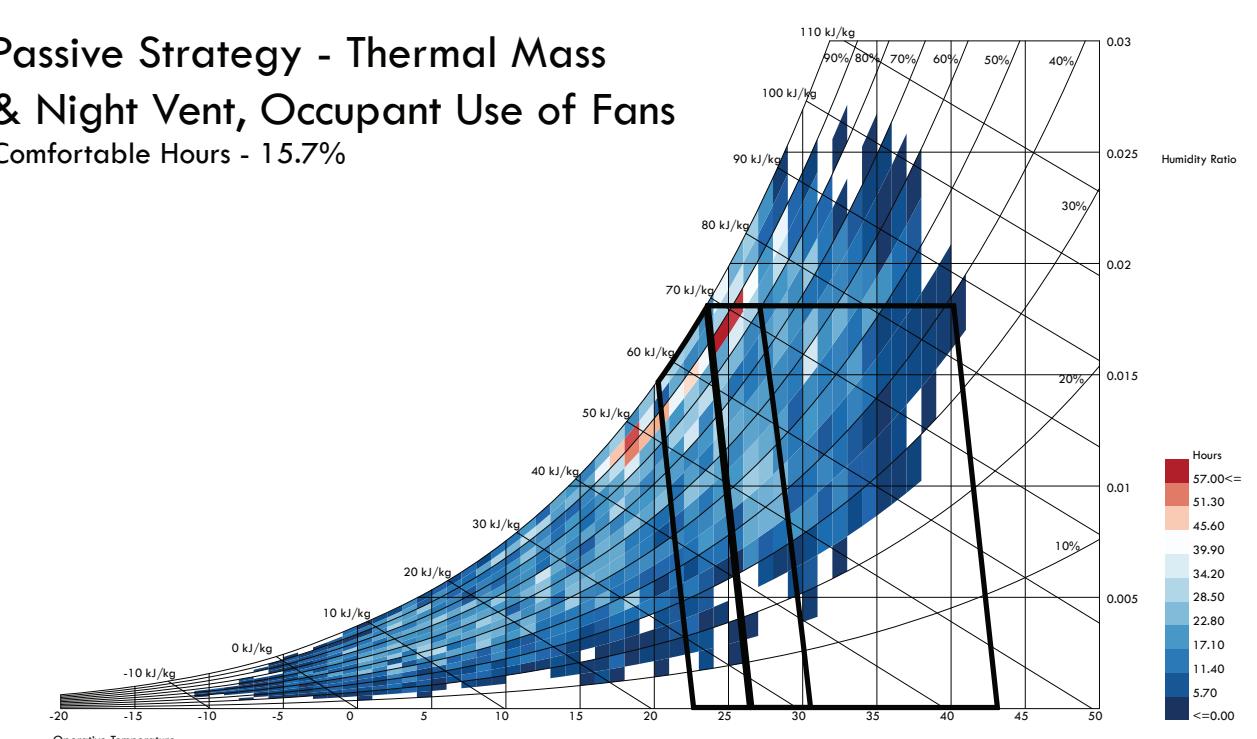
Passive Strategies for comfort

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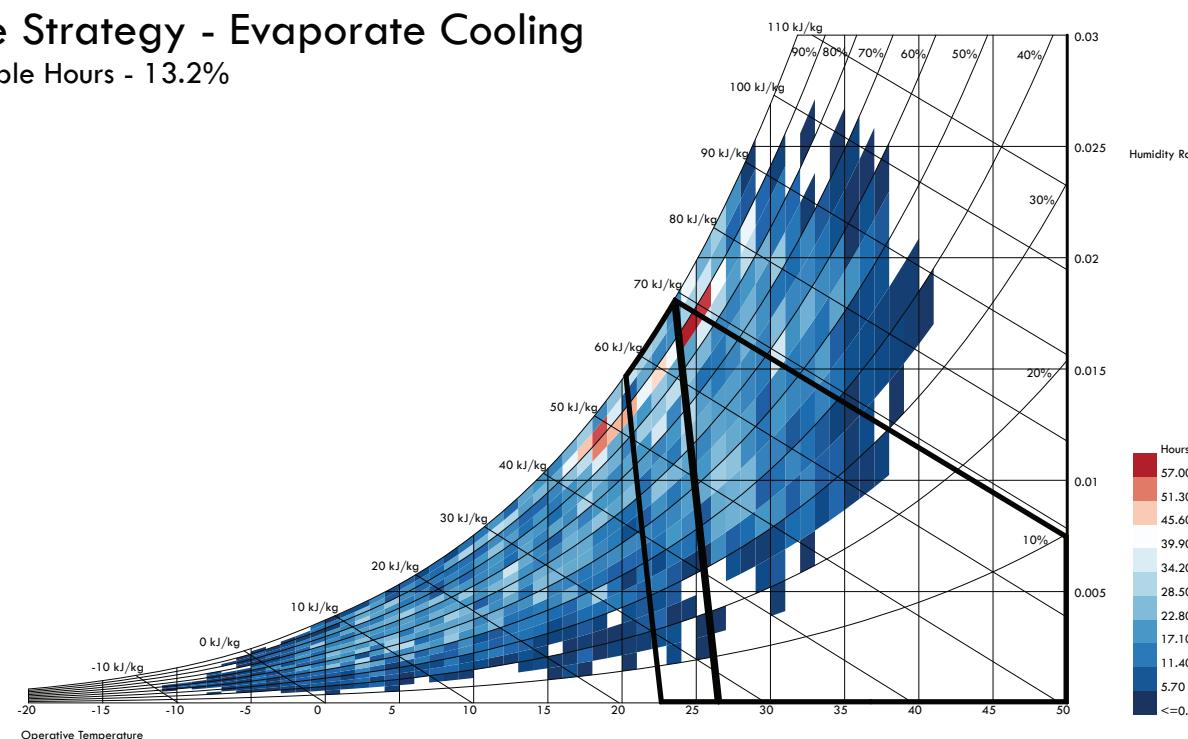
Passive Strategy - None
Comfortable Hours - 10.97%



