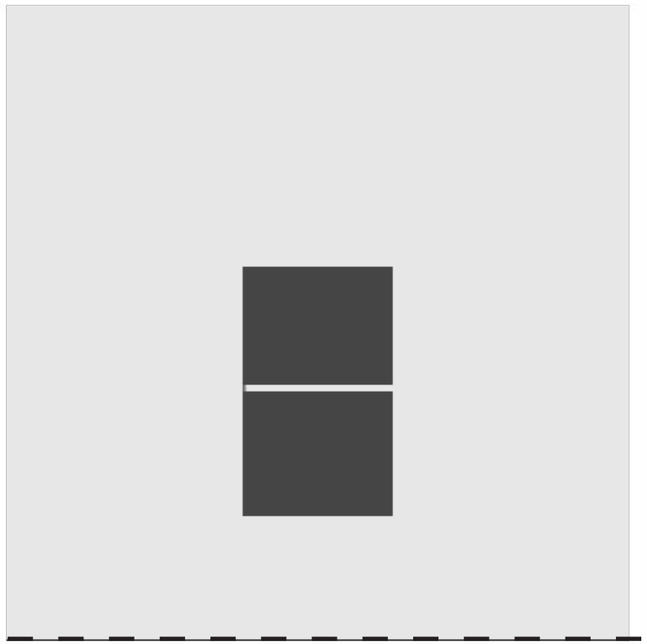
Kirin Kennedy

Building Performance Simulation
Assignmnet 1

Room Information



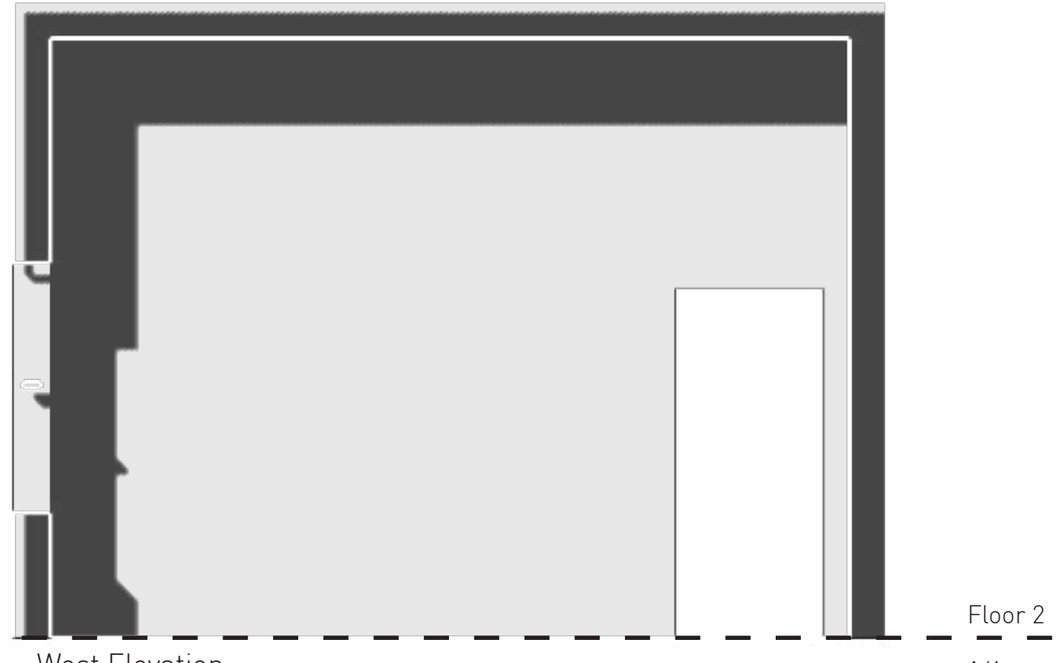
South Exterior Elevation

This room is located on the second floor of a traditional townhouse in Philadelphia. The townhouse was built in 1912 with a brick facade but has been modernized and broken up for apartments. With each floor having two apartments, the spaces are generally not particularly large but have high ceilings.

