

Assignment-
04_climate_data_report_round_2

WEATHER DATA SUMMARY		LOCATION: Philadelphia Ne Philadelphia, PA, USA Latitude/Longitude: 40.08° North, 75.02° West, Time Zone from Greenwich -5 Data Source: TMY3 724085 WMO Station Number, Elevation 98 ft												
MONTHLY MEANS		JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	
Global Horiz Radiation (Avg Hourly)		52	100	87	105	114	124	147	114	100	89	77	52	Btu/sq.ft
Direct Normal Radiation (Avg Hourly)		62	129	83	85	79	87	141	83	88	98	110	71	Btu/sq.ft
Diffuse Radiation (Avg Hourly)		29	40	42	49	58	61	47	57	48	40	33	28	Btu/sq.ft
Global Horiz Radiation (Max Hourly)		164	221	261	295	313	301	305	285	258	228	182	143	Btu/sq.ft
Direct Normal Radiation (Max Hourly)		298	281	304	268	296	256	277	252	251	268	265	280	Btu/sq.ft
Diffuse Radiation (Max Hourly)		110	100	131	136	187	139	173	130	119	114	87	96	Btu/sq.ft
Global Horiz Radiation (Avg Daily Total)		493	1044	1031	1386	1631	1837	2142	1547	1230	973	760	484	Btu/sq.ft
Direct Normal Radiation (Avg Daily Total)		590	1353	982	1124	1138	1293	2059	1137	1079	1072	1084	658	Btu/sq.ft
Diffuse Radiation (Avg Daily Total)		283	422	497	656	838	916	694	776	586	445	328	261	Btu/sq.ft
Global Horiz Illumination (Avg Hourly)		1655	3101	2786	3328	3647	3939	4606	3621	3180	2789	2406	1665	footcandles
Direct Normal Illumination (Avg Hourly)		1652	3573	2356	2446	2332	2555	4093	2445	2528	2745	2989	1868	footcandles
Dry Bulb Temperature (Avg Monthly)		26	34	44	54	61	71	76	78	70	56	46	40	degrees F
Dew Point Temperature (Avg Monthly)		17	18	33	43	48	58	64	65	57	45	35	29	degrees F
Relative Humidity (Avg Monthly)		70	51	65	71	65	66	70	67	67	69	67	65	percent
Wind Direction (Monthly Mode)		300	280	310	200	320	240	280	210	310	350	290	330	degrees
Wind Speed (Avg Monthly)		8	8	10	9	8	6	7	5	7	6	7	7	mph
Ground Temperature (Avg Monthly of 3 Depths)		40	37	38	42	52	61	68	72	70	65	56	47	degrees F

COMFORT MODEL	LOCATION: Philadelphia Ne Philadelphia, PA, USA Latitude/Longitude: 40.08° North, 75.02° West, Time Zone from Greenwich -5 Data Source: TMY3 724085 WMO Station Number, Elevation 98 ft
COMFORT MODELS:	
Human Thermal comfort can be defined primarily by dry bulb temperature and humidity, although different sources have slightly different definitions. Select the model you wish to use:	
<input checked="" type="radio"/> California Energy Code Comfort Model, 2013 (DEFAULT) For the purpose of sizing residential heating and cooling systems the indoor Dry Bulb Design Conditions should be between 68°F (20°C) to 75°F (23.9°C). No Humidity limits are specified in the Code, so 80% Relative Humidity and 66°F (18.9°C) Wet Bulb is used for the upper limit and 27°F (-2.8°C) Dew Point is used for the lower limit (but these can be changed on the Criteria screen).	
<input type="radio"/> ASHRAE Standard 55 and Current Handbook of Fundamentals Model Thermal comfort is based on dry bulb temperature, clothing level (clo), metabolic activity (met), air velocity, humidity, and mean radiant temperature. Indoors it is assumed that mean radiant temperature is close to dry bulb temperature. The zone in which most people are comfortable is calculated using the PMV (Predicted Mean Vote) model. In residential settings people adapt clothing to match the season and feel comfortable in higher air velocities and so have wider comfort range than in buildings with centralized HVAC systems.	
<input type="radio"/> ASHRAE Handbook of Fundamentals Comfort Model up through 2005 For people dressed in normal winter clothes, Effective Temperatures of 68°F (20°C) to 74°F (23.3°C) (measured at 50% relative humidity), which means the temperatures decrease slightly as humidity rises. The upper humidity limit is 64°F (17.8°C) Wet Bulb and a lower Dew Point of 36°F (2.2°C). If people are dressed in light weight summer clothes then this comfort zone shifts 5°F (2.8°C) warmer.	
<input type="radio"/> Adaptive Comfort Model in ASHRAE Standard 55-2010 In naturally ventilated spaces where occupants can open and close windows, their thermal response will depend in part on the outdoor climate, and may have a wider comfort range than in buildings with centralized HVAC systems. This model assumes occupants adapt their clothing to thermal conditions, and are sedentary (1.0 to 1.3 met). There must be no mechanical Cooling System, but this method does not apply if a Mechanical Heating System is in operation.	

