

WEATHER ANALYSIS REPORT FOR CITY OF PHILADELPHIA

Arch631-Enviromental System
Yunzhuo Hao

WEATHER DATA SUMMARY		LOCATION: Philadelphia International Ap, PA, USA Latitude/Longitude: 39.87° North, 75.23° West, Time Zone from Greenwich -5 Data Source: TMY3 724080 WMO Station Number, Elevation 2 m											
MONTHLY MEANS		JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Global Horiz Radiation (Avg Hourly)		212	260	323	364	398	422	394	416	354	299	227	191
Direct Normal Radiation (Avg Hourly)		326	332	332	330	310	324	277	346	338	354	295	296
Diffuse Radiation (Avg Hourly)		94	104	137	152	182	187	196	180	145	126	109	90
Global Horiz Radiation (Max Hourly)		505	710	859	924	954	978	928	911	845	722	545	458
Direct Normal Radiation (Max Hourly)		930	930	905	953	847	882	845	923	857	936	923	916
Diffuse Radiation (Max Hourly)		274	361	404	462	454	495	477	453	481	336	286	240
Global Horiz Radiation (Avg Daily Total)		2016	2730	3819	4779	5655	6252	5714	5626	4365	3269	2224	1766
Direct Normal Radiation (Avg Daily Total)		3085	3491	3922	4324	4385	4791	4026	4681	4169	3847	2889	2732
Diffuse Radiation (Avg Daily Total)		902	1082	1622	1994	2603	2775	2851	2447	1788	1382	1073	834
Global Horiz Illumination (Avg Hourly)		22669	27899	34669	39330	42874	45654	42650	44596	38121	31956	24083	20394
Direct Normal Illumination (Avg Hourly)		29342	31402	31978	32382	30664	32309	27804	34524	33358	33695	27124	26246
Dry Bulb Temperature (Avg Monthly)		-1	0	7	12	18	22	25	23	20	12	7	3
Dew Point Temperature (Avg Monthly)		-7	-6	0	3	10	15	18	17	14	5	2	-4
Relative Humidity (Avg Monthly)		68	59	60	56	64	70	69	70	71	67	72	60
Wind Direction (Monthly Mode)		310	300	300	310	70	240	240	230	0	240	280	300
Wind Speed (Avg Monthly)		5	3	4	4	3	3	3	4	3	3	4	4
Ground Temperature (Avg Monthly of 3 Depths)		4	3	4	5	11	15	19	21	20	17	13	8

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COMFORT MODEL

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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:

- 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).
- 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.
- 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 36F (2.2°C). If people are dressed in light weight summer clothes then this comfort zone shifts 5°F (2.8°C) warmer.
- 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: (Metric Units)

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California Energy Code Comfort Model, 2013 (select Help for definitions)

1. COMFORT: (using California Energy Code Model)

☐ 20.0 Comfort Low - Min. Comfort Dry Bulb Temp (°C)

☐ 23.9 Comfort High - Max. Comfort Dry Bulb Temp, up to 50% RH (°C)

☐ 80.0 Max. Relative Humidity (measured at Min. Comfort Temp) (%)

☐ 18.9 Max. Wet Bulb Temperature (°C)

☐ -2.8 Min. Dew Point Temperature (°C)

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

☐ 20.0 Min. Dry Bulb Temperature when Need for Shading Begins (°C)

☐ 315.5 Min. Global Horiz. Radiation when Need for Shading Begins (Wh/sq.m)

3. HIGH THERMAL MASS ZONE:

☐ 8.3 Max. Outdoor Temperature Difference above Comfort High (°C)

☐ 1.7 Min. Nighttime Temperature Difference below Comfort High (°C)

4. HIGH THERMAL MASS WITH NIGHT FLUSHING ZONE:

☐ 16.7 Max. Outdoor Temperature Difference above Comfort High (°C)

☐ 1.7 Min. Nighttime Temperature Difference below Comfort High (°C)