This bedroom in question is a deep rectangular room with a window located on the south face and a door to the rest of the apartment on the west wall. It contains hard-wood floors which are mostly covered near the window and a high ceiling

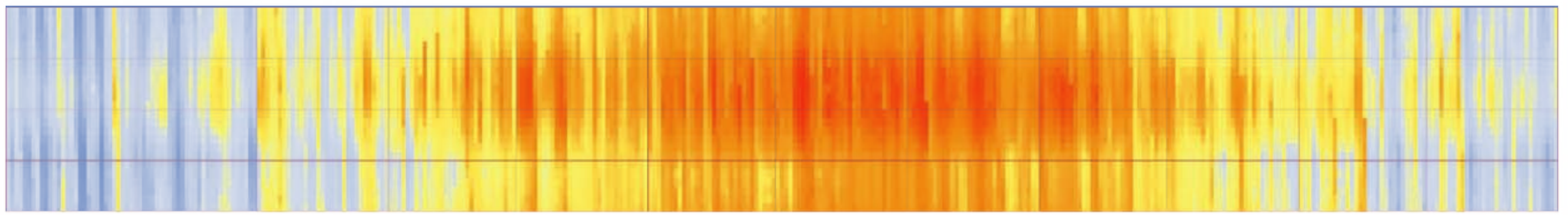
This room presents multiple issues as it is currently insulated and configured. The first is that as this is an older house which has been broken up into apartments, there is no central heating or cooling. Both of these functions are completed by a singular split wall unit in the room to the west of the featured bed room. While this unit should be sufficient for a space this large, it fails to work well in the draft apartment. Due to these issues one of the largest problems for this apartment is regulating temperature. The overlarge window in the south wall works for bringing some light in but also leads to increased air leakage.