CRITERIA: (Imperial Units)

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California Energy Code Comfort Model, 2013 (select Help for definitions)**1. COMFORT: (using California Energy Code Model)**

68.0	Comfort Low - Min. Comfort Dry Bulb Temp (°F)
75.0	Comfort High - Max. Comfort Dry Bulb Temp, up to 50% RH (°F)
80.0	Max. Relative Humidity (measured at Min. Comfort Temp) (%)
66.0	Max. Wet Bulb Temperature (°F)
27.0	Min. Dew Point Temperature (°F)

2. SUN SHADING ZONE: (Defaults to Comfort Low)

68.0	Min. Dry Bulb Temperature when Need for Shading Begins (°F)
100.0	Min. Global Horiz. Radiation when Need for Shading Begins (Btu/sq.ft)

3. HIGH THERMAL MASS ZONE:

15.0	Max. Outdoor Temperature Difference above Comfort High (°F)
3.0	Min. Nighttime Temperature Difference below Comfort High (°F)

4. HIGH THERMAL MASS WITH NIGHT FLUSHING ZONE:

30.0	Max. Outdoor Temperature Difference above Comfort High (°F)
3.0	Min. Nighttime Temperature Difference below Comfort High (°F)

5. DIRECT EVAPORATIVE COOLING ZONE: (Defined by Comfort Zone)

63.8	Max. Wet Bulb set by Max. Comfort Zone Wet Bulb (°F)
48.8	Min. Wet Bulb set by Min. Comfort Zone Wet Bulb (°F)

6. TWO-STAGE EVAPORATIVE COOLING ZONE:

50.0	% Efficiency of Indirect Stage
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7. NATURAL VENTILATION COOLING ZONE:

2.0	Terrain Category to modify Wind Speed (2=suburban)
40.0	Min. Indoor Velocity to Effect Indoor Comfort (fpm)
300.0	Max. Comfortable Velocity (per ASHRAE Std. 55) (fpm)
6.6	Max. Perceived Temperature Reduction (°F)
90.0	Max. Relative Humidity (%)
73.0	Max. Wet Bulb Temperature (°F)

8. FAN-FORCED VENTILATION COOLING ZONE:

160.0	Max. Mechanical Ventilation Velocity (fpm)
5.4	Max. Perceived Temperature Reduction (°F) (Min Vel, Max RH, Max WB match Natural Ventilation)

9. INTERNAL HEAT GAIN ZONE (lights, people, equipment):

55.0	Balance Point Temperature below which Heating is Needed (°F)
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10. PASSIVE SOLAR DIRECT GAIN LOW MASS ZONE:

50.0	Min. South Window Radiation for 10° F Temperature Rise (Btu/sq.ft)
3.0	Thermal Time Lag for Low Mass Buildings (hours)

11. PASSIVE SOLAR DIRECT GAIN HIGH MASS ZONE:

100.0	Min. South Window Radiation for 10° F Temperature Rise (Btu/sq.ft)
12.0	Thermal Time Lag for High Mass Buildings (hours)

12. WIND PROTECTION OF OUTDOOR SPACES:

19.0	Velocity above which Wind Protection is Desirable (mph)
20.0	Dry Bulb Temperature Above or Below Comfort Zone (°F)

13. HUMIDIFICATION ZONE: (defined by and below Comfort Zone)**14. DEHUMIDIFICATION ZONE: (defined by and above Comfort Zone)**

TEMPERATURE RANGE
California Energy Code

LOCATION: Philadelphia Ne Philadelphia, PA, USA
Latitude/Longitude: 40.08° North, 75.02° West, **Time Zone from Greenwich** -5
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LEGEND

RECORDED HIGH	○
DESIGN HIGH	█
AVERAGE HIGH	█
MEAN	█
AVERAGE LOW	█
DESIGN LOW	█
RECORDED LOW	○
COMFORT ZONE	■

DESIGN HIGH: Residential

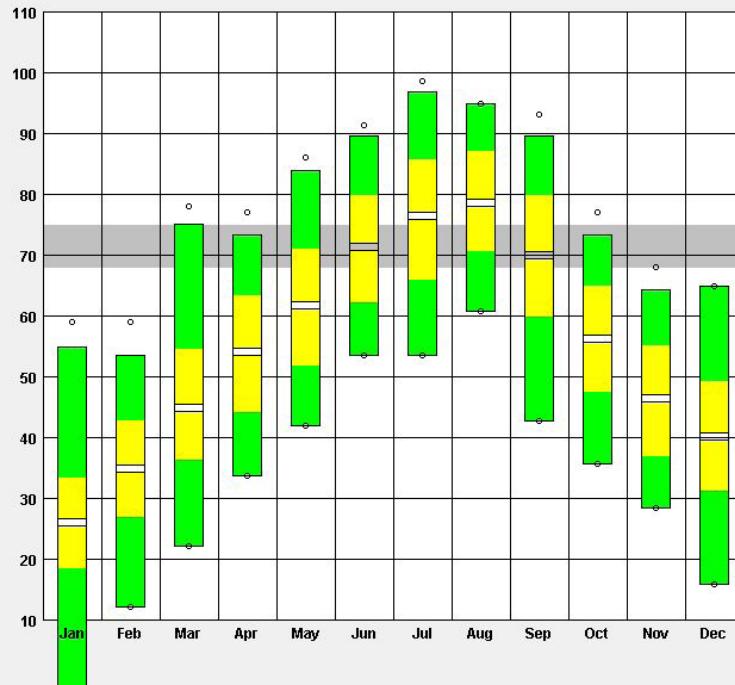
- 1% of Hours Above
- .5% of Hours Above
- 0% of Hours Above

