

# PHILADELPHIA, PENNSYLVANIA

Passive Design Strategies

Jieming Jin | M.Arch 2015 Candidate  
Arch 753 Building Performance Simulation  
Instructor: Mostapha S. Roudsari  
University of Pennsylvania  
School of Design

# CLIMATE ZONES

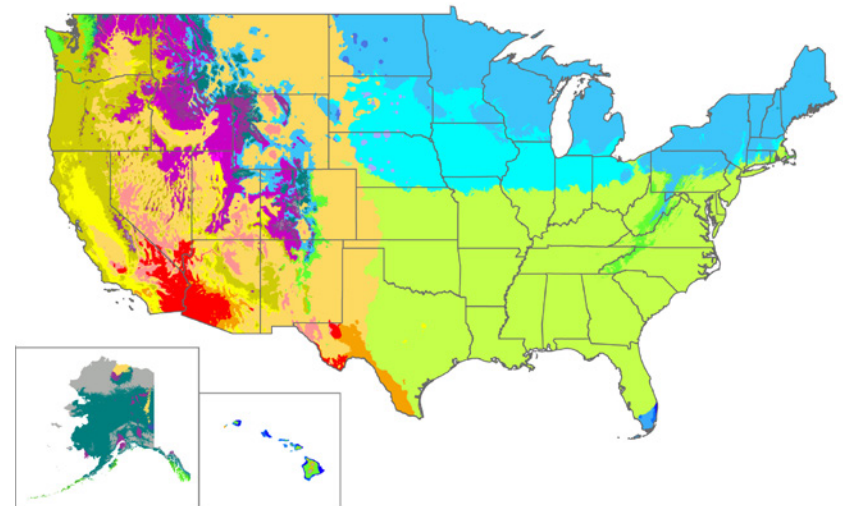
WEATHER DATA: USA\_PA\_Philadelphia.  
Intl.AP.724080\_TMY3  
DATA SOURCE: TMV3  
LATITUDE: 39.87  
LONGITUDE: -75.23

Strong Cold Stress: 1146 hrs  
Moderate Cold Stress: 1862 hrs  
Slight Cold Stress: 1610 hrs  
Comfort: 3616 hrs  
Slight Heat Stress: 251 hrs  
Moderate Heat Stress: 221 hrs  
Strong Heat Stress: 54 hrs

Climate Zone: Zone 4  
Ceiling R-value: 38  
Wood Frame Wall R-value: 13  
Mass Wall R-value<sup>i</sup>: 5/10  
Floor R-value: 19  
Basement Wall R-value<sup>c</sup>: 10/13  
Slab R-value<sup>d</sup>, Depth: 10,2ft  
Crawlspace Wall R-value<sup>c</sup>: 10/13  
Fenestration U-Factor<sup>b</sup>: 0.35  
Skylight U-Factor<sup>b</sup>: 0.6  
Glazed fenestration SHGC<sup>b,e</sup>: NR

<https://energycode.pnl.gov/EnergyCodeReqs/?state=Pennsylvania>

## Köppen climate types of the United States



### Köppen climate type

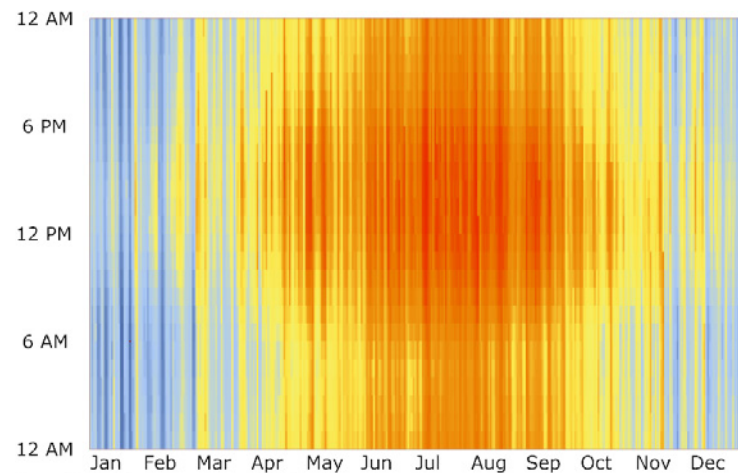
EF (Ice-cap)	Dsb (Warm-summer mediterranean continental)	Csa (Hot-summer mediterranean)
ET (Tundra)	Dsa (Hot-summer mediterranean continental)	BSk (Cold semi-arid)
Dfc (Subarctic)	Cfc (Subpolar oceanic)	BSh (Hot semi-arid)
Dfb (Warm-summer humid continental)	Cfb (Oceanic)	BWk (Cold desert)
Dfa (Hot-summer humid continental)	Cfa (Humid subtropical)	BWh (Hot desert)
Dwc (Subarctic)	Cwb (Subtropical highland)	Aw (Savanna)
Dwb (Warm-summer humid continental)	Cwa (Humid subtropical)	Am (Monsoon)
Dwa (Hot-summer humid continental)	Csc (Cold-summer mediterranean)	Af (Rainforest)
Dsc (Dry-summer subarctic)	Csb (Warm-summer mediterranean)	

