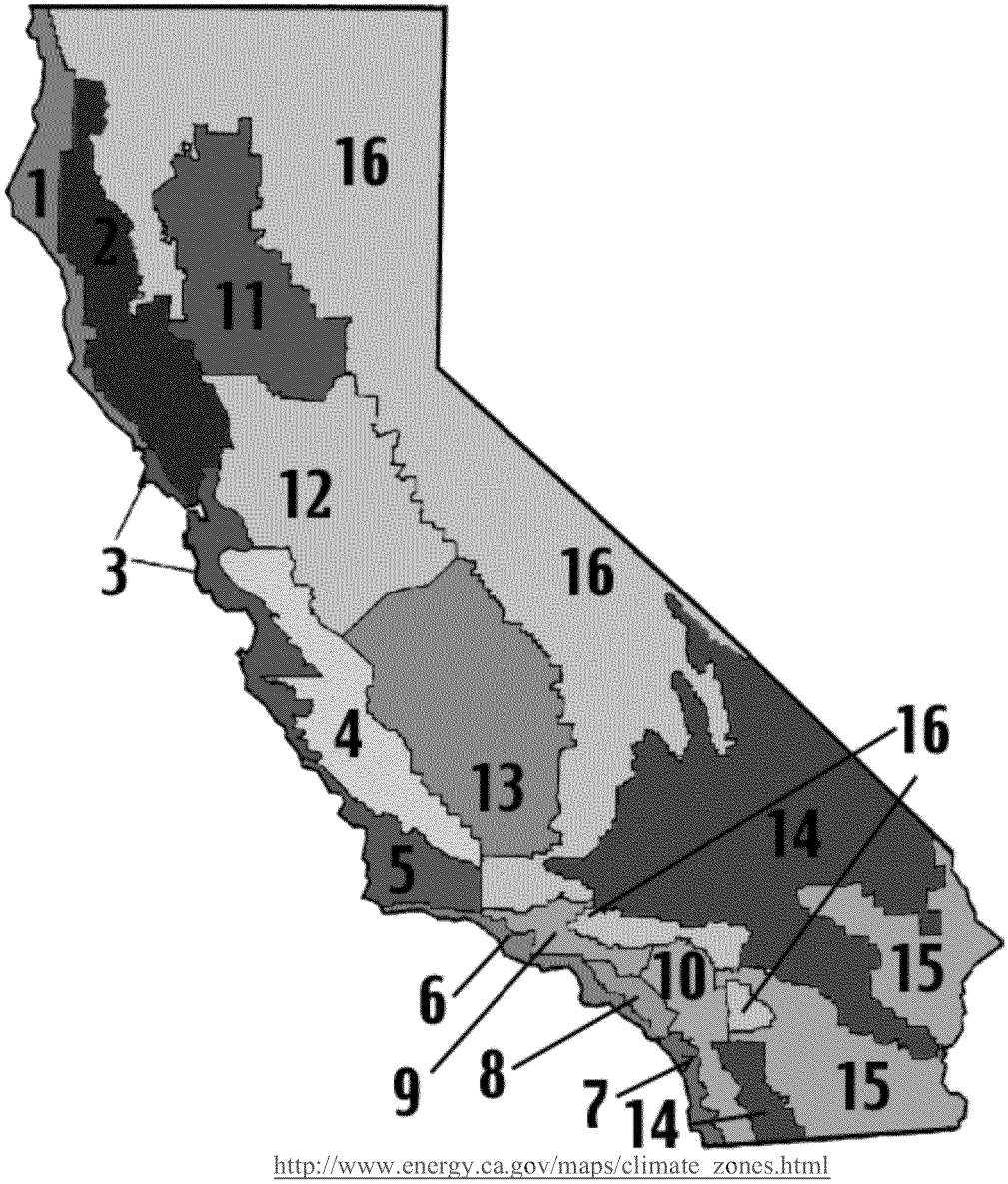
The Pacific Energy Center's Guide to:

California Climate Zones



http://www.energy.ca.gov/maps/climate_zones.html

and Bioclimatic Design

October 2006

PEC's Guide to California Climate Zones

This document of climate data was made for designers to inform energy-conscious design decisions. The information for 16 California Climate Zones is summarized and suggestions are given for passive design strategies appropriate to each climate.

Weather data is given for a reference city typical of each zone. Each zone contains a summary of the following types of data:

Basic Climate Conditions: Summer Temperature Range, Record High and Low Temperature
Design Day Data: Percentage of time dry bulb temperature in given season is *above* the stated value. Mean Coincident Wet-bulb Temperatures, and Relative Humidity also given for the summer.
Climate Design Priorities: Suggestions of design strategies to use in this zone for winter and summer seasons for a more energy passive design.
Title 24 Requirements: California's residential building energy code requires minimum ceiling and wall insulation values specific to different zones. Window U-values and maximum total area is also given. The complete document of requirements can be found on the California Energy Commission's website www.energy.ca.gov.
Climate Description: An overview of the general characteristics of the climate zone, such as geographical influence, typical patterns of weather and seasons, and precipitation.
HDD (Heating Degree Days) and CDD (Cooling Degree Days): Given for four cities in each zone. HDD value is the summation of degrees of the average temperature per day below 65F for the year. CDD is the summation of degrees of the average temperature per day above 80F for the year.

Charts and Graphs

Bioclimatic Chart: Defines dry bulb temperature and humidity levels for occupant thermal comfort and passive design strategies. The average minimum relative humidity and maximum temperature is plotted with the maximum relative humidity and minimum temperature for each month on the Bioclimatic chart. The chart is broken up into zones corresponding to design strategies for thermal comfort appropriate for that particular combination of temperature and humidity ranges. The best passive design strategies for each location are identifiable from the plotted data.

Zones and Strategies for the Bioclimatic Chart:

Comfort Zone: Humans are comfortable within a relatively small range of temperature and humidity conditions, roughly between 68-80 F (20-26.7 C) and 20-80% relative humidity (RH).
Passive Solar Heating: If 1700 BTU-day/sf from the sun comes into a given space, then occupants will feel comfortable inside if it is between 45-68 outside. This range can be lowered with better the insulation and more effective solar heat collected in thermal mass.
Natural Ventilation: Passive cooling strategies for natural ventilation are effective for temperatures in the range 68F to 90F. Cooling effectiveness decreases with higher humidity. In conditions below 20% RH natural ventilation may seem too dry.
Evaporative Cooling: Below 80% RH, evaporative cooling can be an effective passive cooling strategy. Adding moisture to the air can effectively cool temperatures up to 105F.
High Thermal Mass: Thermal Mass dampens and delays temperature swings to make it cool during the warm day, and warm during cool nights. It is most effective for places with large diurnal temperature changes. Thermal Mass is effective for temperatures up to 95F, with decreasing effectiveness in higher humidity.
High Thermal Mass with Night Ventilation: Thermal mass absorbs heat during the day and releases heat at night. By opening the building at night, cool air flushes out the hot air and cools down the thermal mass. This strategy is effective for average high temperatures up to 110F. This strategy requires occupant intervention.

Shading: Though not part of the Bioclimatic Chart, shading is an important part of passive cooling. All of the temperature ranges for cooling can be increased with proper shading and mitigation of solar heat into the space.
Heating: Temperatures below 45F is often too cold for passive methods of heating. In these conditions heating using any variety of fuels and methods of delivery are necessary to keep the space warm. Some methods of heating include mechanical heating through forced air vents, radiant heating systems, electrical heating systems, and wood fire stoves. The energy and pollution impacts are important to consider in selecting an efficient active heating system.
Air Conditioning: When temperatures exceed the temperature range of passive cooling strategies air conditioning is required for comfort. The amount of energy needed to cool something is more than to heat it.
Humidification and Dehumidification: Humidity can be added or removed using mechanical systems and energy.

Temperature: Monthly average, maximum, and minimum temperatures are shown on this graph.
Degree-Days: The monthly averages of degrees above or below a base temperature are graphed for an average year. The base temperature of 65°F is used for heating degree-days; 80F is used for cooling degree-days.
Relative Humidity: Monthly average, maximum, and minimum relative humidity levels are shown on this graph.
Terrestrial Radiation: Terrestrial radiation is solar radiation filtered through the atmosphere as well as reflected from terrestrial (earth-bound) objects. Also known as global radiation, the value provided is the sum of direct and diffuse radiation striking a horizontal surface at ground level.
Wind Speed and Direction: Average monthly wind speed in mph, and prevailing wind direction are plotted on this graph. Arrows indicate the direction that the wind generally comes from during that month – north is up. Natural ventilation is most effective when wind speed is 5 mph or greater. Alignment with the wind direction is necessary to achieve the wind speed indicated.