DESIGN LOW: Residential

- 1% of Hours Below
- .5% of Hours Below
- 0% of Hours Below

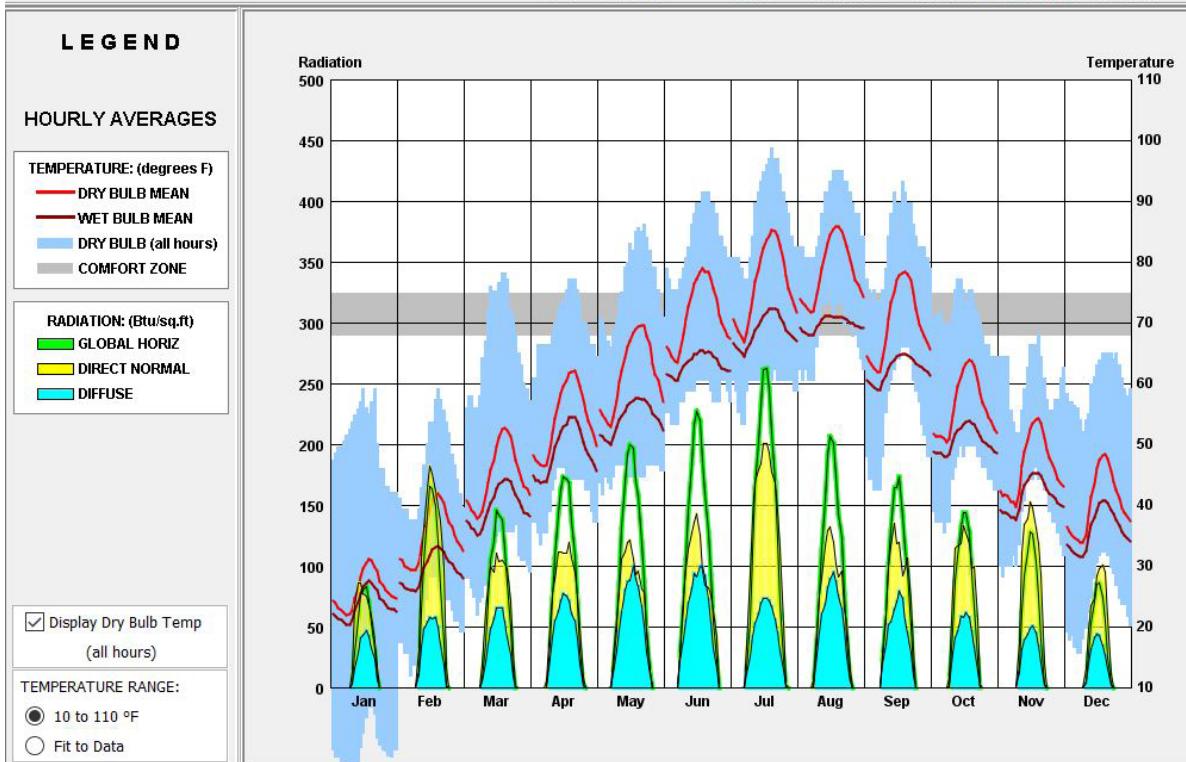
TEMPERATURE RANGE:

- 10 to 110 °F
- Fit to Data



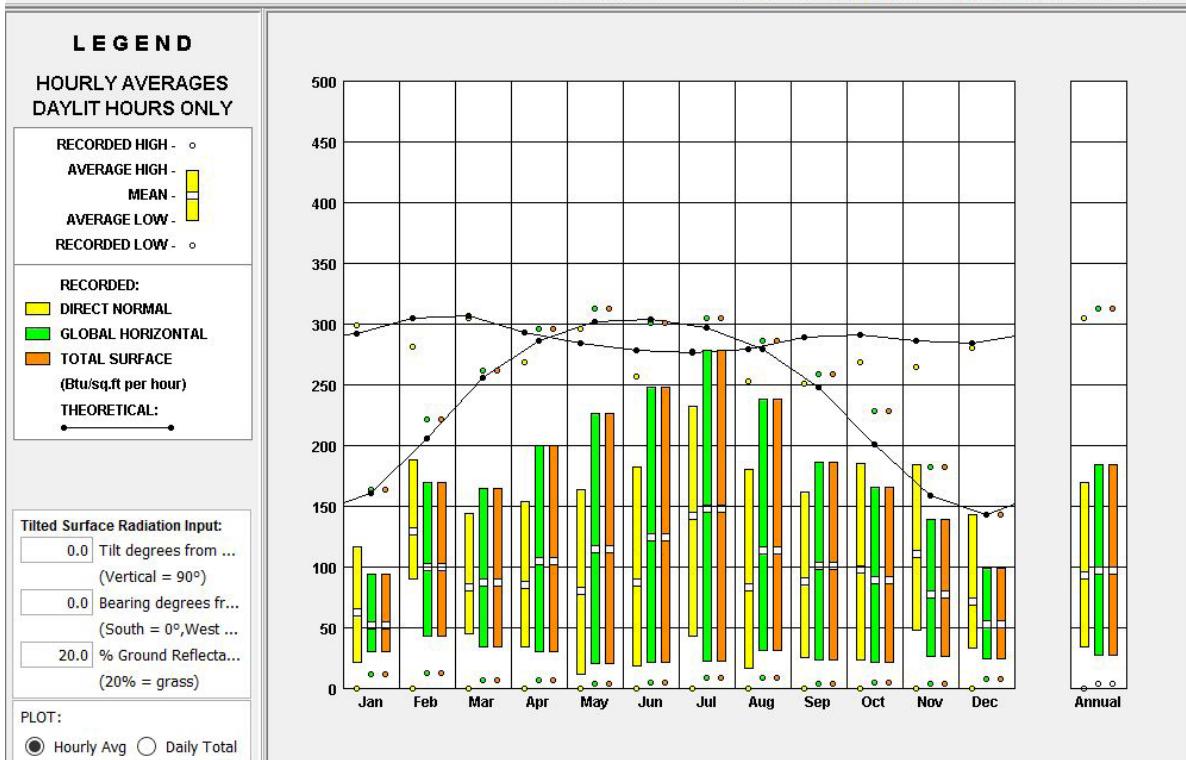
MONTHLY DIURNAL AVERAGES
California Energy Code

LOCATION: Philadelphia Ne Philadelphia, PA, USA
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RADIATION RANGE