Plan

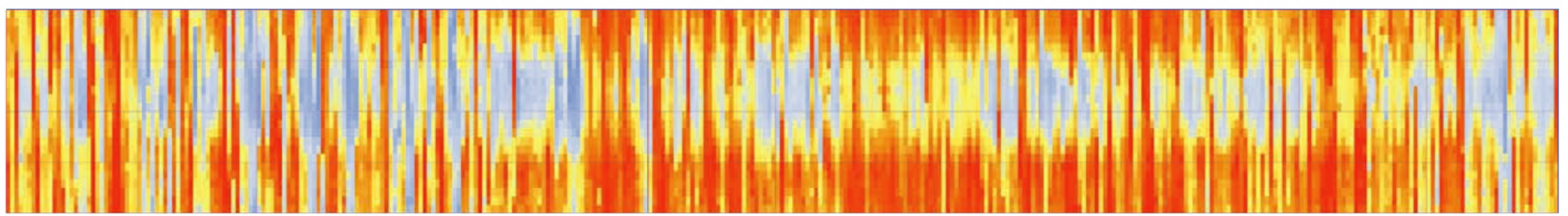


West Elevation

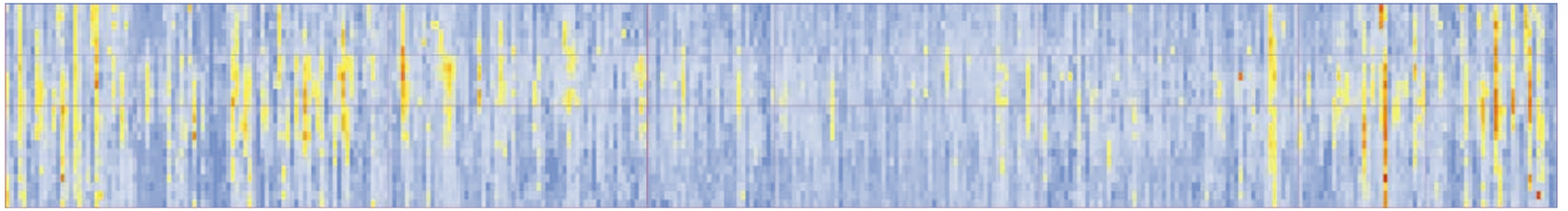
Environmental Data



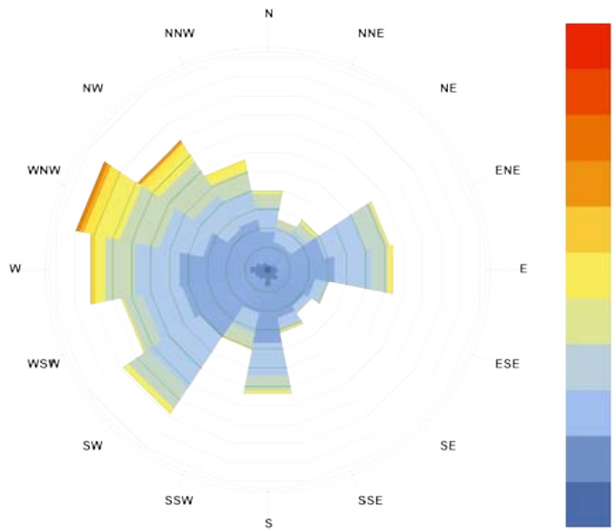
Dry- Bulb Temperature
Hourly, Jan 1- Dec 31
Philadelphia



Relative Humidity (%)
Hourly, Jan 1- Dec 31
Philadelphia



Wind Speed
Hourly, Jan 1- Dec 31
Philadelphia

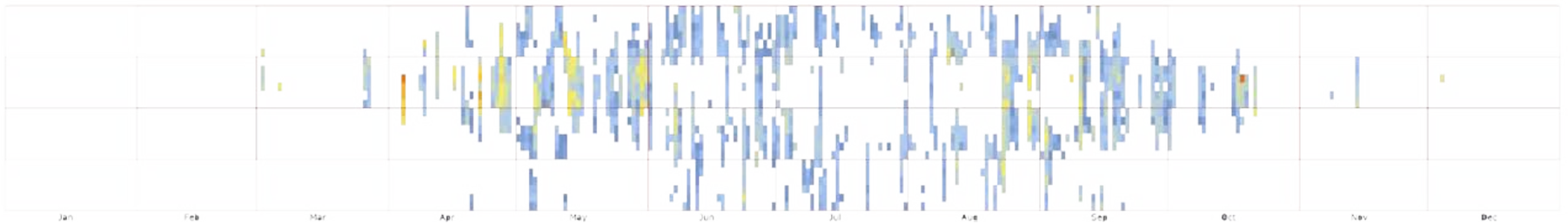


Wind Rose
Hourly, Jan 1- Dec 31
Philadelphia

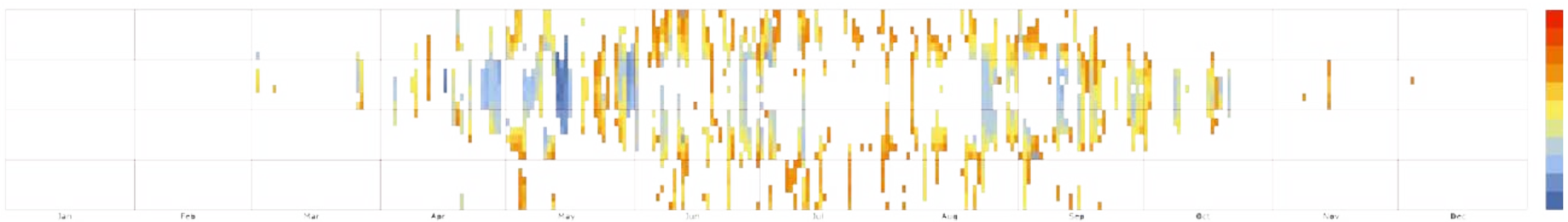
Philadelphia has a wide range of conditions throughout the year. With colder winters and a hot humid summer, Philadelphia proposes issues with passive heating and cooling techniques. As can be seen in the charts above and to the left, this city provides extremes which are uncomfortable for all occupants.

In this case this room, with its bad insulation and lacking cooling and heating, needs some passive heating and cooling techniques to be comfortable. However, to better understand the situation, further information must be identified with relation to the times when heating and cooling is needed.