Bibliography

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California Energy Commission. California Climate Zone Descriptions for New Buildings. July 1995.

California Energy Commission. Climate Zone Weather Data Analysis and Revision Project. Augustyn and Company, March 22, 1991.

California Energy Commission Web Site: www.energy.ca.gov

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Editors of Sunset Books and Sunset Magazine, New Western Garden Book. Menlo Park: Lane Publishing Co, 1986

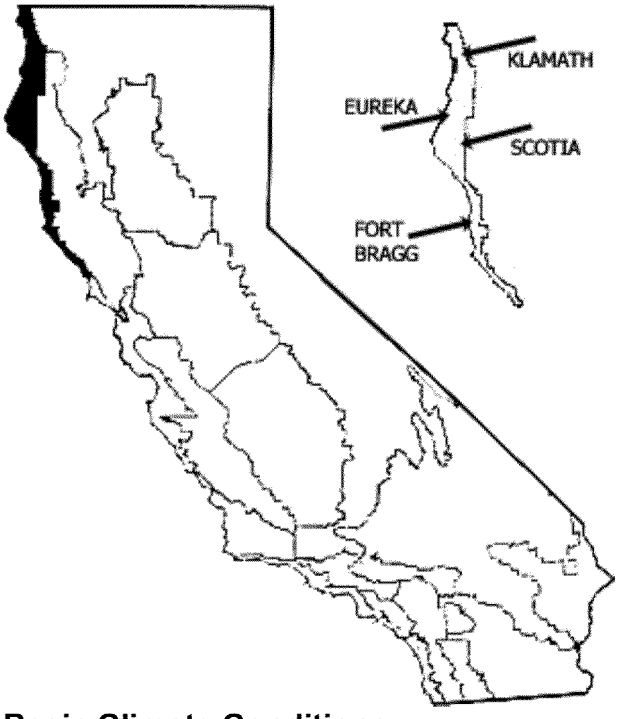
Engineering Computer Applications. Solar Radiation in Pacific Gas and Electric's Service Area. 1976.

Lechner, Norbert. Heating, Cooling, Lighting: Design Methods for Architects. New York: John Wiley and Sons, 1991.

Western Regional Climate Center Web Site: www.wrcc.dri.edu

California Climate Zone 1

Reference City: Eureka
Latitude: 41.3 N
Longitude: 124.28 W
Elevation: 43 ft



Design Day Data

	Eureka (F)	RH	Arcata (F)	RH
Winter 99%	35		31	
Winter 97.5%	38		33	
Summer 1%			68	63
Summer 2.5%			65	71

Degree Days

	Eureka	*Scotia*	*Klamath*	*Fort Bragg*
HDD	4496	3828	4554	4301
CDD	0	47	5	6

HDD = Heating Degree Days (base 65F)
CDD = Cooling Degree Days (base 80F)

Climatic Design Priorities

Winter:	Insulate
	Reduce Infiltration
	Passive Solar
Summer:	Shade
	Allow natural ventilation

Title 24 Requirements

Package	*C*	*D*
Ceiling Insulation	R49	R38
Wood Frame Walls	R29	R21
Glazing U-Value	0.42	0.57
Maximum Total Area	14%	20%

Basic Climate Conditions

Summer Temperature Range (F)	15
Record High Temperature (1979)	85
Record Low Temperature (1972)	21

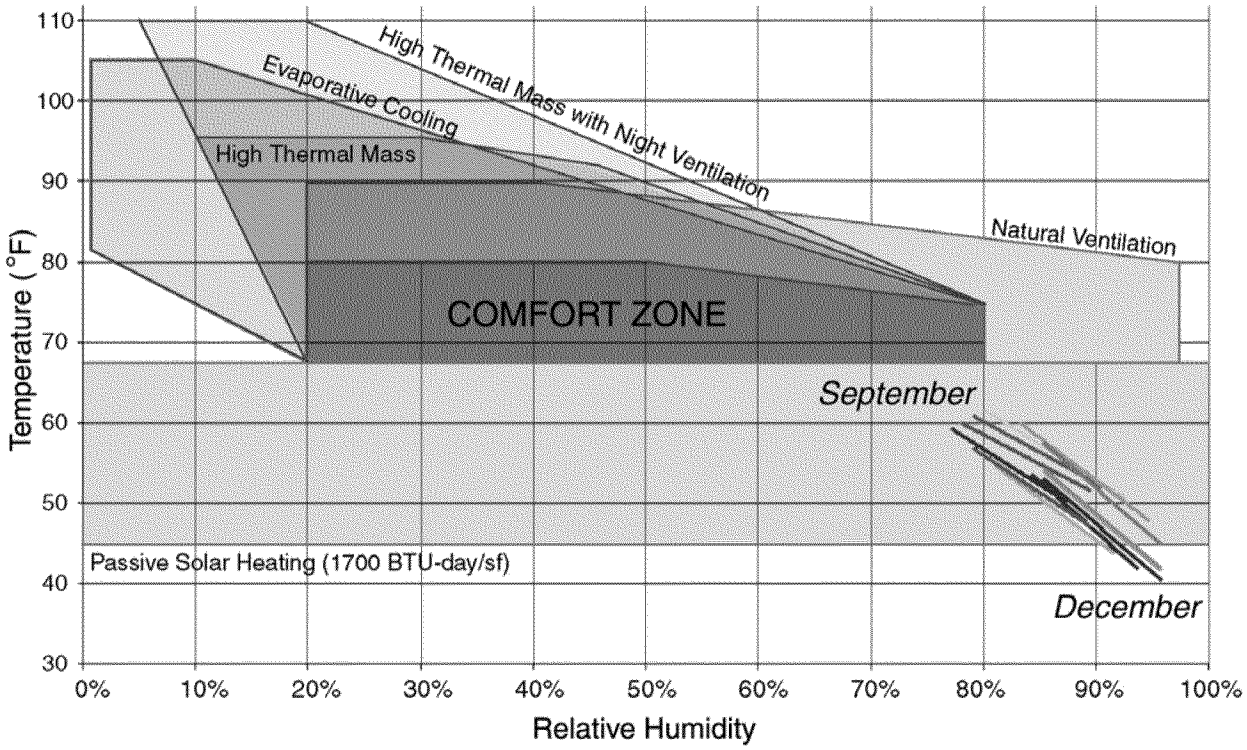
Climate

The northern coastal region is situated west of the Northern Coastal Range and has a moist, cool climate influenced greatly by the conditions of the Pacific Ocean.

The cool, wet winters, and cool summers with frequent fog and strong winds make it a climate that requires a lot of heat for comfort. Fog comes in high and fast, interposing a cooling and humidifying blanket between the sun and the earth, reducing the intensity of the light and sunshine. In winter the temperatures are cool and rain is common.

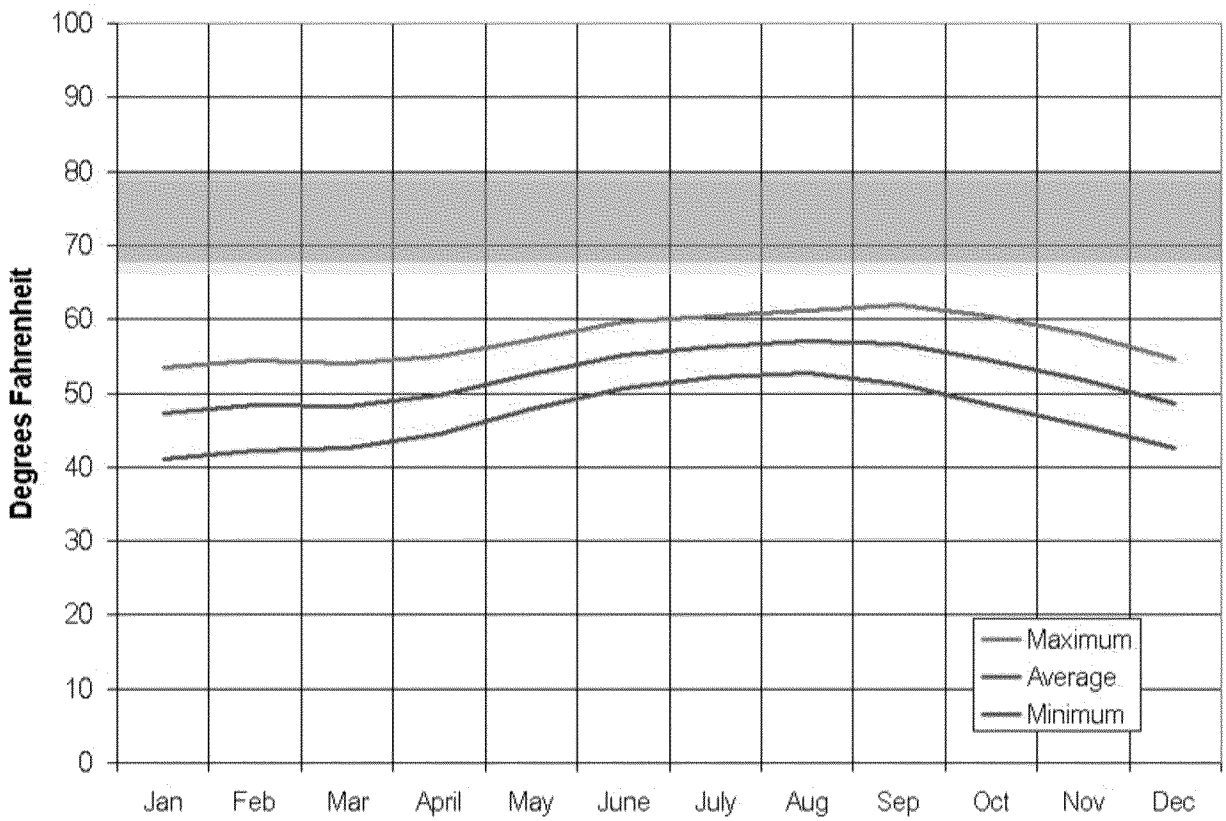
The annual precipitation for Climate Zone 1 is about 25 inches annually, most of it occurring in the winter months. The summers are drier and sunnier, but only warm enough to call for a few CDD. Though Climate Zone 1 is the coolest climate in California with the most HDD, it rarely freezes and seldom frosts.