LOCATION: Philadelphia Ne Philadelphia, PA, USA
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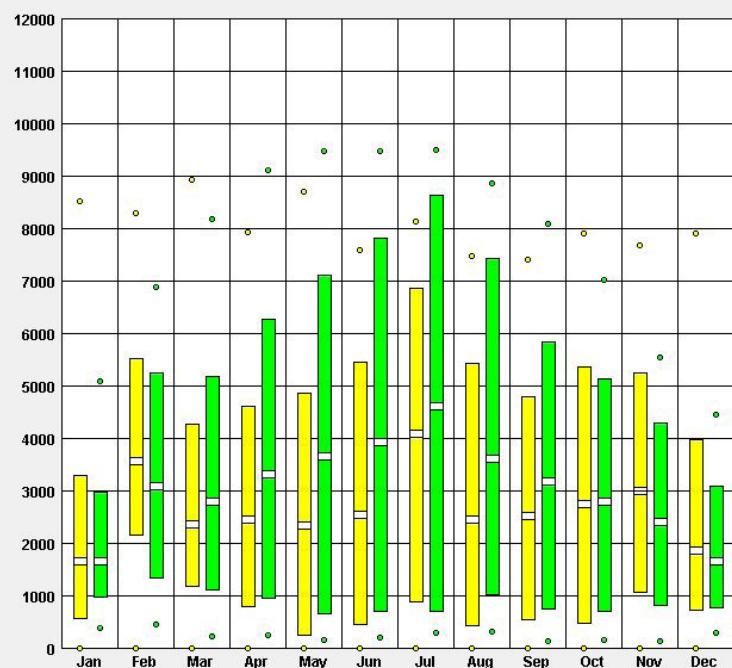
ILLUMINATION RANGE

LOCATION: Philadelphia Ne Philadelphia, PA, USA
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Data Source: TMY3 724085 WMO Station Number, **Elevation** 98 ft

LEGEND**HOURLY ILLUMINATION
DAYLIT HOURS ONLY**

RECORDED HIGH - ○
AVERAGE HIGH - █
MEAN - ███
AVERAGE LOW - █
RECORDED LOW - ○

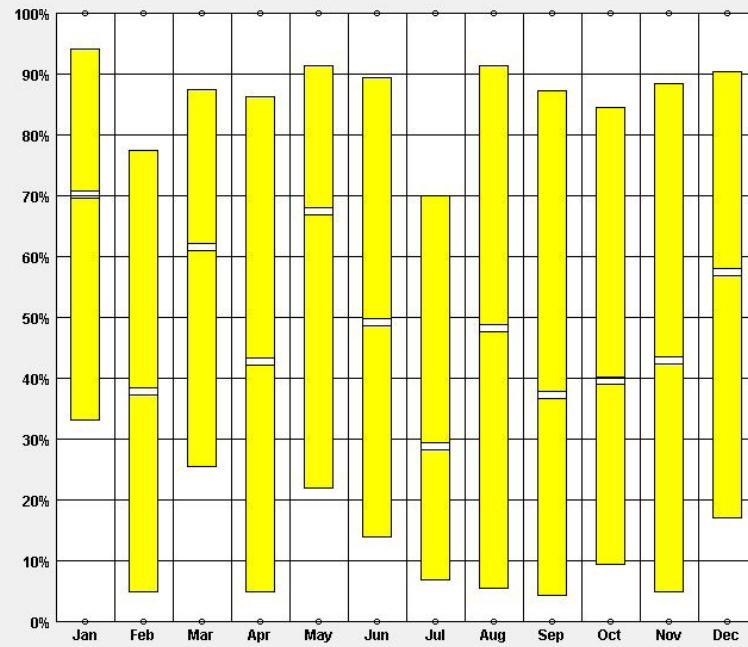
RECORDED:
█ DIRECT NORMAL
█ GLOBAL HORIZONTAL
(footcandles)

**SKY COVER RANGE**

LOCATION: Philadelphia Ne Philadelphia, PA, USA
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LEGEND

Total Cloud Cover 100%
RECORDED HIGH - ○
AVERAGE HIGH - █
MEAN - ███
AVERAGE LOW - █
RECORDED LOW - ○
Clear Skies 0

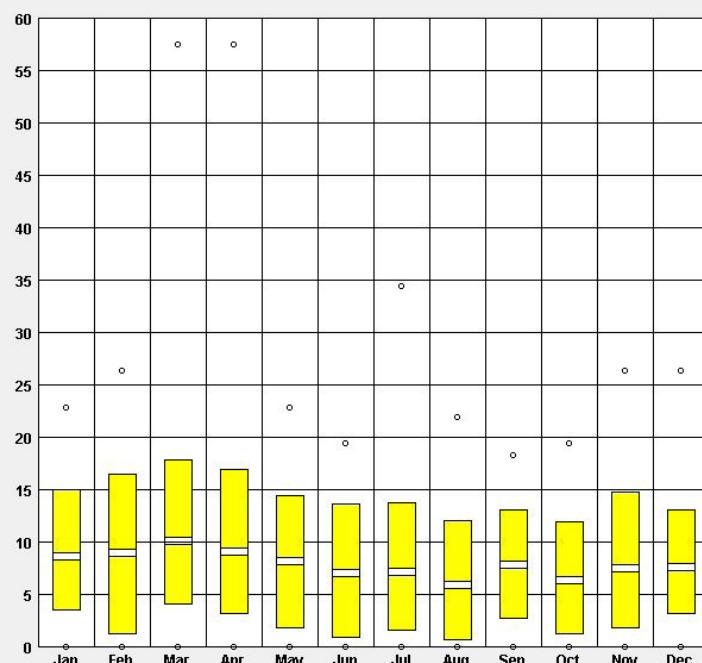


WIND VELOCITY RANGE

LOCATION: Philadelphia Ne Philadelphia, PA, USA
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LEGEND