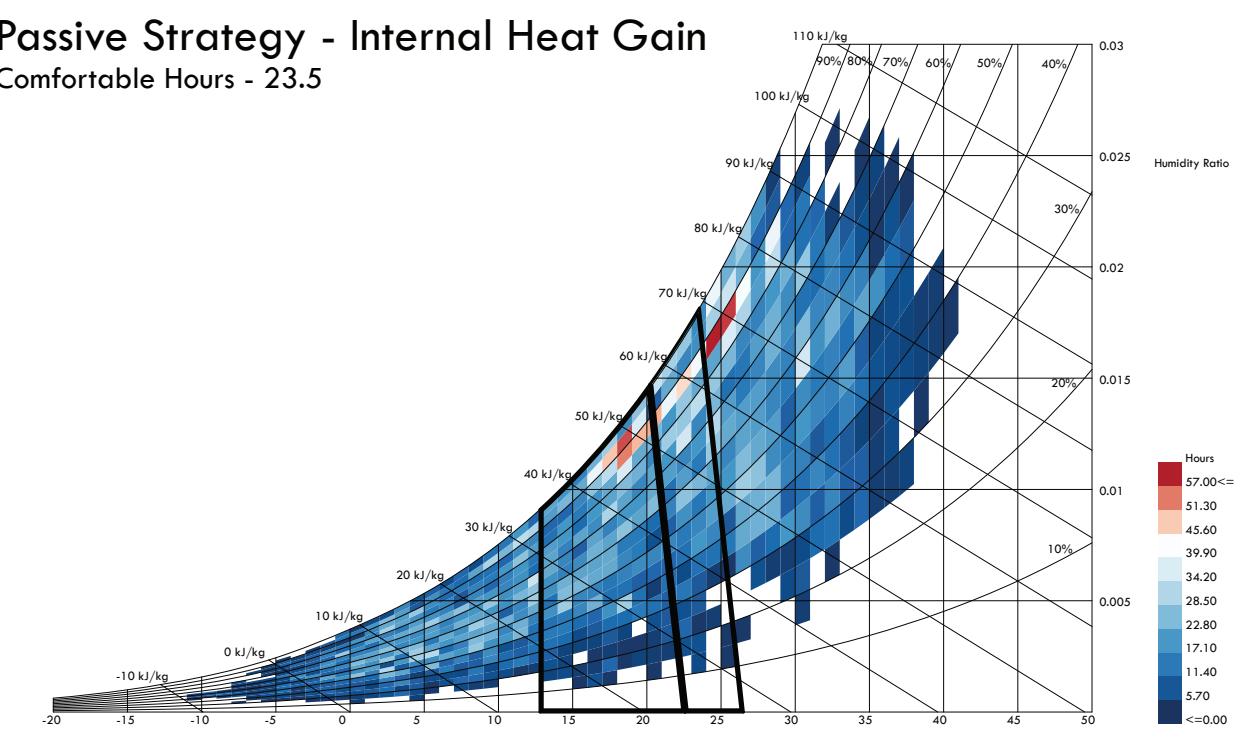
Passive Strategy - Thermal Mass & Night Vent, Occupant Use of Fans
Comfortable Hours - 15.7%



Passive Strategy - Evaporate Cooling
Comfortable Hours - 13.2%



Passive Strategy - Internal Heat Gain
Comfortable Hours - 23.5



Combining all Passive Strategies
Comfortable Hours - 51.7%