Bioclimatic Chart

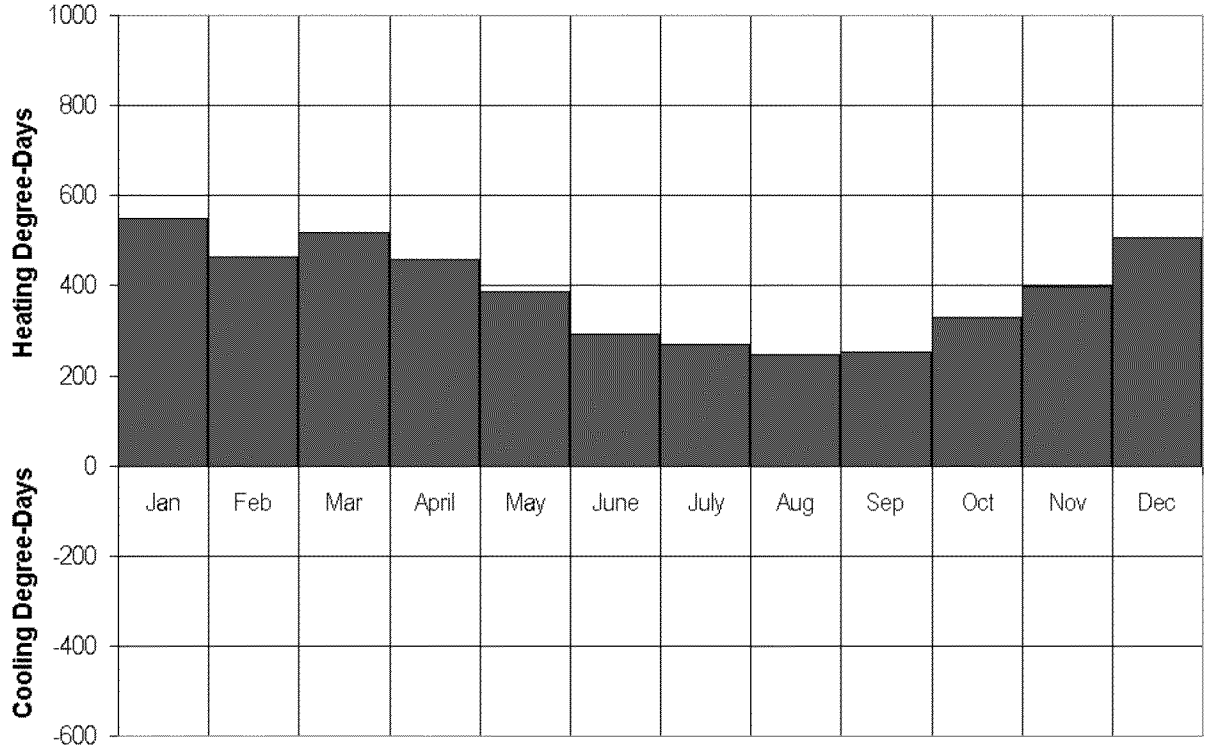


Temperature

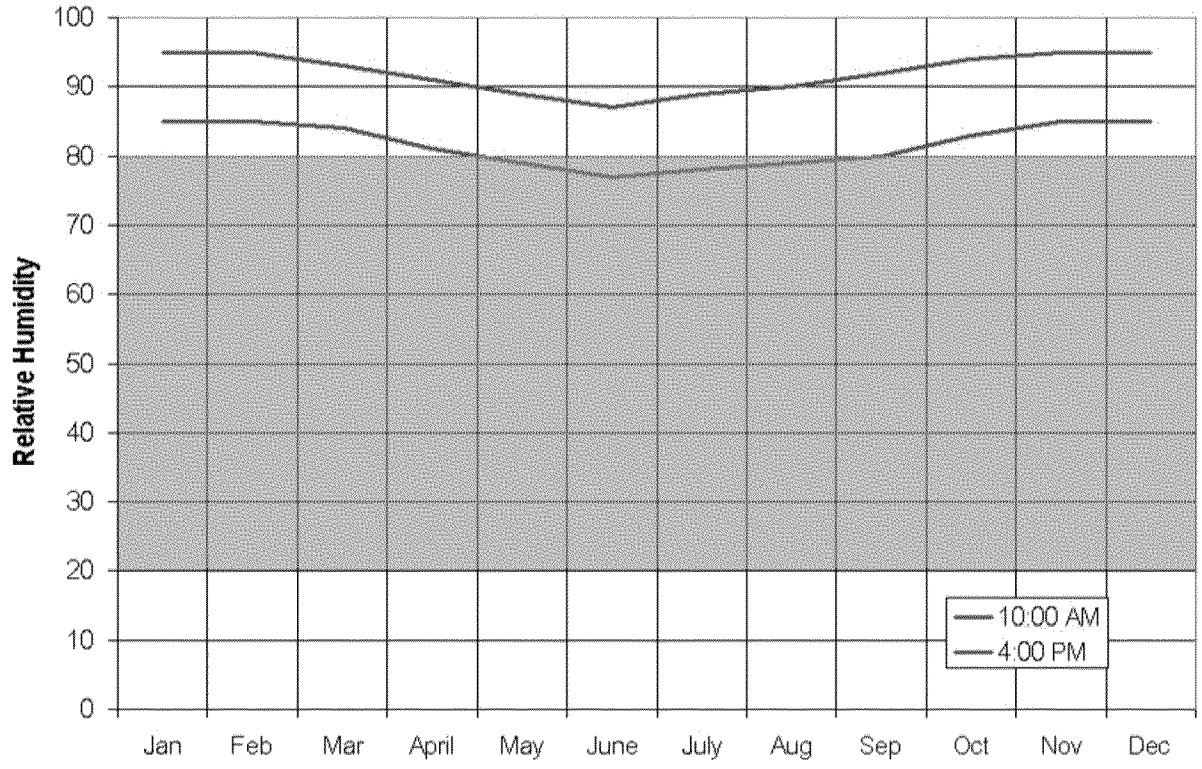
(Typical Comfort Zone: 68-80°F)



Degree Day
(Base 65°)