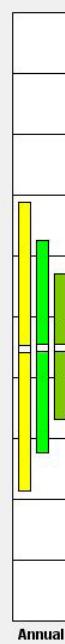
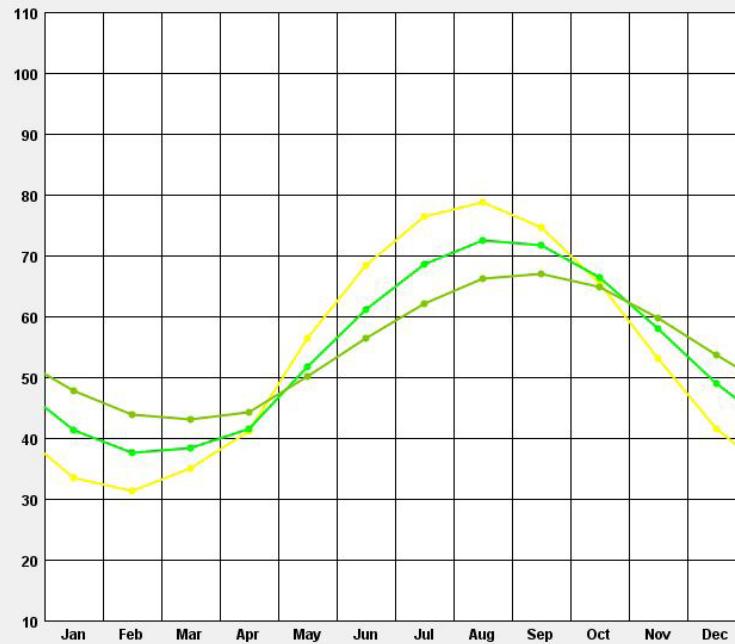
RECORDED HIGH - ○
AVERAGE HIGH - █
MEAN - ███
AVERAGE LOW - █
RECORDED LOW - ○
(mph)

PLOT:
 mph fpmWIND VELOCITY:
 0 to 60 mph
 Fit to Data**GROUND TEMPERATURE (MONTHLY AVERAGE)**

LOCATION: Philadelphia Ne Philadelphia, PA, USA
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LEGEND

DEPTH
(feet)
1.64
6.56
13.12
(Surface is freshly
mown grass.)

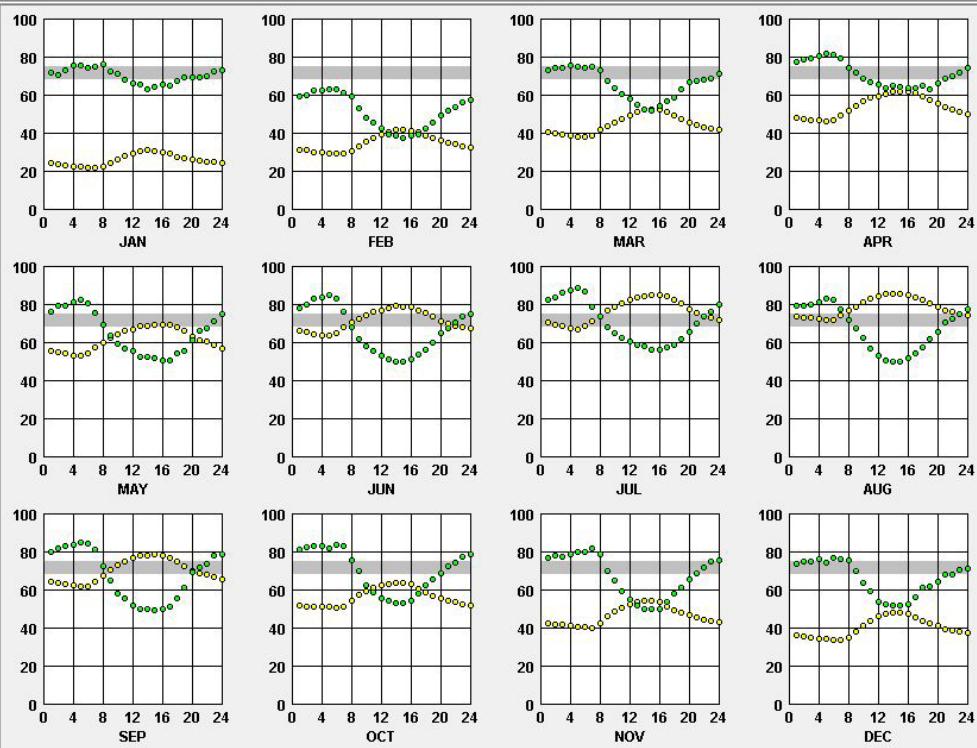
TEMPERATURE RANGE:
 10 to 110 °F
 Fit to Data