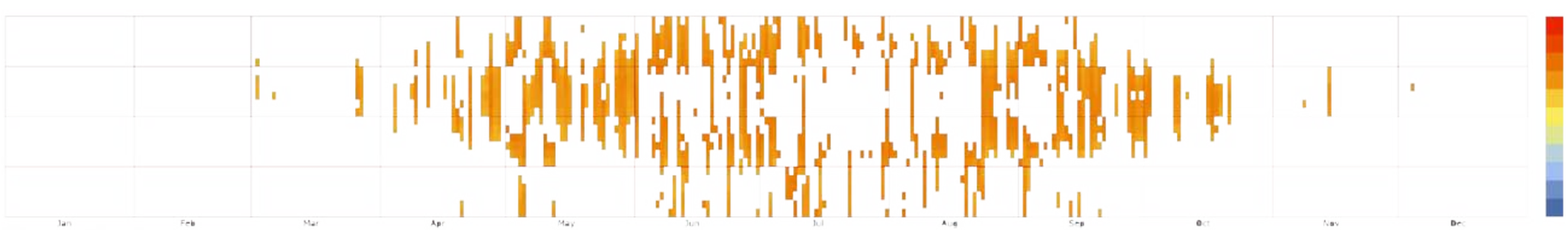
Environmental Data



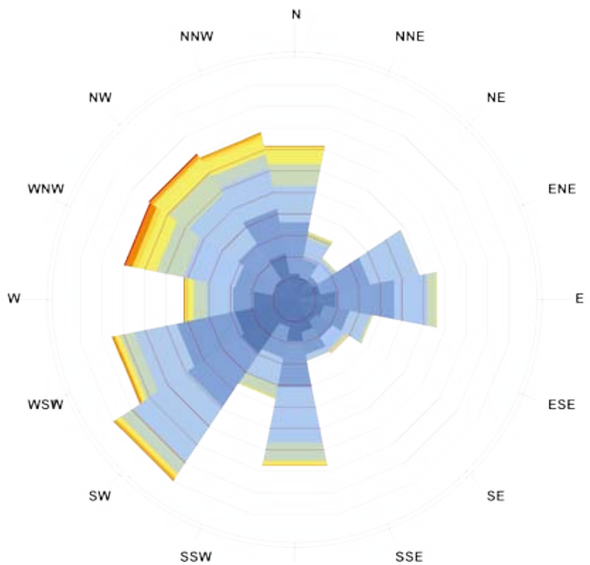
Dry- Bulb Temperature
Hourly, Jan 1- Dec 31
Philadelphia
Temp betwen 18 and 26
Relative Humidity Below 80
Windspeed Below 2 m/s



Relative Humidity (%)
Hourly, Jan 1- Dec 31
Philadelphia
Temp betwen 18 and 26
Relative Humidity Below 80
Windspeed Below 2 m/s