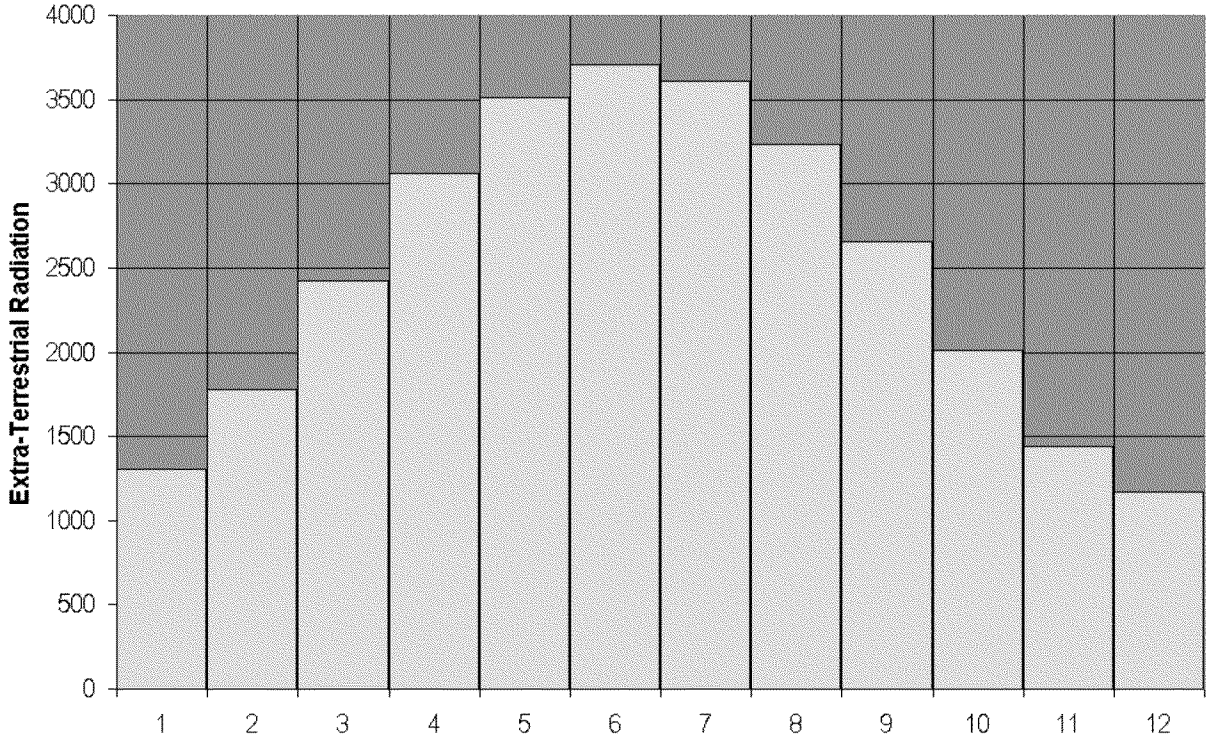


Relative Humidity
(Typical Comfort Zone: 20-80%)

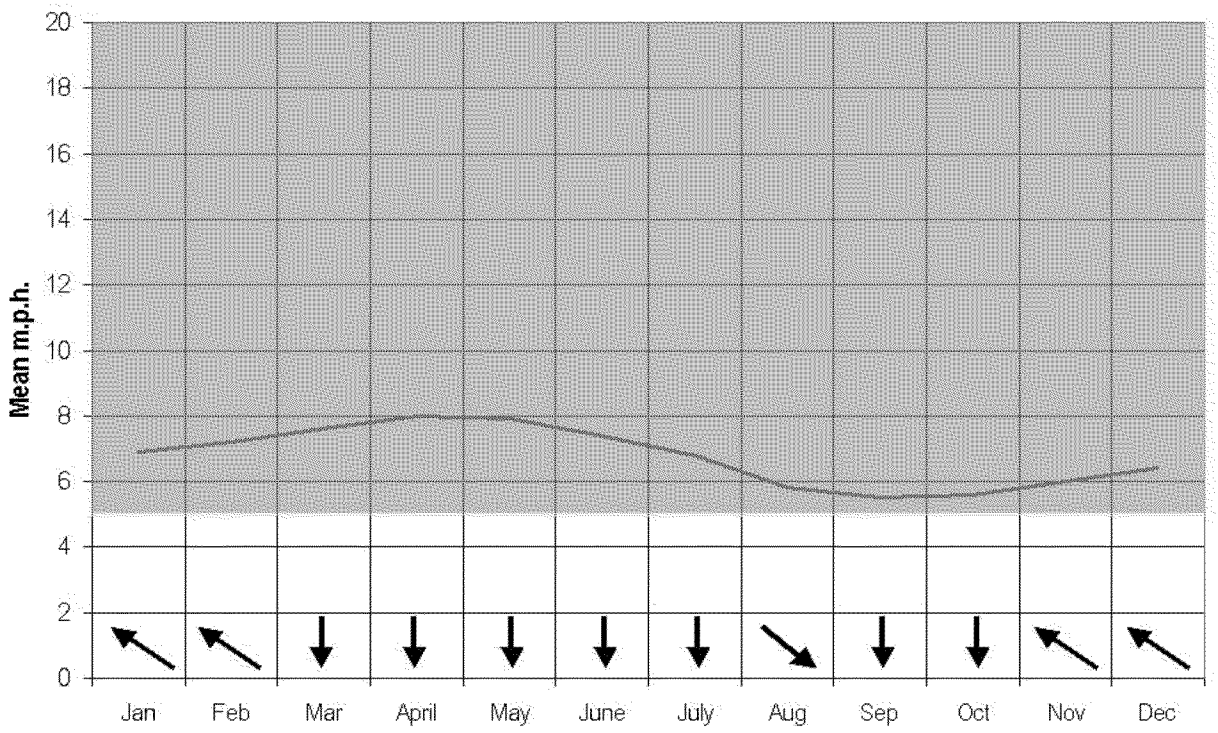


Extra-Terrestrial Radiation

Daily Mean ETR: 2493



Wind Speed



Prevailing Wind Direction
Summer: N
Winter: SE

Natural Ventilation is most effective when wind speed is 5 mph or greater.

California Climate Zone 2

Reference City: Napa
Latitude: 38.28 N
Longitude: 122.27 W
Elevation: 60 ft

Design Day Data

	Napa (F)	RH	Mare Island (F)	RH
Winter 99%	31		30	
Winter 97.5%	34		32	
Summer 1%			89	MCWB 68
Summer 2.5%			84	MCWB 66

Degree Days

	Napa	*Ukiah*	*Willits*	*San Rafael*
HDD	2844	2954	4195	2581
CDD	456	894	202	449

HDD = Heating Degree Days (base 65F)
CDD = Cooling Degree Days (base 80F)

Climatic Design Priorities

Winter: Insulate
Reduce Infiltration
Passive Solar
Summer: Shade
Allow natural ventilation
Distribute Thermal Mass

Title 24 Requirements

Package	*C*	*D*
Ceiling Insulation	R49	R30
Wood Frame Walls	R29	R13
Glazing U-Value	0.38	0.57
Maximum Total Area	16%	20%

Basic Climate Conditions

Summer Temperature Range (F)	29
Record High Temperature (1961)	113
Record Low Temperature (1990)	14

Climate

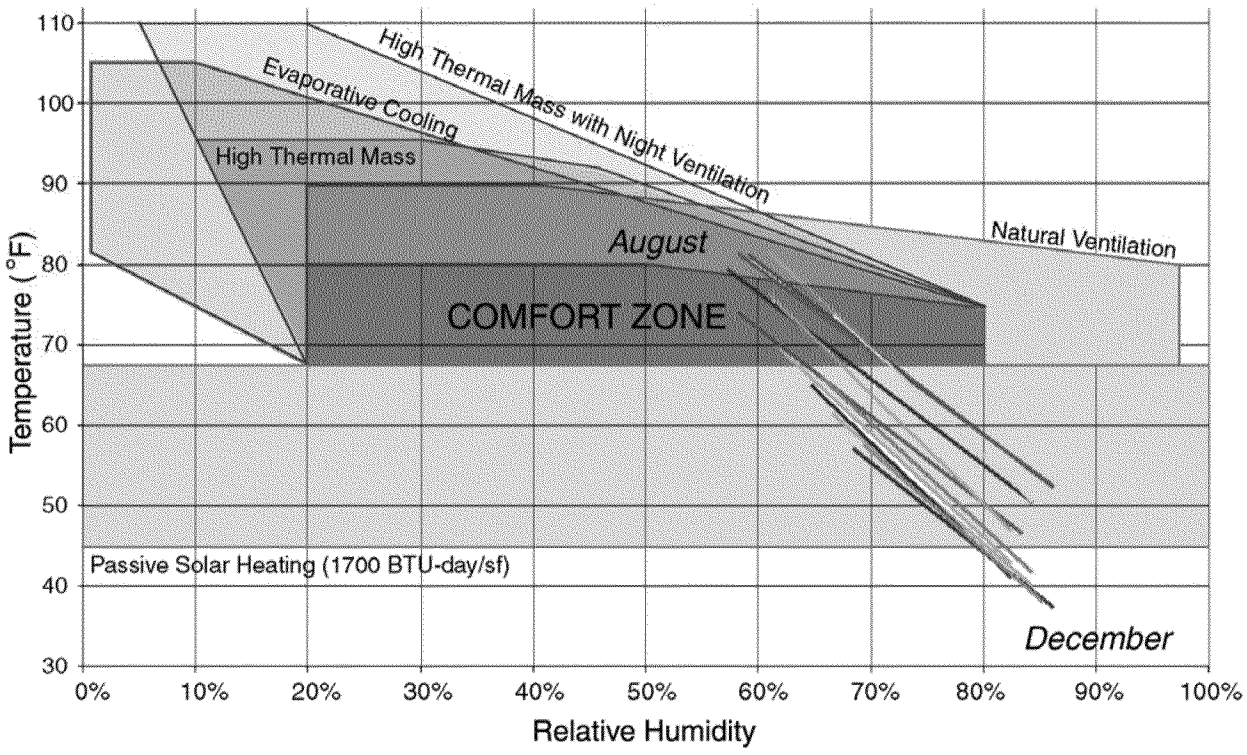
Climate Zone 2 includes the hilly Coastal range to the edge of the Northern Central Valley.