DRY BULB X RELATIVE HUMIDITY
California Energy Code

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LEGEND

- Dry Bulb
- Humidity
- Comfort Zone



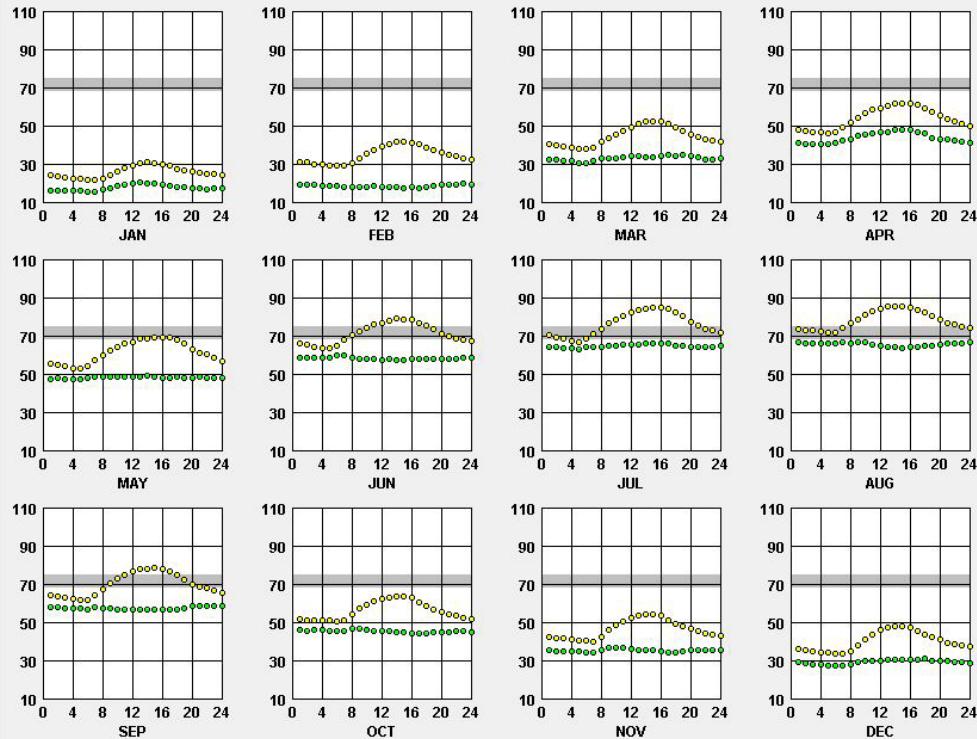
DRY BULB X DEW POINT
California Energy Code

LOCATION: Philadelphia Ne Philadelphia, PA, USA
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LEGEND

- Dry Bulb
- Dew Point
- Comfort Zone

TEMPERATURE RANGE:
 10 to 110 °F
 Fit to Data



SUN SHADING CHART

LOCATION: Philadelphia Ne Philadelphia, PA, USA
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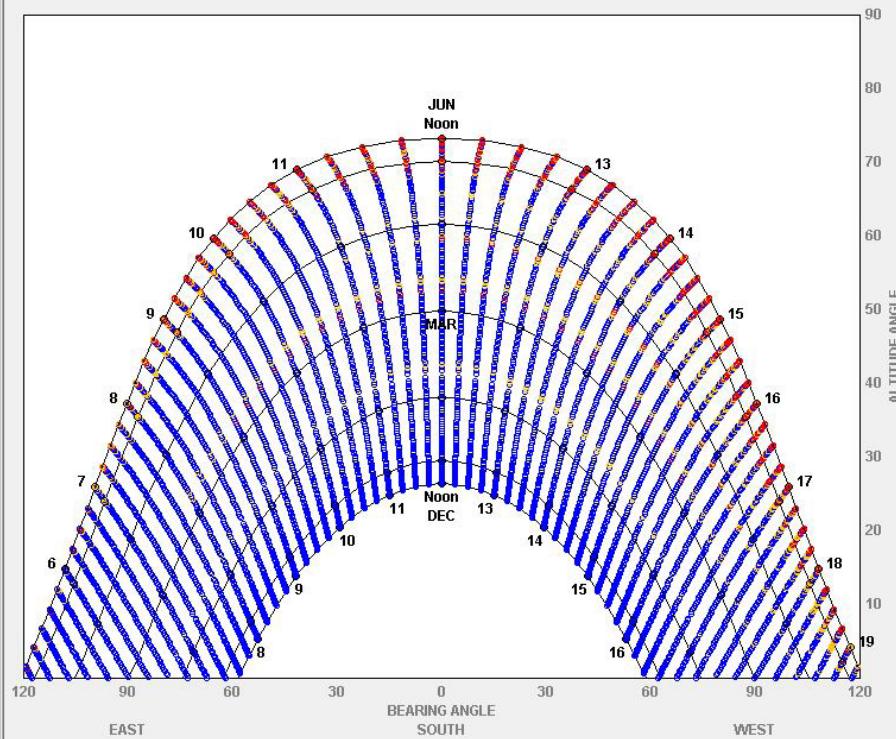
LEGEND

- WARM/HOT > 75°F
(SHADE NEEDED)
330 Hours Exposed
0 Hours Shaded
- COMFORT > 68°F
(SHADE HELPS)
255 Hours Exposed
0 Hours Shaded
- COOL/COLD < 68°F
(SUN NEEDED)
1923 Hours Exposed
0 Hours Shaded

PLOT MONTHS:

- WINTER SPRING
 December 21 to June 21
 SUMMER FALL
 June 21 to December 21

- Display Grid
 Display Shading Calculator
 Display Obstruction Elevation
 Input Obstructions