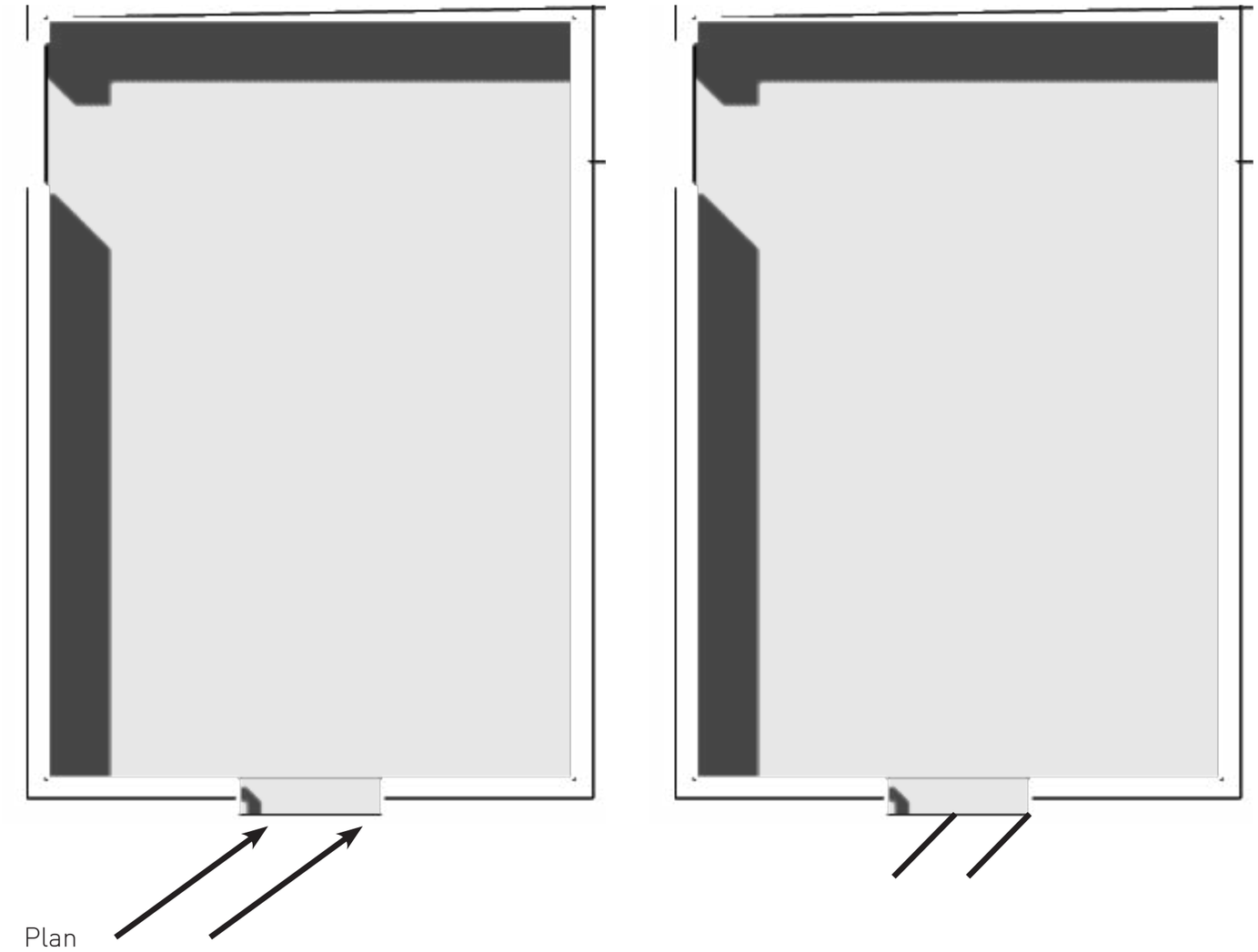
Wind Speed
Hourly, Jan 1- Dec 31
Philadelphia
Temp betwen 18 and 26
Relative Humidity Below 80
Windspeed Below 2 m/s



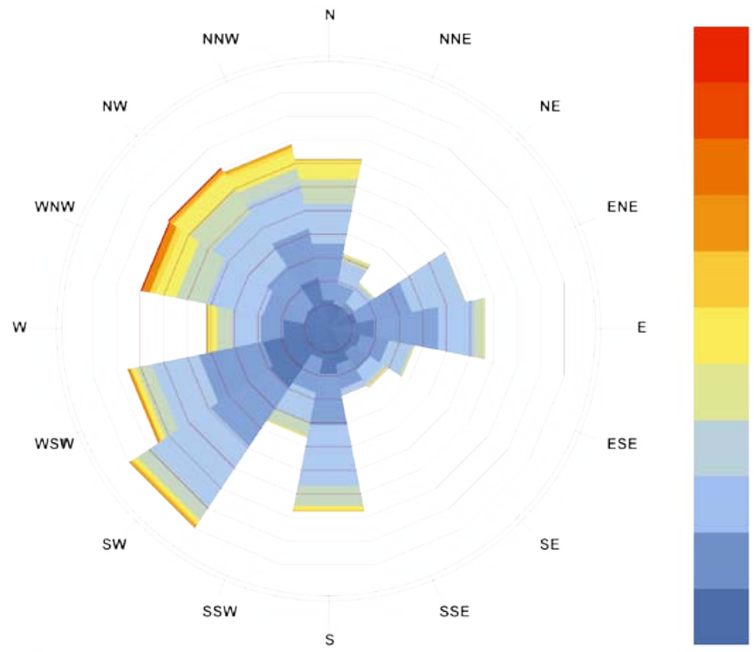
Wind Rose
Hourly, Jan 1- Dec 31
Philadelphia
Temp betwen 18 and 26
Relative Humidity Below 80
Windspeed Below 2 m/s