The zone has a coastal climate, influenced by the ocean approximately 85% of the time and by inland air 15% of the time. HDD dominates the climate design, although some cooling is necessary in the summer.

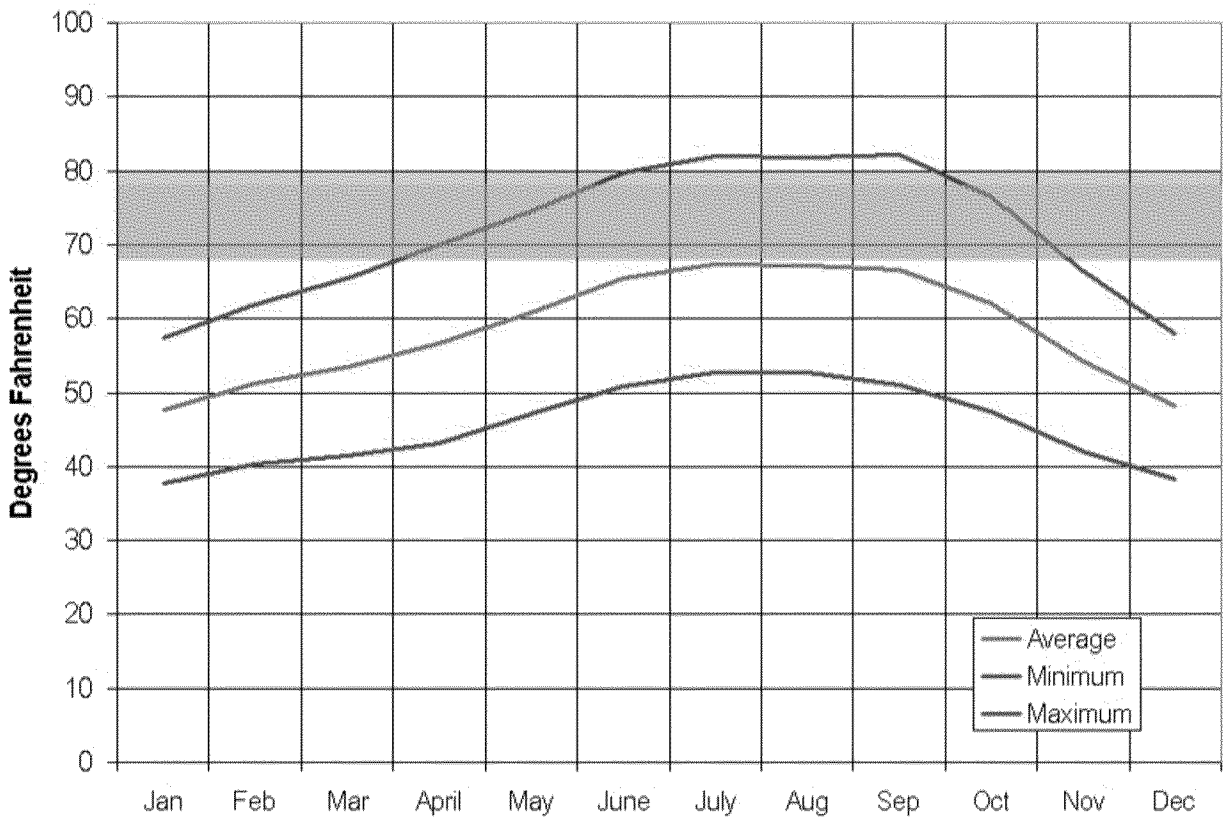
There are many microclimates in this varied geography that are affected by proximity to the ocean and elevation. Marine air influence lessens with distance from the san Francisco Bay Area.

Cold air flows downhill to the valley floors, canyons, and land-troughs. Winters are cool and mild, slightly warmer in comparison to Zone 1. The summers are very comfortable and often windy in the afternoon. Diurnal temperature fluctuates over 20F over the day all year.