SUN CHART

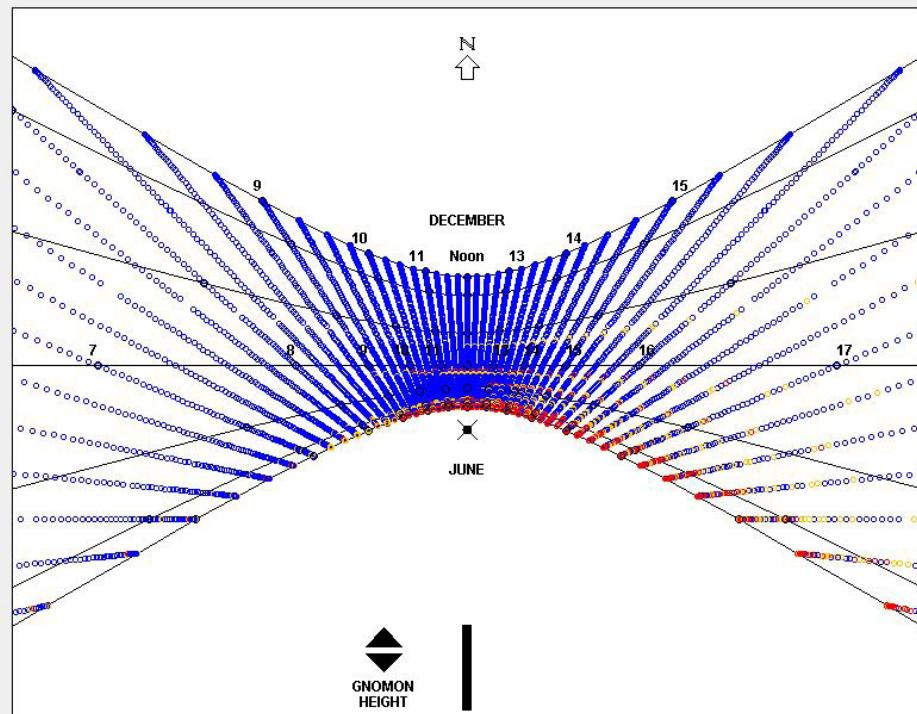
LOCATION: Philadelphia Ne Philadelphia, PA, USA
Latitude/Longitude: 40.08° North, 75.02° West, **Time Zone from Greenwich** -5
Data Source: TMY3 724085 WMO Station Number, **Elevation** 98 ft

LEGEND

- WARM/HOT > 75°F
(SHADE NEEDED)
- COMFORT > 68°F
(SHADE HELPS)
- COOL/COLD < 68°F
(SUN NEEDED)

GNOMON POSITION

- WINTER SPRING
 December 21 to June 21
 SUMMER FALL
 June 21 to December 21



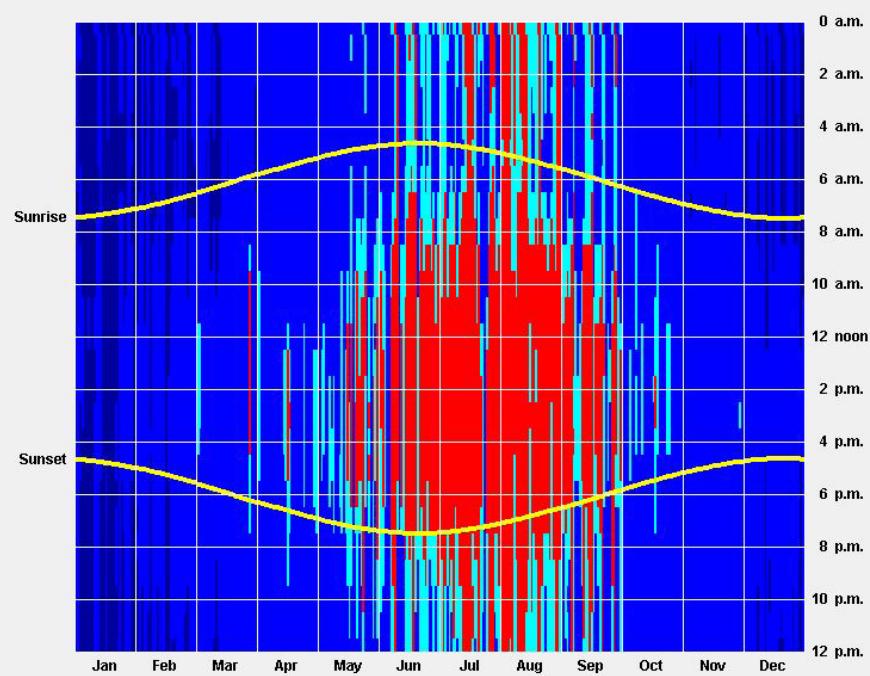
TIMETABLE PLOT

LOCATION: Philadelphia Ne Philadelphia, PA, USA
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LEGEND

DRY BULB TEMP
(degrees F)

- | | |
|-----|----------|
| 10% | < 32 |
| 60% | 32 - 68 |
| 12% | 68 - 75 |
| 17% | 75 - 100 |
| 0% | > 100 |

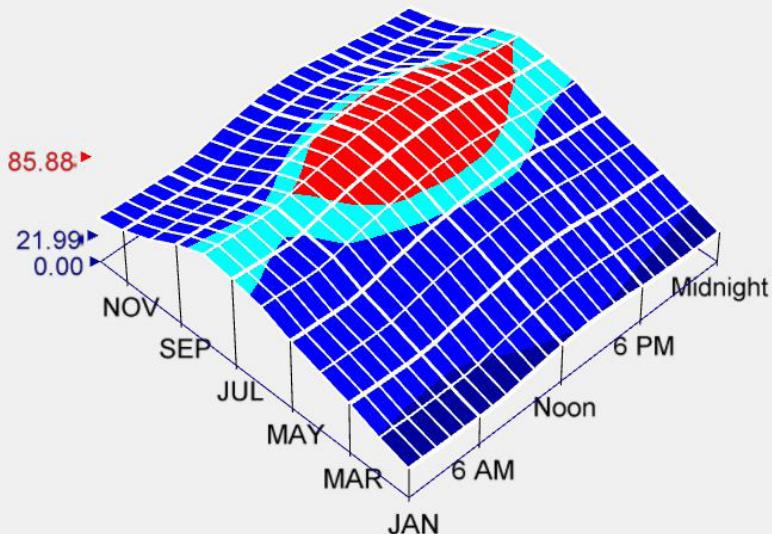
**PLOT:****DRY BULB TEMP** Monthly Avg Daily**3D CHARTS**