\*Isotherm used to distinguish temperate (C) and continental (D) climates is -3°C

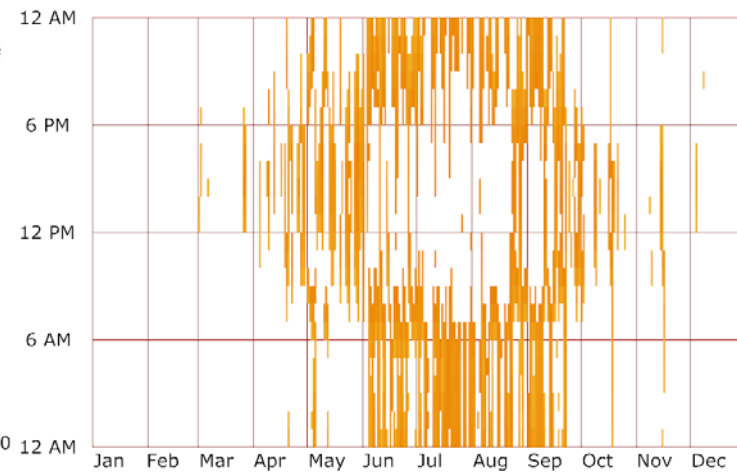
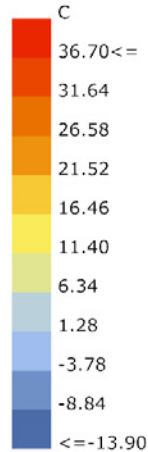
Data sources: Köppen types calculated from data from PRISM Climate Group, Oregon State University, <http://prism.oregonstate.edu>;  
Outline map from US Census Bureau

[https://en.wikipedia.org/wiki/Climate\\_of\\_the\\_United\\_States](https://en.wikipedia.org/wiki/Climate_of_the_United_States)

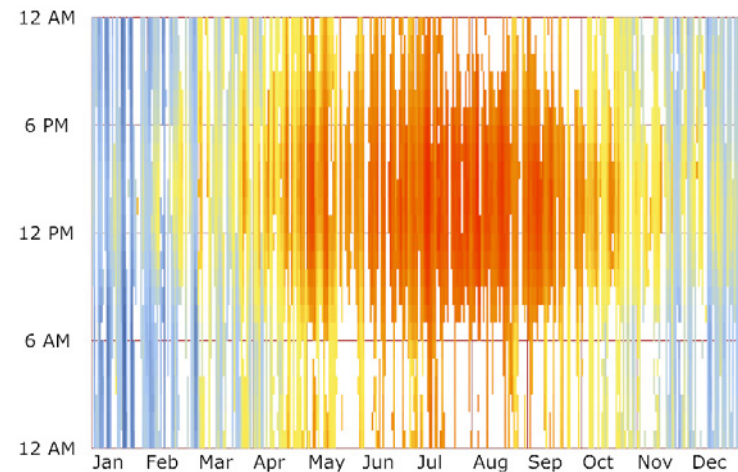
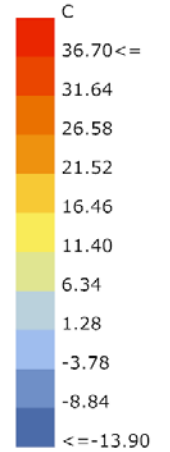
# TEMPERATURE ANALYSIS