These maps represent the times during which the conditions are comfortable with respect to the Dry-Bulb Temperature, the Relative Humidity, and the Wind Speed. In addition, the Wind Rose to the left shows the direction of the wind during these comfortable times. These charts show what would be expected in a climate like Philadelphia. The optimal times to be outdoors is during the spring and fall with the evenings and nights during the summer.
These begin to give a better idea of how best use passive strategies in the room.

Ventilation

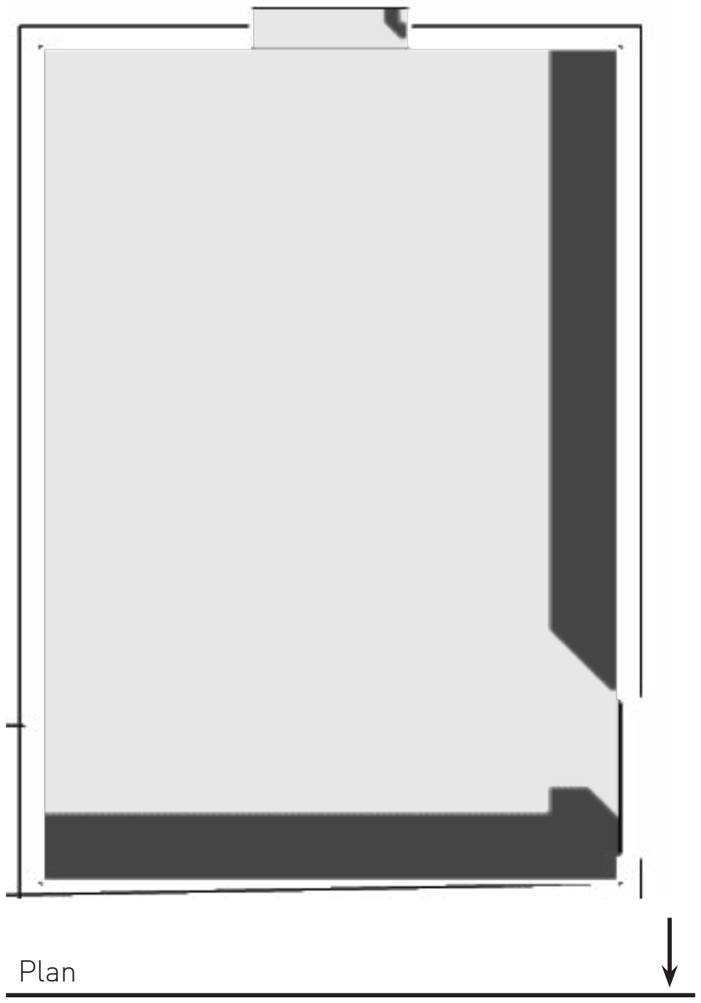


Plan

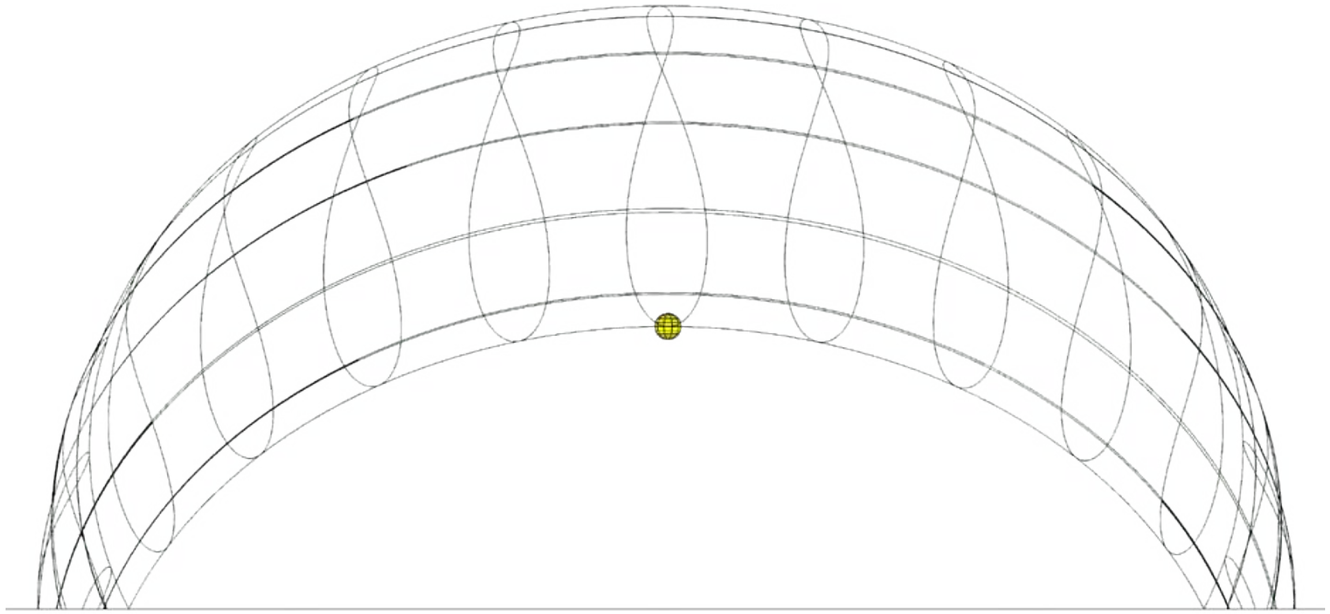


Wind Rose
Hourly, Jan 1- Dec 31
Philadelphia
Temp betwen 18 and 26
Relative Humidity Below 80
Windspeed Below 2 m/s

With the Wind Rose above and to the right, it is clear that the most comfortable winds are from the SW and WSW directions. As these winds occur during periods which are favorable, they are also those which would be best to introduce into the apartment itself. Luckily, the window faces south and is therefore able to capture some of these breezes. By implementing vertical louvres, further wind might be able to be captured and directed into the apartment.
Ventilation in this space which overheats in the summer would allow for night purging during the summer. This would allow for a cooler and more comfortable temperature during the day.