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LEGEND

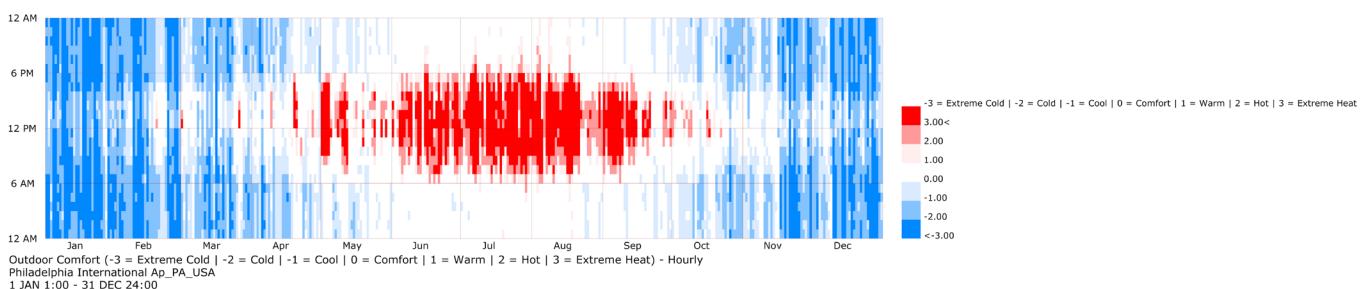
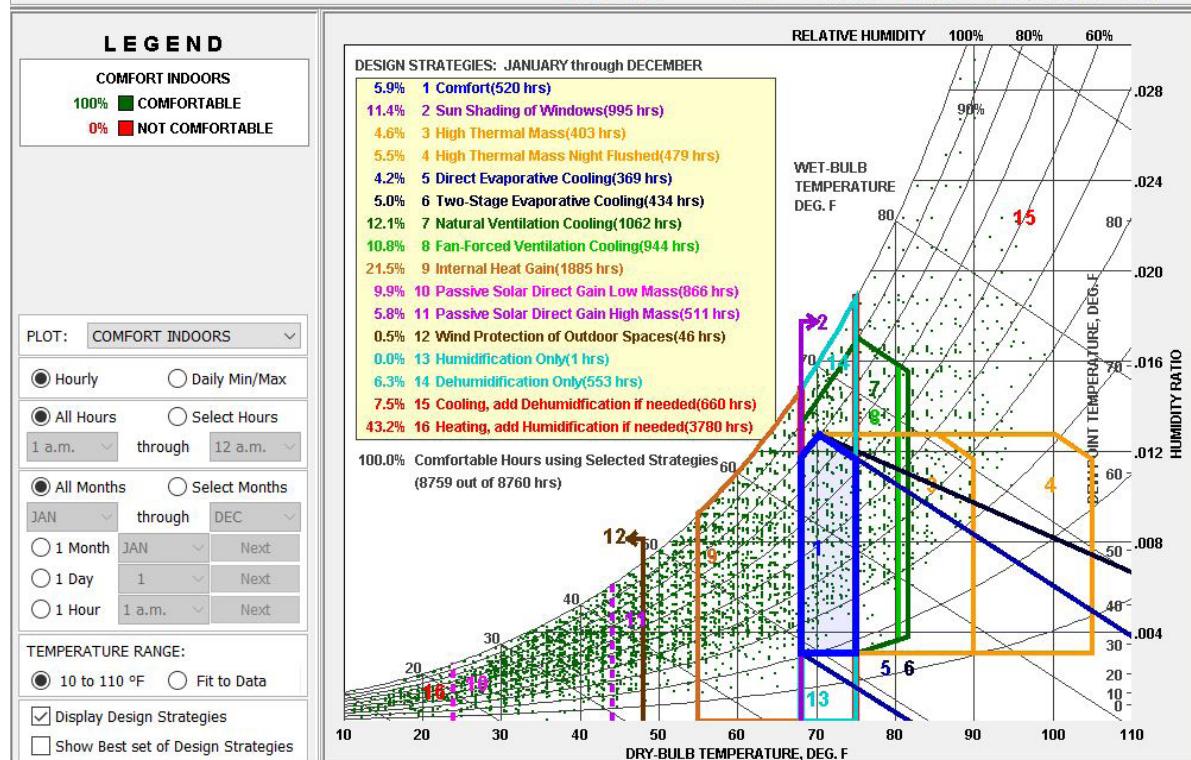
DRY BULB TEMP
(degrees F)

- | | |
|-----|----------|
| 11% | < 32 |
| 61% | 32 - 68 |
| 13% | 68 - 75 |
| 15% | 75 - 100 |
| 0% | > 100 |

**PLOT:** Not Shaded Shaded**DRY BULB TEMP** Monthly Avg Daily

PSYCHROMETRIC CHART
California Energy Code

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Global Situation in Philly:

Percent of Time Comfortable in Philly: 37.34%

Percent Heat Stress: 12.51%

Percent Cold Stress: 31.64%

Passive Design Strategies

1. According to the graph of Temperature Range, the monthly temperatures are colder than the comfort temperature most of the time in winter in Philadelphia. By adding operable external shading would increase the indoor temperature, and reduce the energy consumed during active heating in winter, while it would also shade the building in summer, as a design strategy of passive solar heating.
2. By adding wind tower would create naturally occurring air flow in the building and bring the fresh air from exterior to interior as a design strategy of passive ventilation.
3. Using building materials that could absorb and save heat energy would increase the thermal mass of a building and keep the building from overheating due to solar gain or internal heat gain as a design strategy of passive cooling.