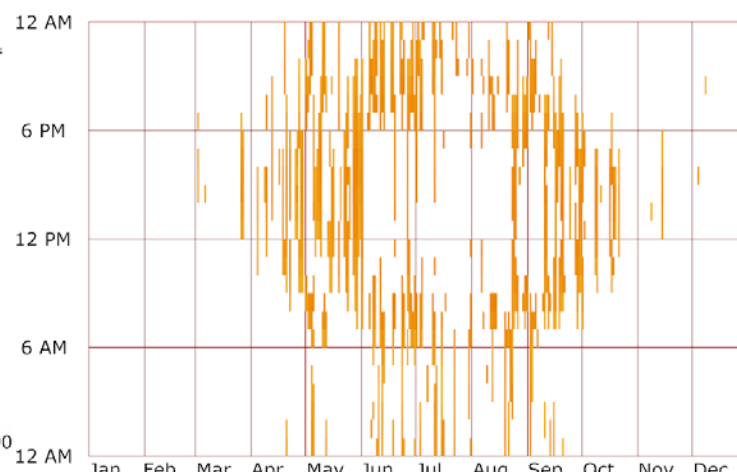
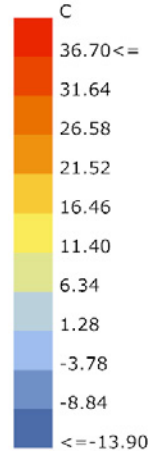
Dry Bulb Temperature (C) - Hourly  
Philadelphia International Ap\_PA\_USA  
1 JAN 1:00 - 31 DEC 24:00



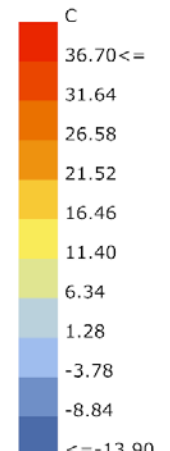
Dry Bulb Temperature (C) - Hourly  
Philadelphia International Ap\_PA\_USA  
1 JAN 1:00 - 31 DEC 24:00