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

☐ 20.0 Max. Wet Bulb set by Max. Comfort Zone Wet Bulb (°C)

☒ 6.6 Min. Wet Bulb set by Min. Comfort Zone Wet Bulb (°C)

7. NATURAL VENTILATION COOLING ZONE:

☐ 2.0 Terrain Category to modify Wind Speed (2=suburban)

☐ 0.2 Min. Indoor Velocity to Effect Indoor Comfort (m/s)

☐ 1.5 Max. Comfortable Velocity (per ASHRAE Std. 55) (m/s)

☒ 3.6 Max. Perceived Temperature Reduction (°C)

☐ 90.0 Max. Relative Humidity (%)

☐ 22.8 Max. Wet Bulb Temperature (°C)

8. FAN-FORCED VENTILATION COOLING ZONE:

☐ 0.8 Max. Mechanical Ventilation Velocity (m/s)

☒ 3.0 Max. Perceived Temperature Reduction (°C)

(Min Vel, Max RH, Max WB match Natural Ventilation)

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

☐ 12.8 Balance Point Temperature below which Heating is Needed (°C)

10. PASSIVE SOLAR DIRECT GAIN LOW MASS ZONE:

☐ 157.7 Min. South Window Radiation for 5.56°C Temperature Rise (Wh/sq.m)

☐ 3.0 Thermal Time Lag for Low Mass Buildings (hours)

11. PASSIVE SOLAR DIRECT GAIN HIGH MASS ZONE:

☐ 157.7 Min. South Window Radiation for 5.56°C Temperature Rise (Wh/sq.m)