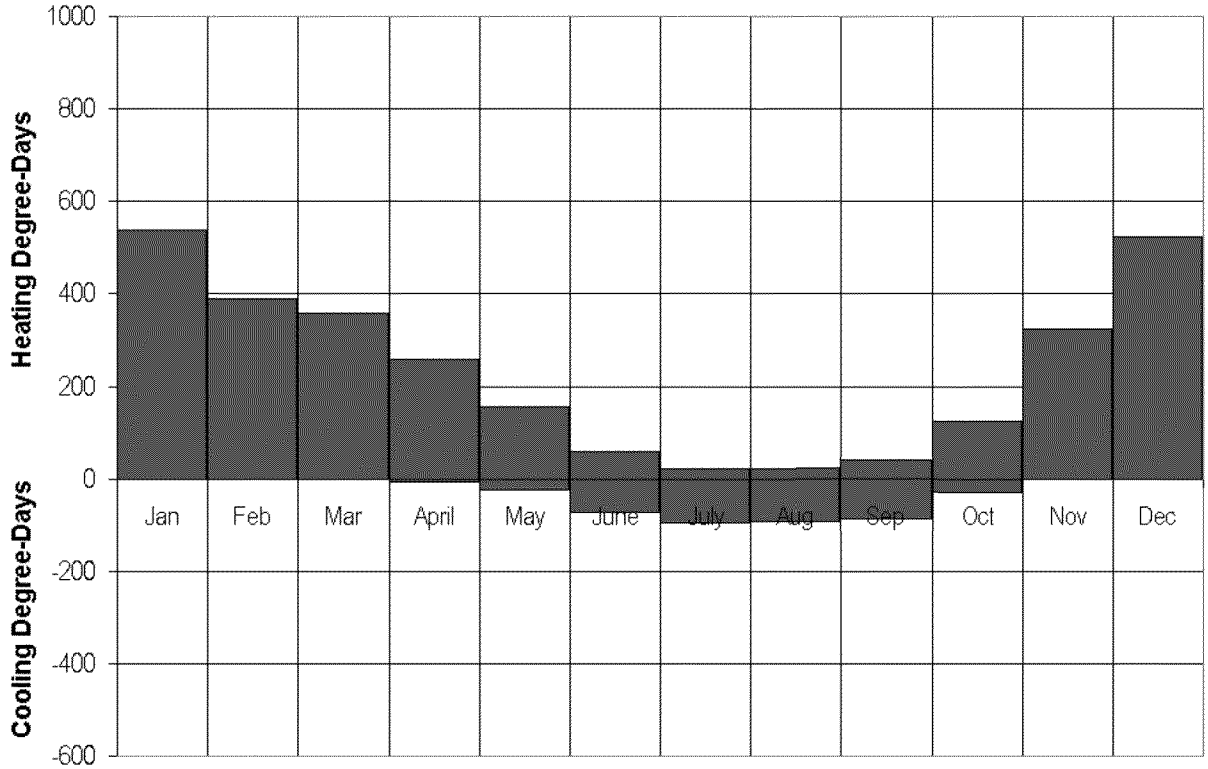
Bioclimatic Chart



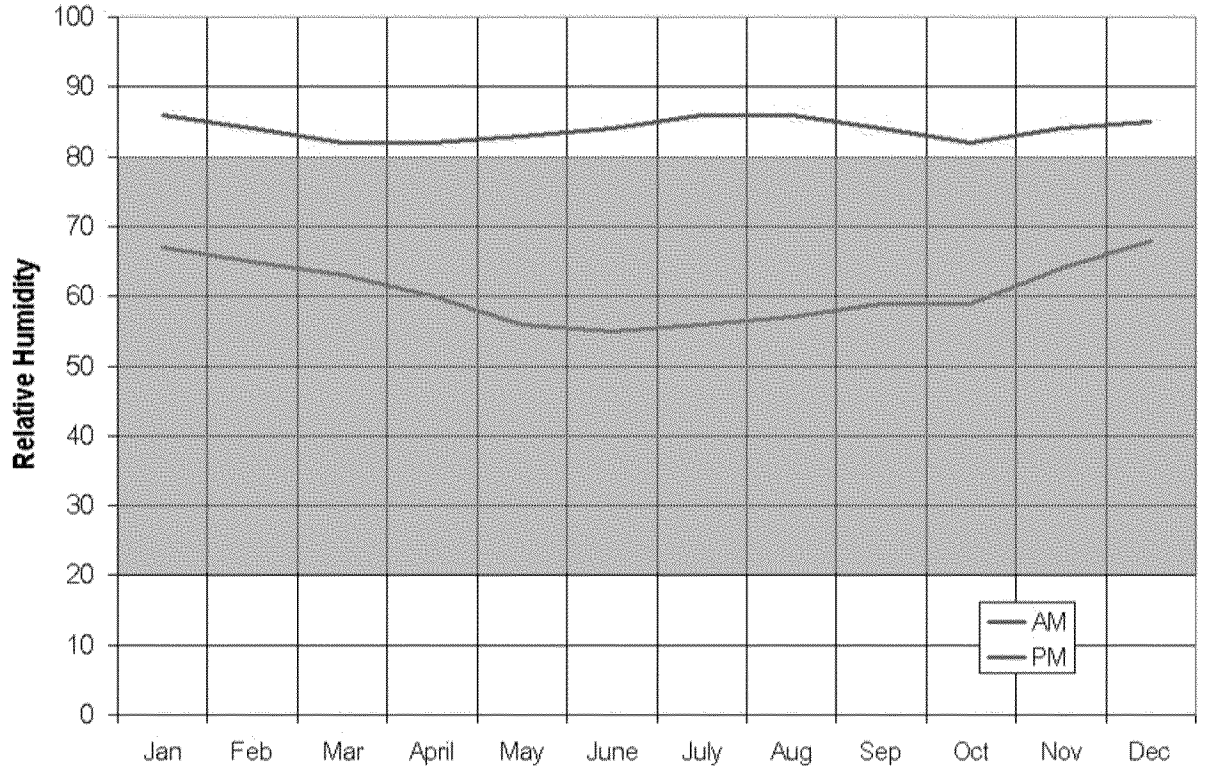
Temperature
(Typical Comfort Zone: 68-80°F)



Degree Day
(Base 65°)

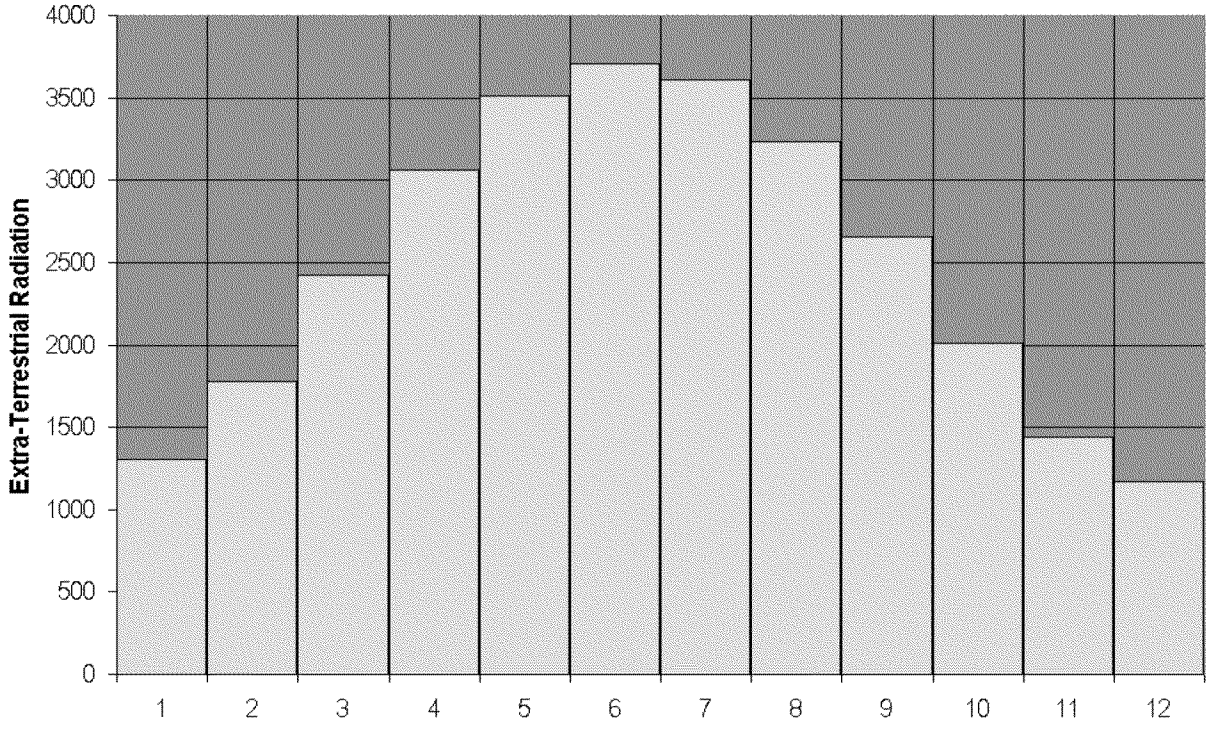


Relative Humidity
(Typical Comfort Zone: 20-80%)

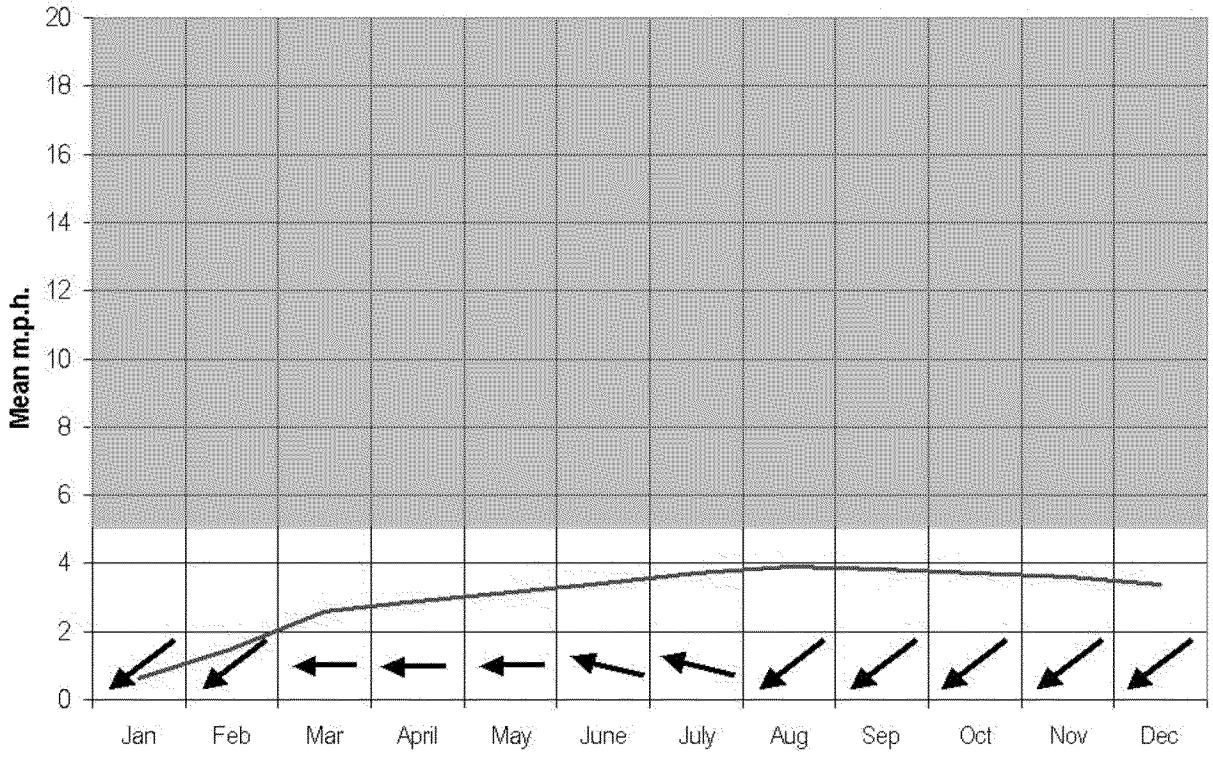


Extra-Terrestrial Radiation

TO BE REPLACED Daily Mean ETR: 2493



Wind Speed



Prevailing Wind Direction
Summer: ESE / NE
Winter: NE

Natural Ventilation is most effective when wind speed is 5 mph or greater.