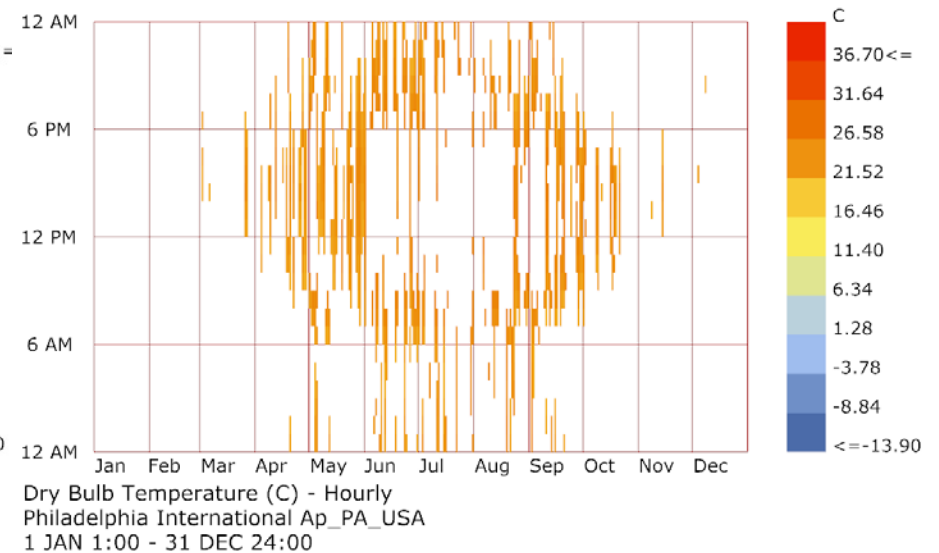
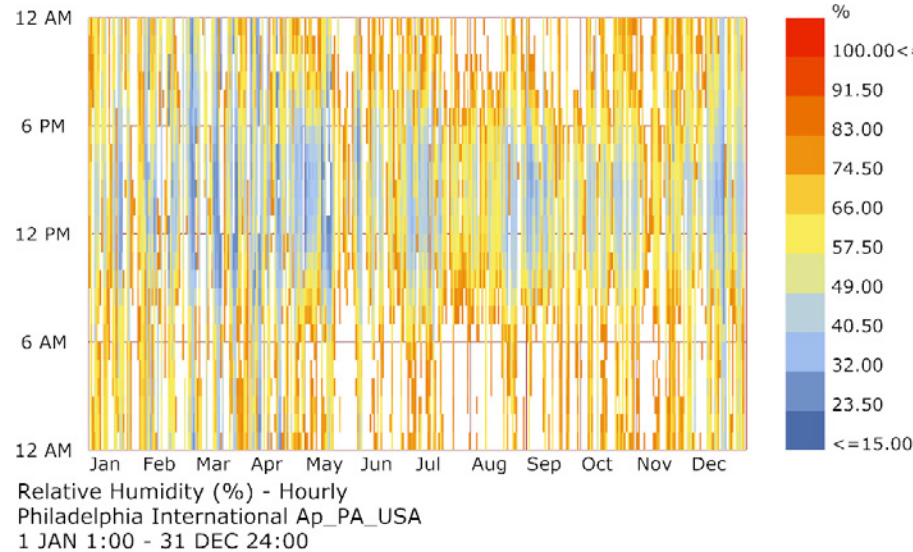
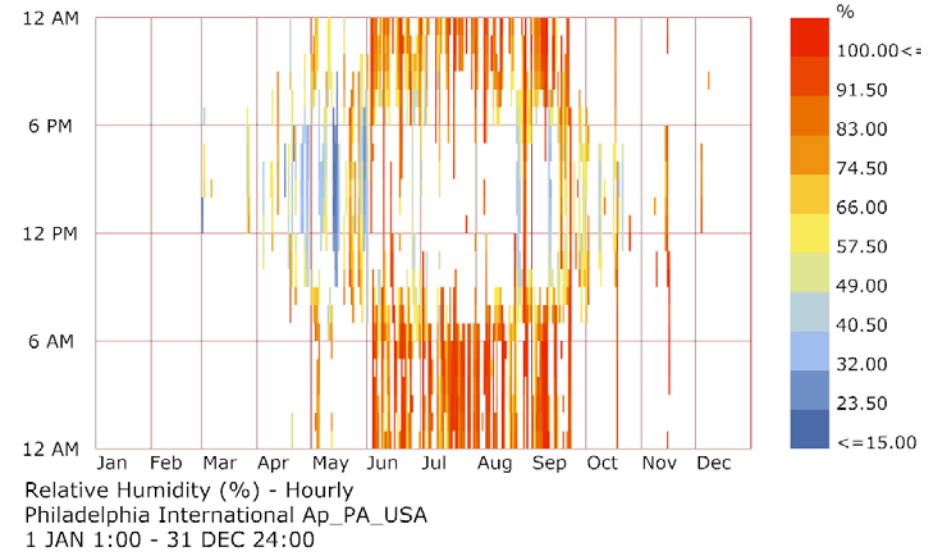
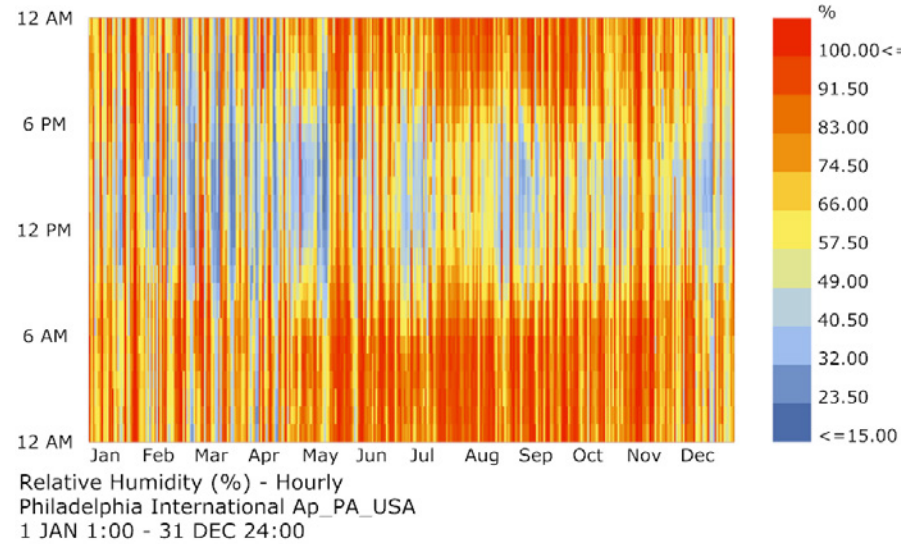
Dry Bulb Temperature (C) - Hourly  
Philadelphia International Ap\_PA\_USA  
1 JAN 1:00 - 31 DEC 24:00