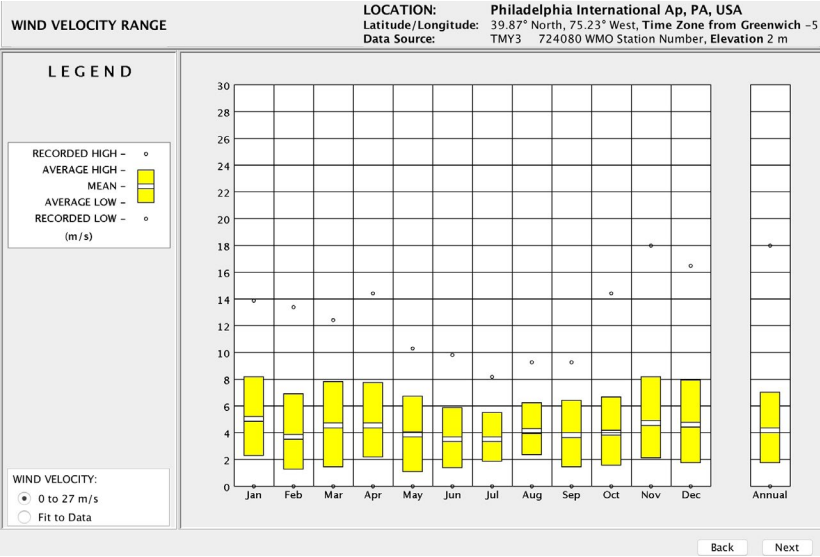
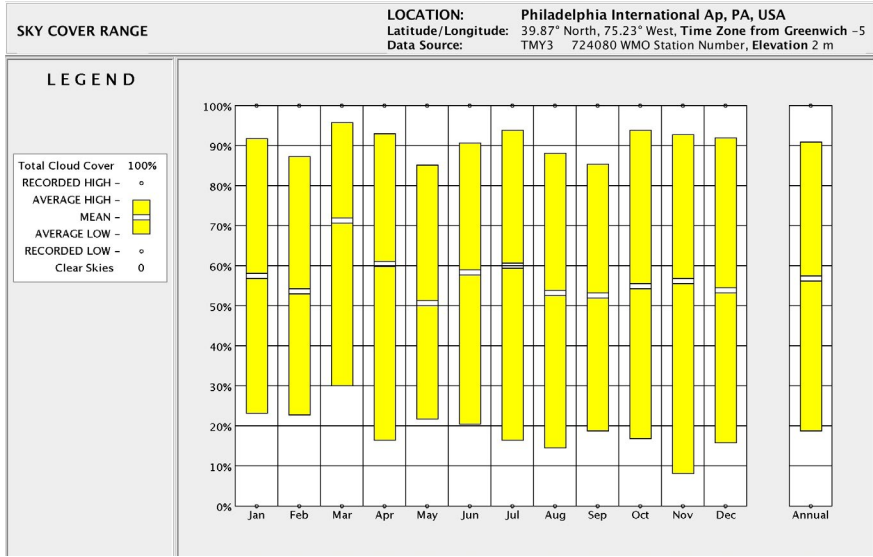
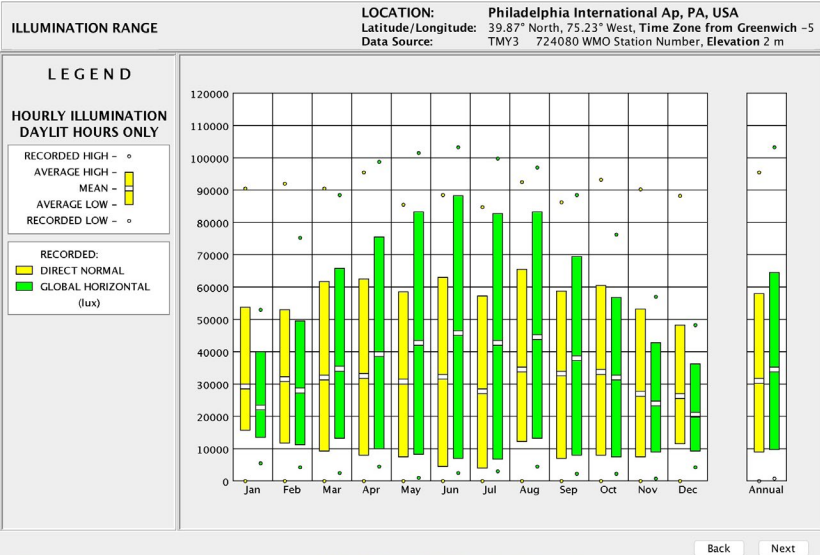
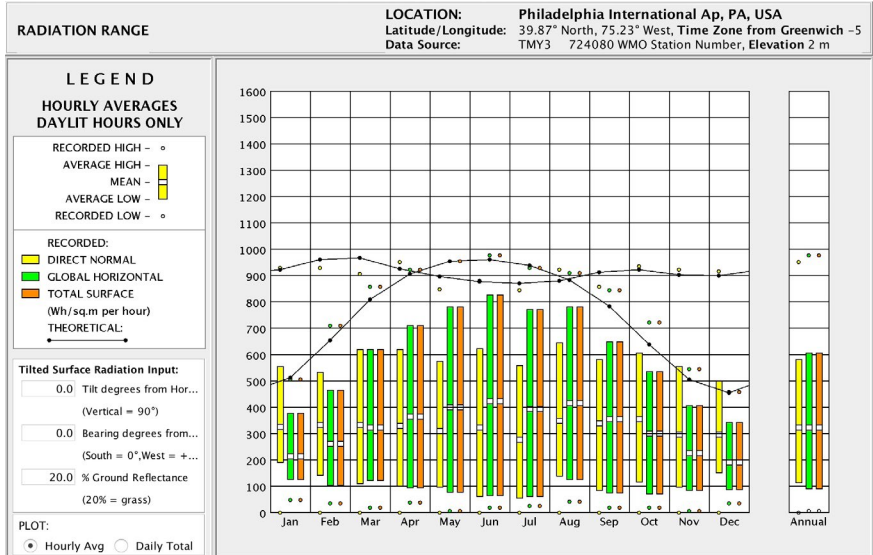