California Climate Zone 3

Reference City: Oakland
San Francisco
Latitude: 37.75 N
Longitude: 122.2 W
Elevation: 10 ft

Design Day Data

	Oakland (F)	RH	San Francisco (F)	RH
Winter 99%	34		35	
Winter 97.5%	35		38	
Summer 1%	85	MCWB 64	82	MCWB 64
Summer 2.5%	80	MCWB 64	77	MCWB 63

Degree Days

	OAK	*SFO*	*Half Moon Bay*	*Redwood City*
HDD	2909	3042	3770	2563
CDD	128	108	11	486

HDD = Heating Degree Days (base 65F)
CDD = Cooling Degree Days (base 80F)

Climatic Design Priorities

Winter: Insulate
Reduce Infiltration
Passive Solar
Summer: Shade
Allow natural ventilation

Title 24 Requirements

Package	*C*	*D*
Ceiling Insulation	R38	R30
Wood Frame Walls	R25	R13
Glazing U-Value	0.42	0.67
Maximum Total Area	14%	20%

Basic Climate Conditions

	OAK	SFO
Summer Temperature Range (F)	29	23
Record High Temperature	113 (1960)	106 (1961)
Record Low Temperature	14 (1930)	20 (1932)

Climate

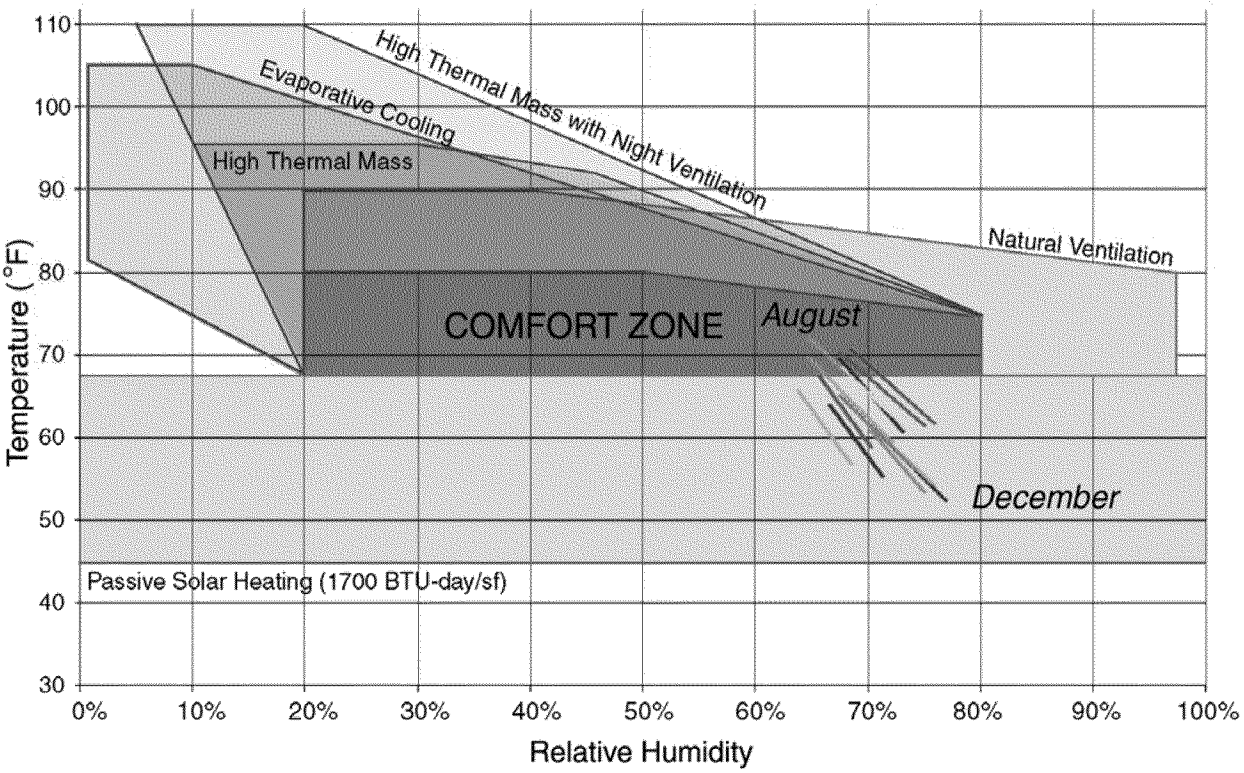
The climate of Zone 3 varies greatly with elevation and the amount of coastal influence. Areas with more coastal influence experience moderate temperatures year round with precipitation in the winter and fog likely from June through mid-August.

Inland from the beaches and sea cliffs, local geography may reduce the fog cover, lessen the winds, and boost summer heat.

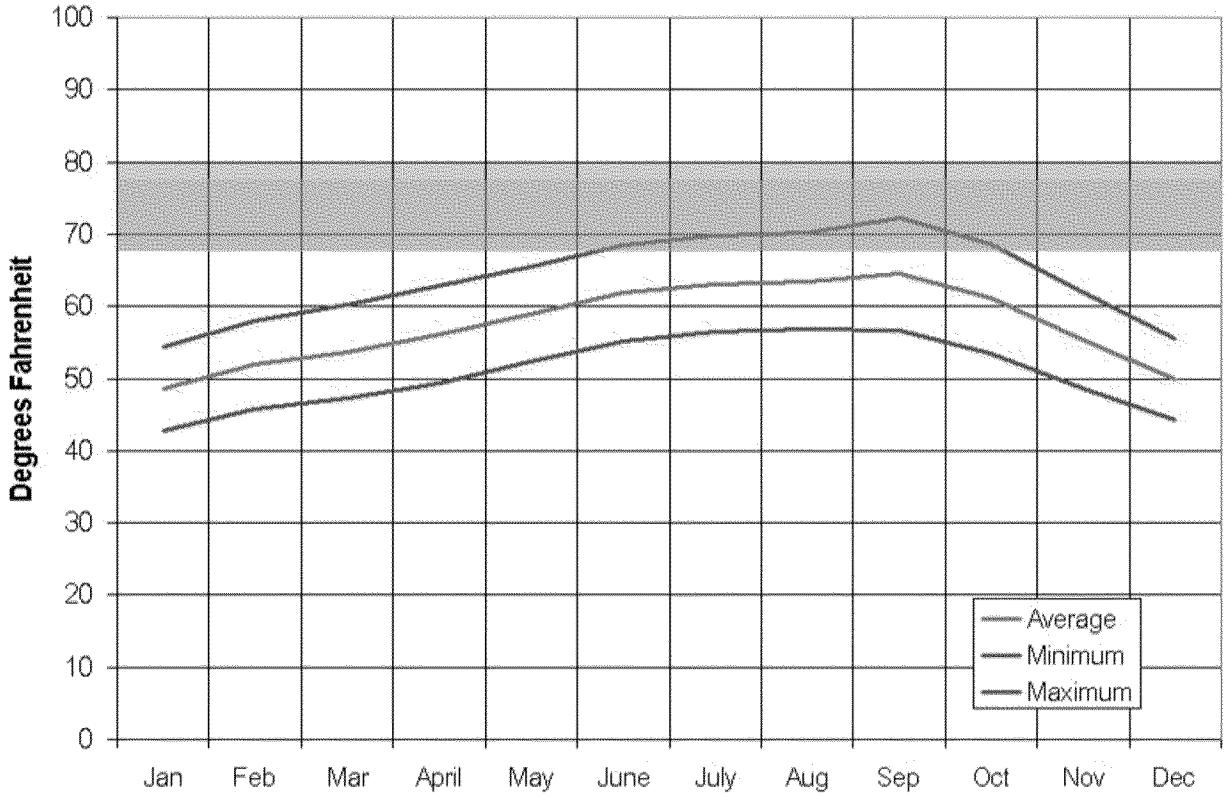
Winters are moderately cold with most of the annual rain falling between October and March. Winter sunshine nevertheless is plentiful. Summers are warm and dry, but the nights are cool. Rain is rare during the summer months.

A need for heating is the dominant design concern, but the climate is mild enough that energy consumption is relatively low.