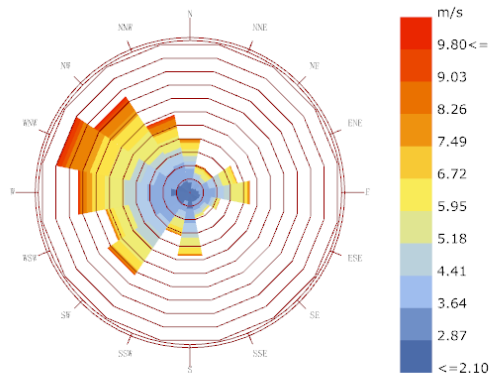
Dry Bulb Temperature (C) - Hourly  
Philadelphia International Ap\_PA\_USA  
1 JAN 1:00 - 31 DEC 24:00



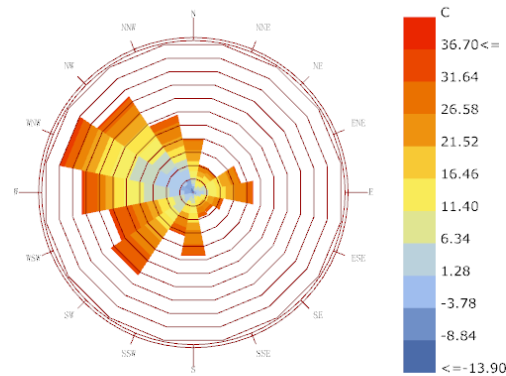
# HUMIDITY ANALYSIS



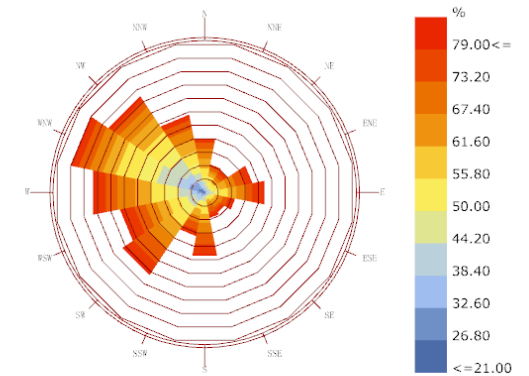
# WIND-ROSE ANALYSIS



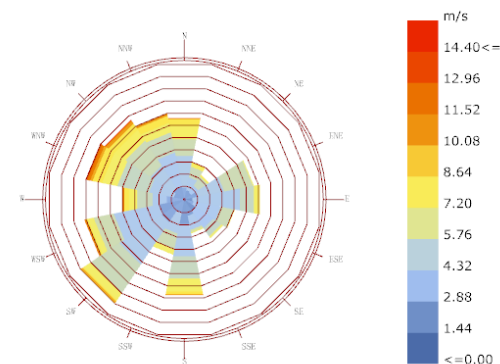
Conditional Selection Applied:  
20 < Relative Humidity < 80  
and 2 < Wind Speed < 10  
5288.0 hours of total 8760.0 hours (60.37%).



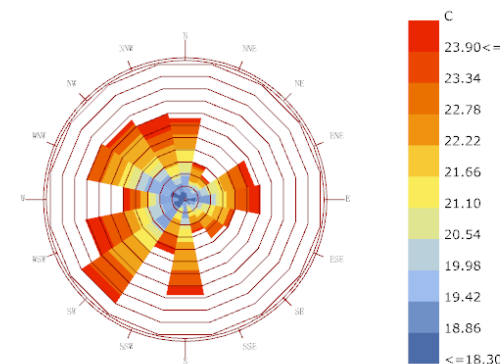
Conditional Selection Applied:  
20 < Relative Humidity < 80  
and 2 < Wind Speed < 10  
5288.0 hours of total 8760.0 hours (60.37%).