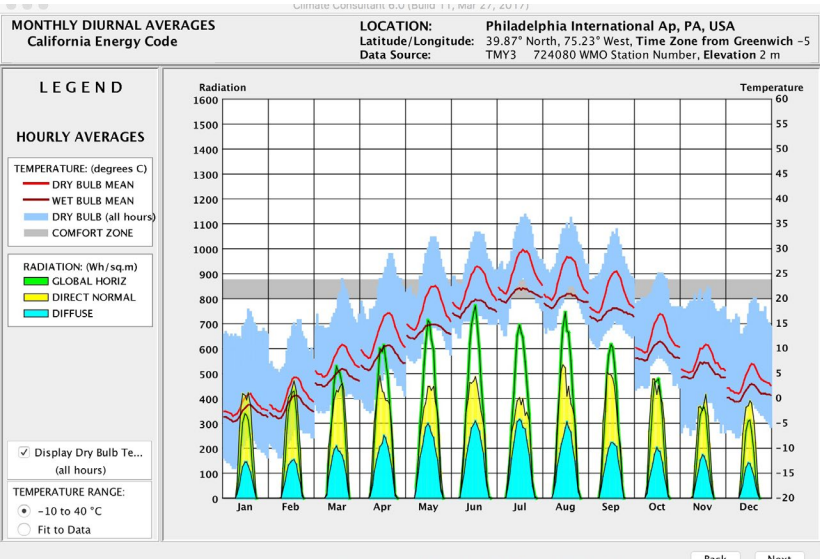
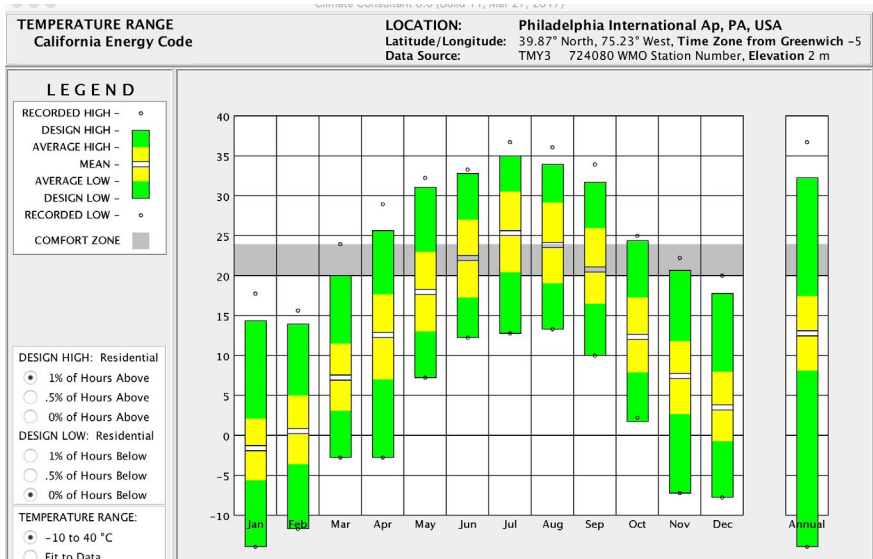
☐ 12.0 Thermal Time Lag for High Mass Buildings (hours)