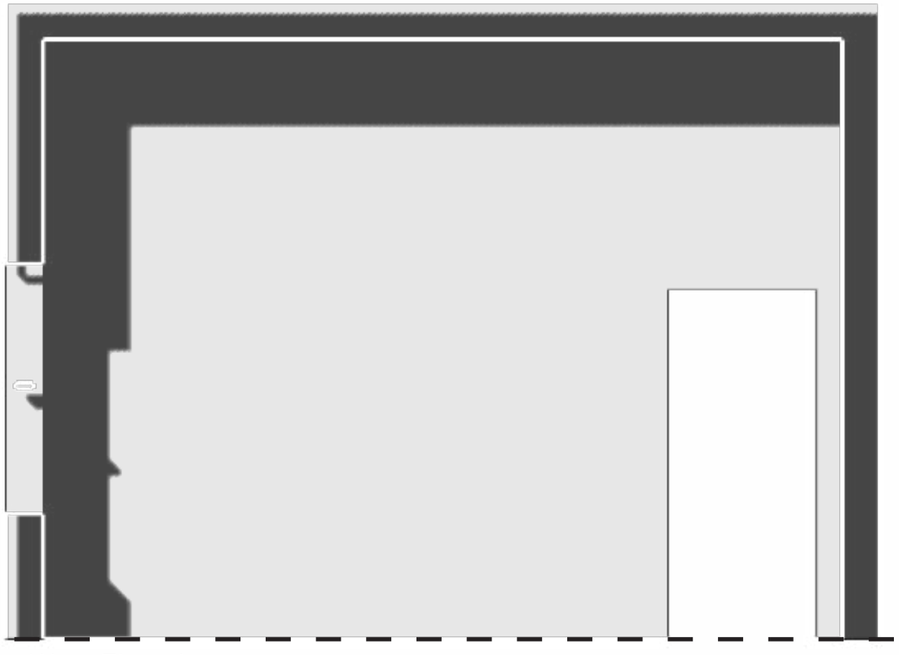
Plan



Sun Path Diagram
Hourly, Jan 1- Dec 31
Philadelphia
Looking South

With the room having a tendency to turn cold during the winter, the ability to hold on to the heat from the solar radiation could help keep the room warm. With the current layout of the room with soft materials near the window and coverings over a great deal of the floor, the heat of radiation is not well used. By moving the soft materials away from the window and into the darker depths of the room, the floors and walls might be able better absorb the radiation. Additionally painting these surfaces a darker color or adding a thermally massive object in front of the window, like water tubes, could further help maintain a warmer temperature in the winter.

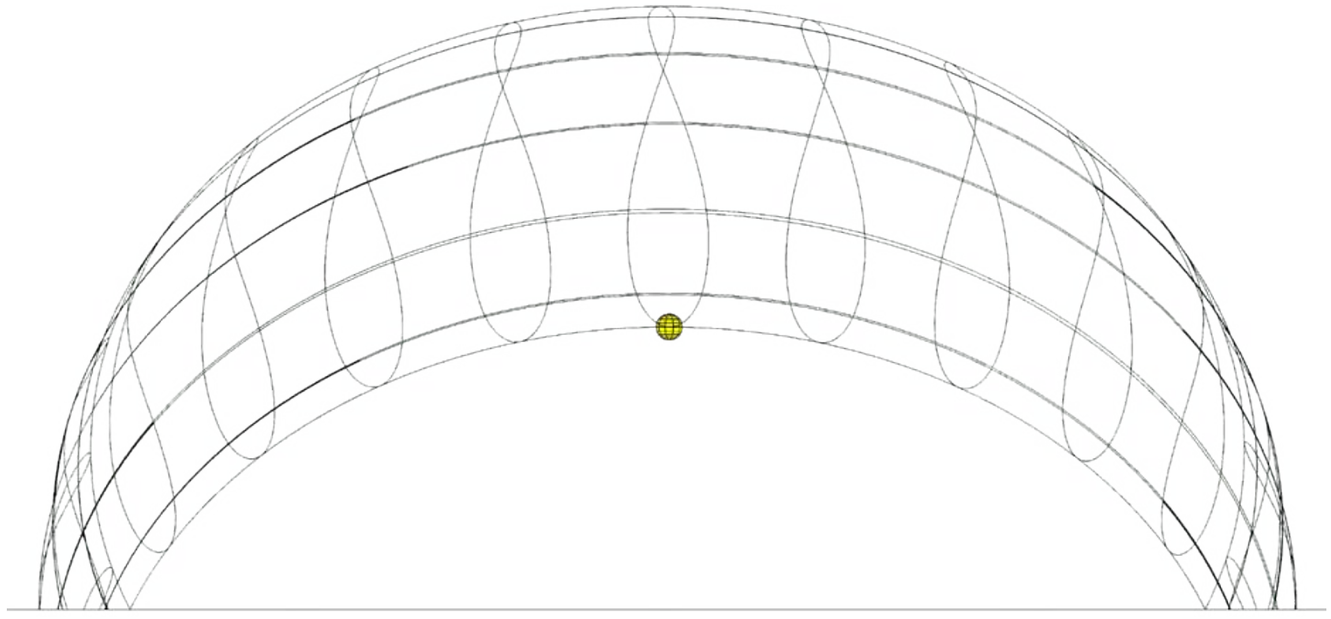
Shading



Floor 2

14'

West Elevation



Sun Path Diagram
Hourly, Jan 1- Dec 31
Philadelphia
Looking South

Floor 2

14'

West Elevation

Although the south window is a great benefit during the winter, the excessive sunlight can be detrimental during the summer. As can be seen in the sun path diagram above, the summer sun is significantly higher in the sky than during the winter. By implementing horizontal shading devices, it is possible to block the summer sun and reducing the heat gain while allowing the lower winter sun in to warm it up. This is an easy solution to make the room more comfortable without additional heating and cooling.