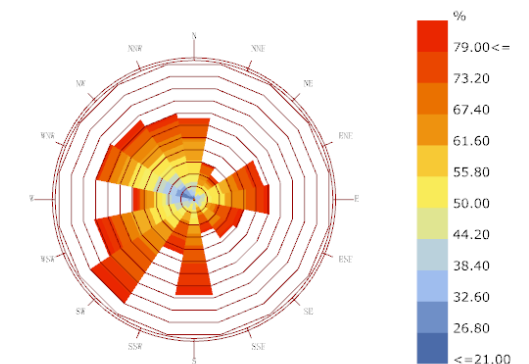
Conditional Selection Applied:  
20 < Relative Humidity < 80  
and 2 < Wind Speed < 10  
5288.0 hours of total 8760.0 hours (60.37%).



Conditional Selection Applied:  
20 < Relative Humidity < 80  
and 18 < Dry Bulb Temperature < 24  
963.0 hours of total 8760.0 hours (10.99%).



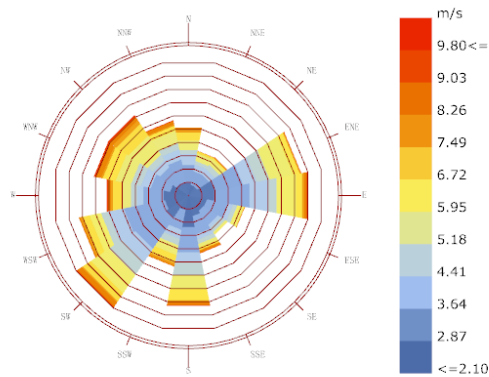
Conditional Selection Applied:  
20 < Relative Humidity < 80  
and 18 < Dry Bulb Temperature < 24  
963.0 hours of total 8760.0 hours (10.99%).



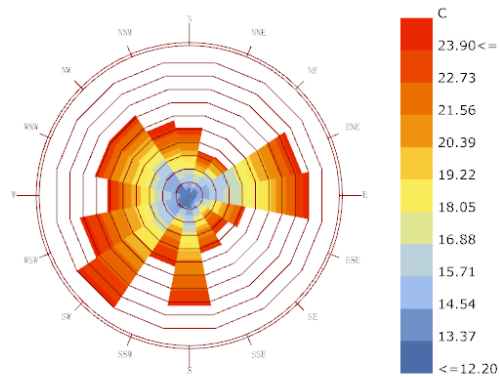
Conditional Selection Applied:  
20 < Relative Humidity < 80  
and 18 < Dry Bulb Temperature < 24  
963.0 hours of total 8760.0 hours (10.99%).



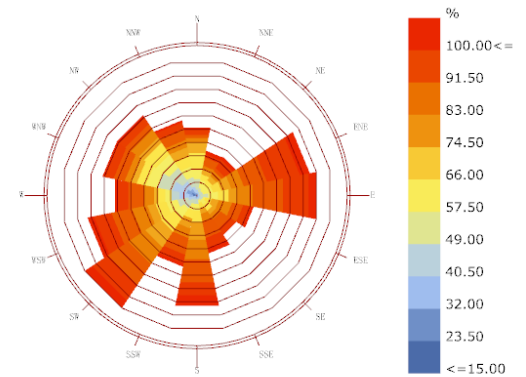
# WIND-ROSE ANALYSIS



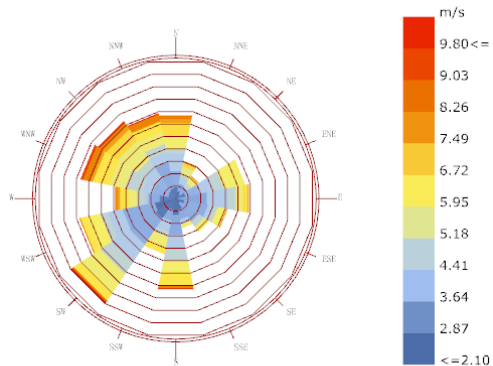
Conditional Selection Applied:  
12 < Dry Bulb Temperature < 24  
and 2 < Wind Speed < 10  
3084.0 hours of total 8760.0 hours (35.21%).