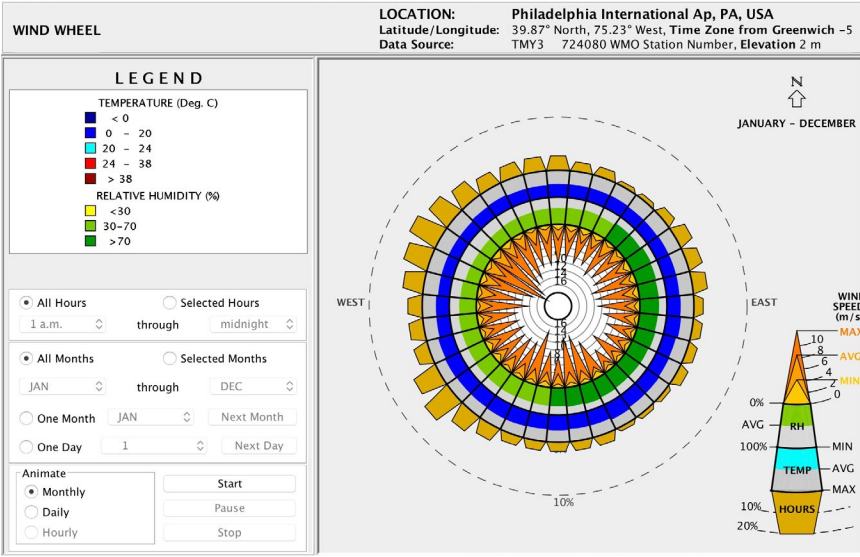
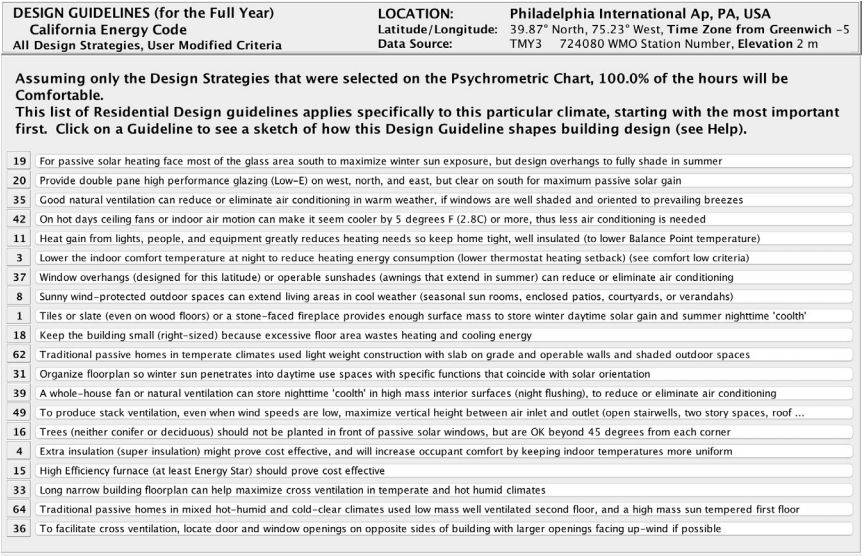
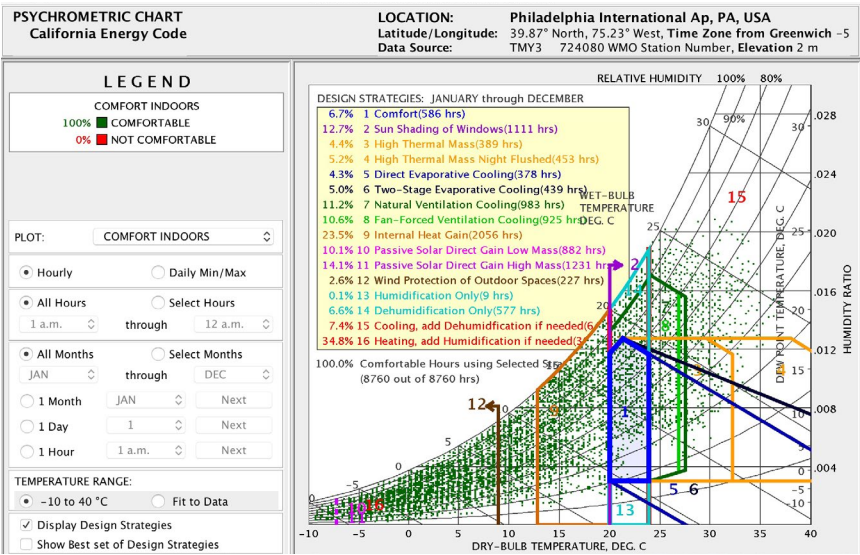
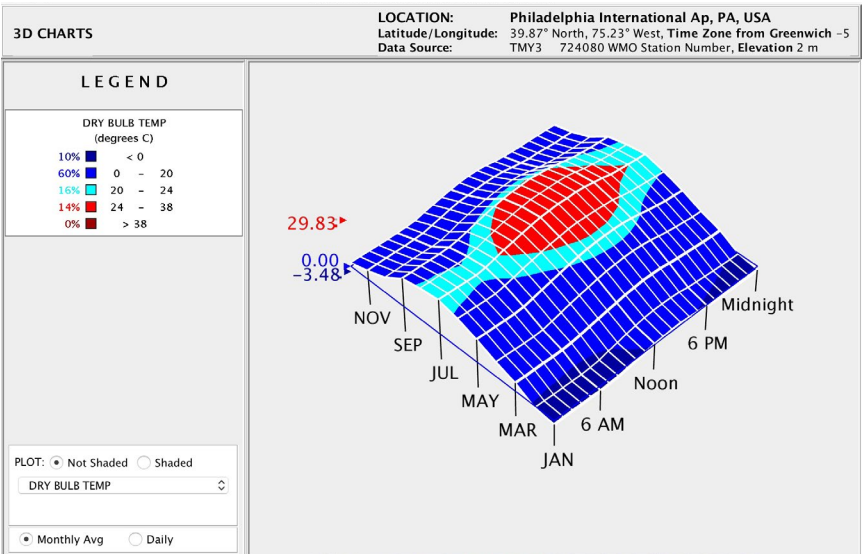
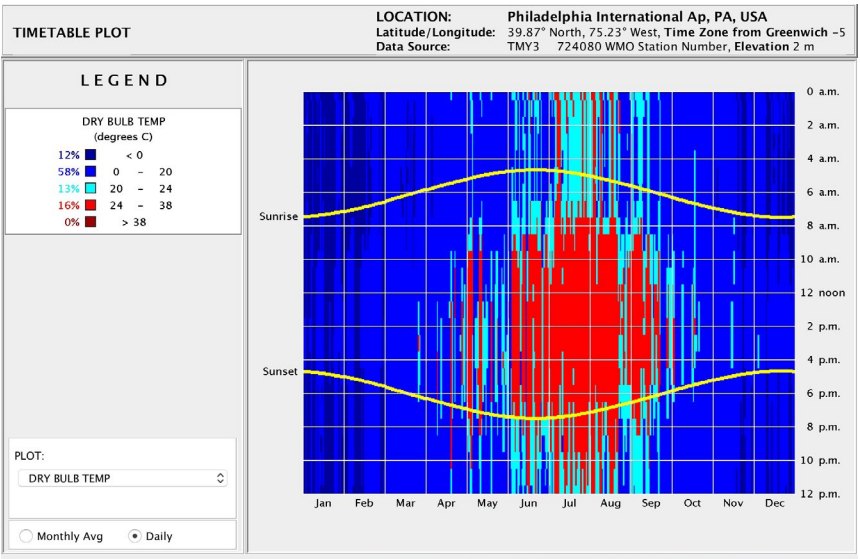
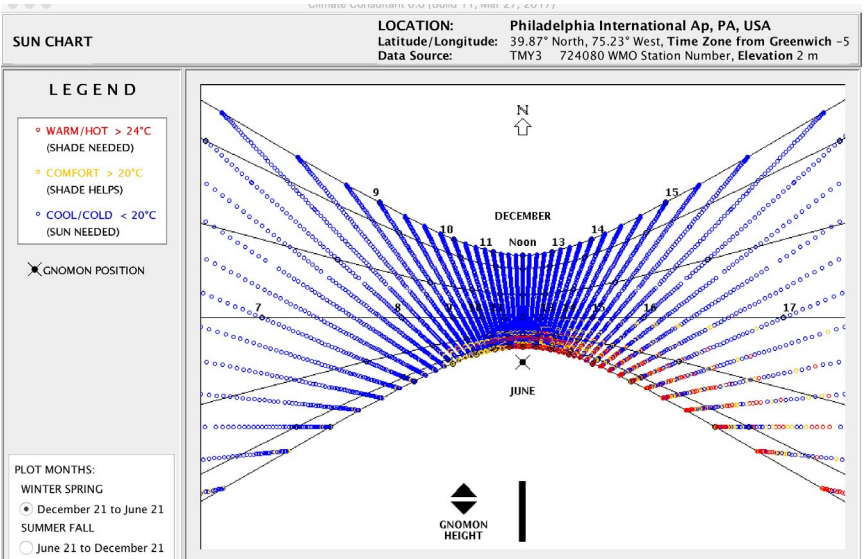
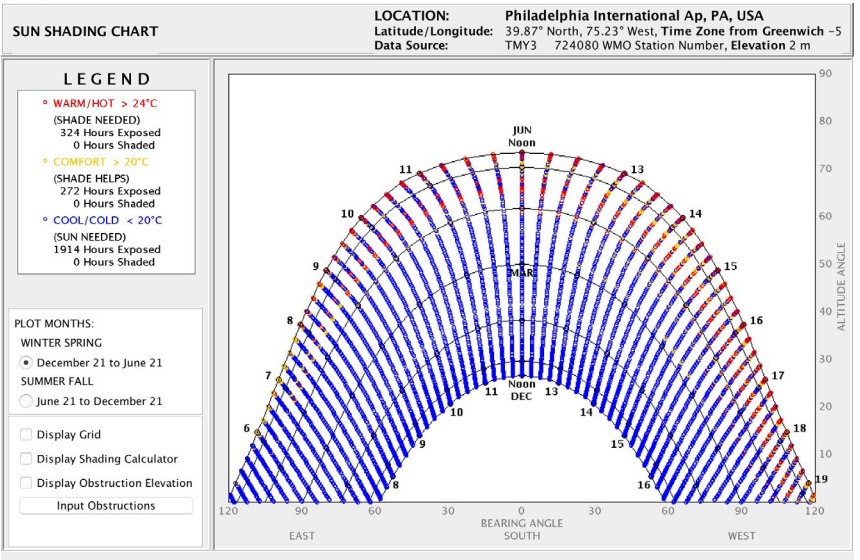
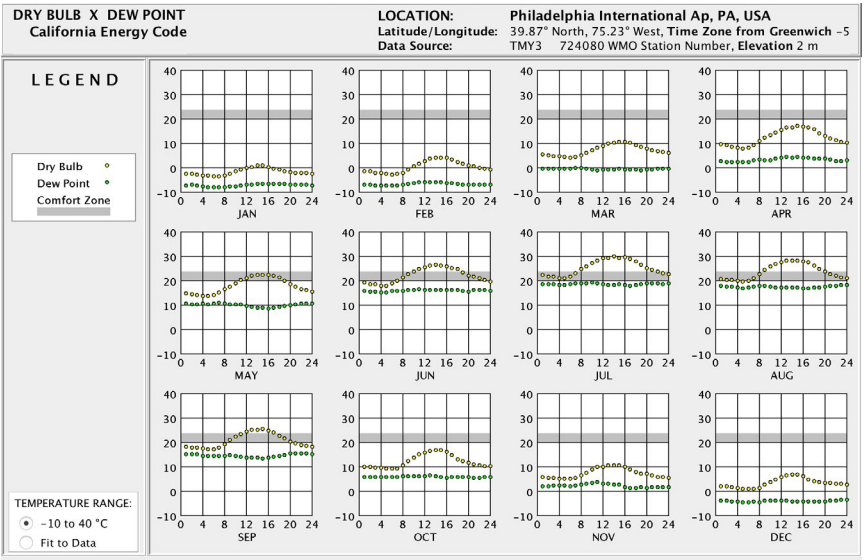
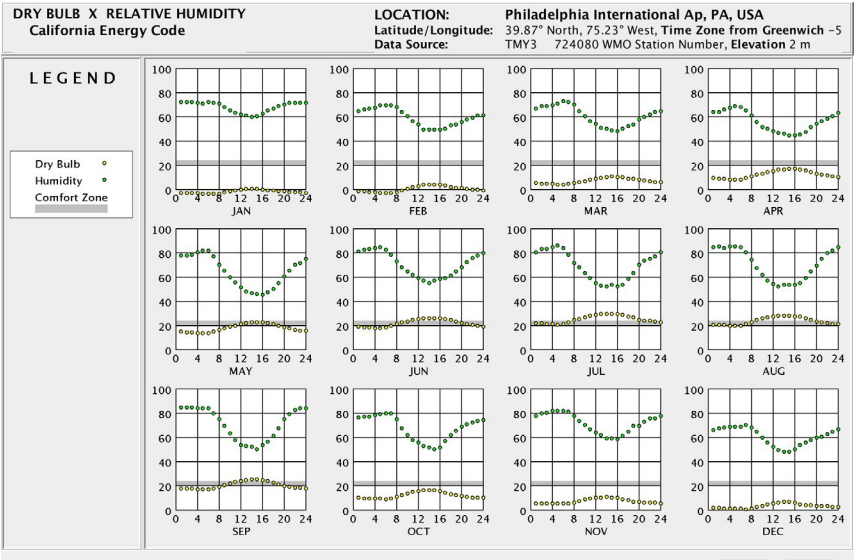
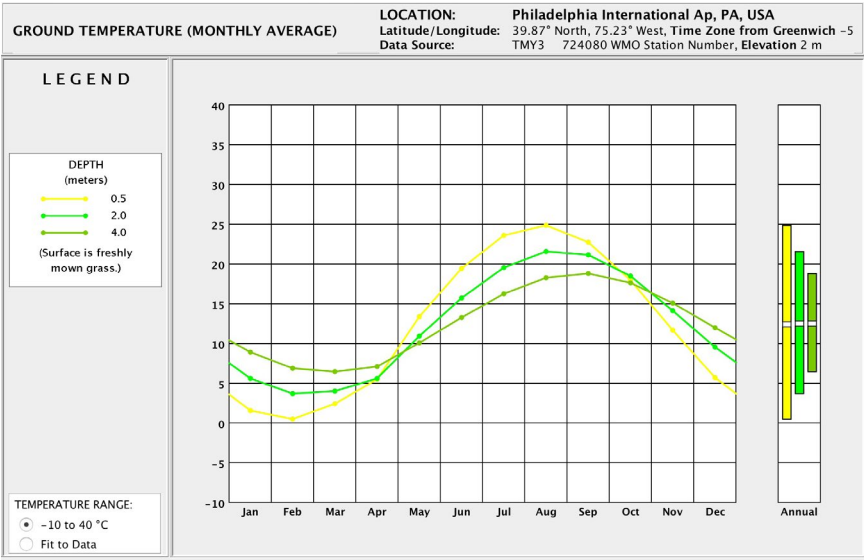
12. WIND PROTECTION OF OUTDOOR SPACES:

☐ 8.5 Velocity above which Wind Protection is Desirable (m/s)

☐ 11.1 Dry Bulb Temperature Above or Below Comfort Zone (°C)

Restore Default Values Recalculate Back Next





DESIGN STRATEGIES

1. Design window opening in building toward the south at Philly to maximize passive solar gain in the window. but provide shading system along with the window system to allow users to reduce the solar energy into the building during the summer.
2. Water features (eg. fountain, water pond) and green spaces (eg. trees, grass, lawn) located around the concrete building will help cooler the ground temperature of the building and its adjacent environment.
3. If possible, allow window openings at the different direction of a building design to allow natural ventilation during the spring and fall seasons and help reduce the waste of cooling and heating energy provided by the air conditioner.