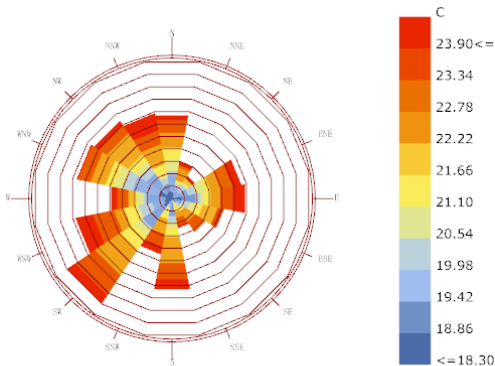
Conditional Selection Applied:  
12 < Dry Bulb Temperature < 24  
and 2 < Wind Speed < 10  
3084.0 hours of total 8760.0 hours (35.21%).



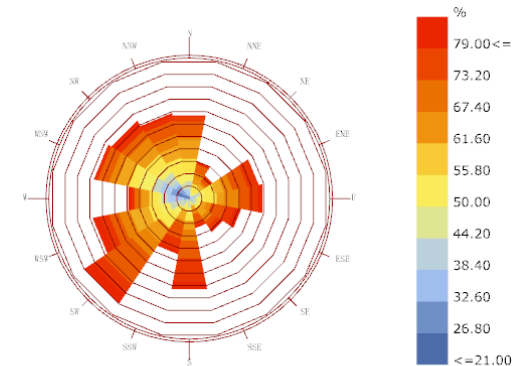
Conditional Selection Applied:  
12 < Dry Bulb Temperature < 24  
and 2 < Wind Speed < 10  
3084.0 hours of total 8760.0 hours (35.21%).



Conditional Selection Applied:  
18 < Dry Bulb Temperature < 24  
and 20 < Relative Humidity < 80  
and 2 < Wind Speed < 10  
897.0 hours of total 8760.0 hours (10.24%).



Conditional Selection Applied:  
18 < Dry Bulb Temperature < 24  
and 20 < Relative Humidity < 80  
and 2 < Wind Speed < 10  
897.0 hours of total 8760.0 hours (10.24%).



Conditional Selection Applied:  
18 < Dry Bulb Temperature < 24  
and 20 < Relative Humidity < 80  
and 2 < Wind Speed < 10  
897.0 hours of total 8760.0 hours (10.24%).

# CONCLUSION

According to the weather data, Philadelphia is a comfortable city to live.

If we define the "comfort" as: Dry Bulb Temperature is between 18°C to 24°C, the Relative Humidity is between 20% to 80% and the Wind Speed is between 2m/s to 10m/s, then there are 897 hours of total 8760 hours (10.24%) that can be called "comfortable".

-From the Wind-Rose diagram we can learn that when the Dry Bulb Temperature is between 18°C to 24°C and the Relative Humidity is between 20% to 80%, the best wind speed comes mostly from South-West direction.

-When the Dry Bulb Temperature is between 18°C to 24°C and the Wind Speed is between 2m/s to 10m/s, Philadelphia is always wet. There are 3084 hours of total 8760 hours that both the wind and the temperature is comfortable but the Relative Humidity is always more than 70%.

-When the Relative Humidity is between 20% to 80% and the Wind Speed is between 2m/s to 10m/s, there are 5288 hours of total 8760 hours that both the humidity and the wind is comfortable but the Dry Bulb Temperature is above 26°C which means not comfortable because it's a little bit hot outside.

-When the Relative Humidity is between 20% to 80% and the Temperature is between 2m/s to 10m/s, there are 963 hours of total 8760 hours that both the humidity and the temperature is comfortable but the wind speed is above 8.64m/s which means not comfortable because the wind is a little bit strong.

My strategy for having more sunlight:

- (1) Open the windows from 6am to 6pm in the spring and fall and 8pm to 0am in summer and 8am to 10am in the winter.
- (2) In summer, Philadelphia will be very wet so use air conditioner to dry the air.
- (3) Don't open the South-East window in winter since it's very cold outside and the wind comes mainly from this direction.