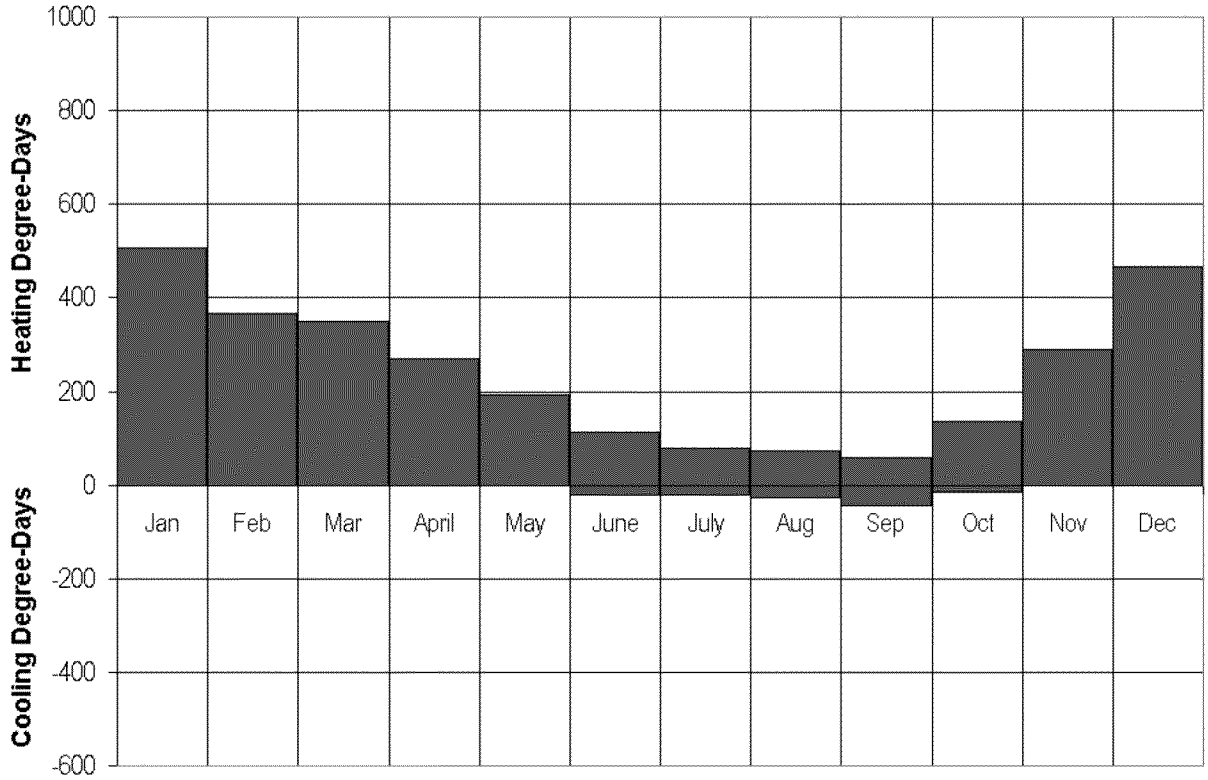
Bioclimatic Chart (Oakland)



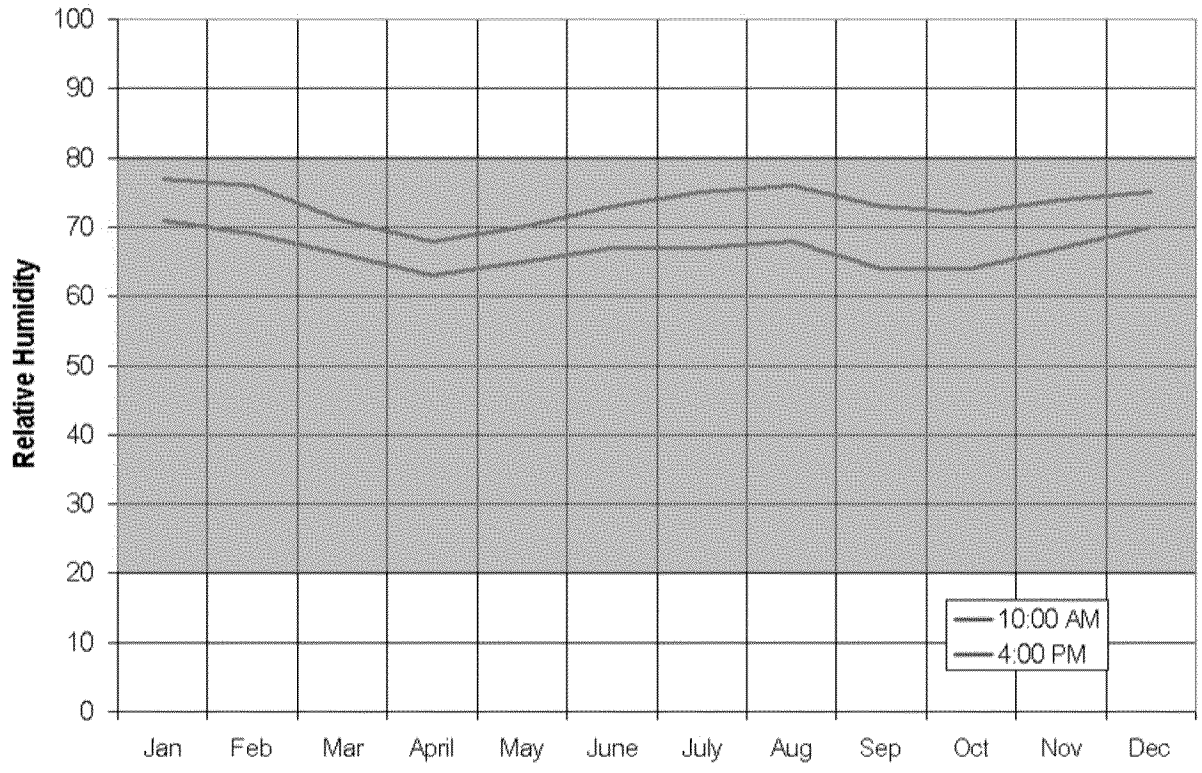
Temperature
(Typical Comfort Zone: 68-80°F)



Degree Day
(Base 65°)

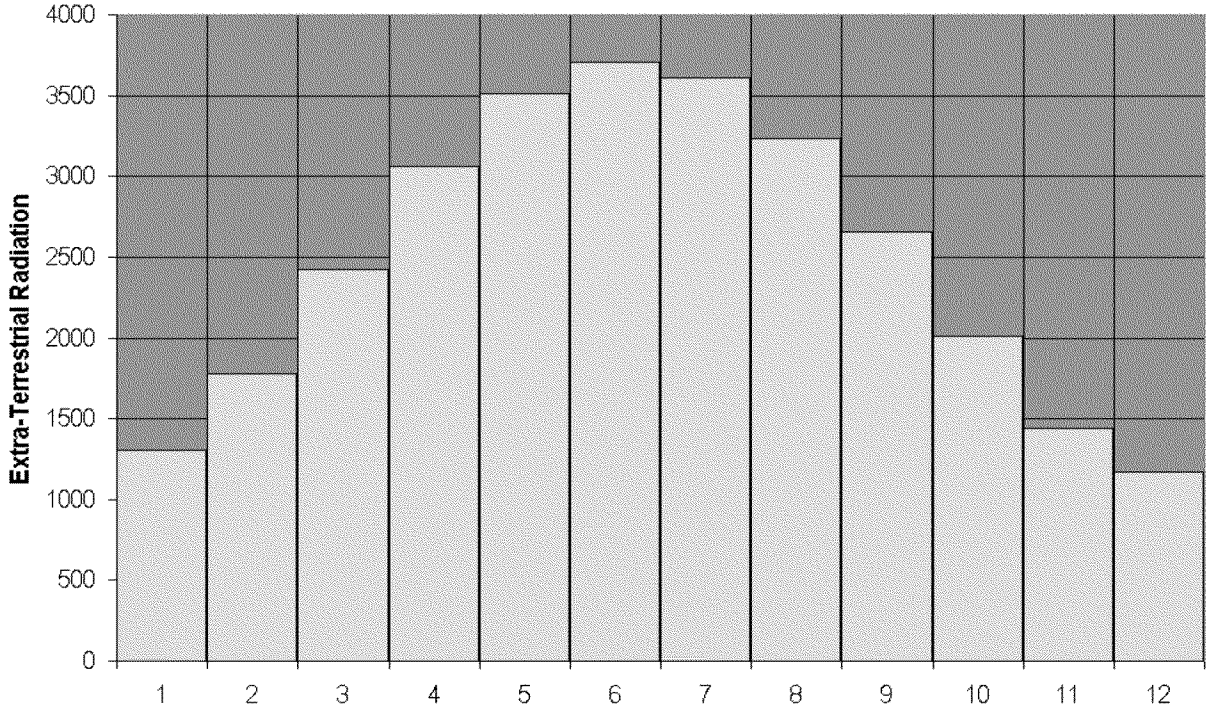


Relative Humidity
(Typical Comfort Zone: 20-80%)

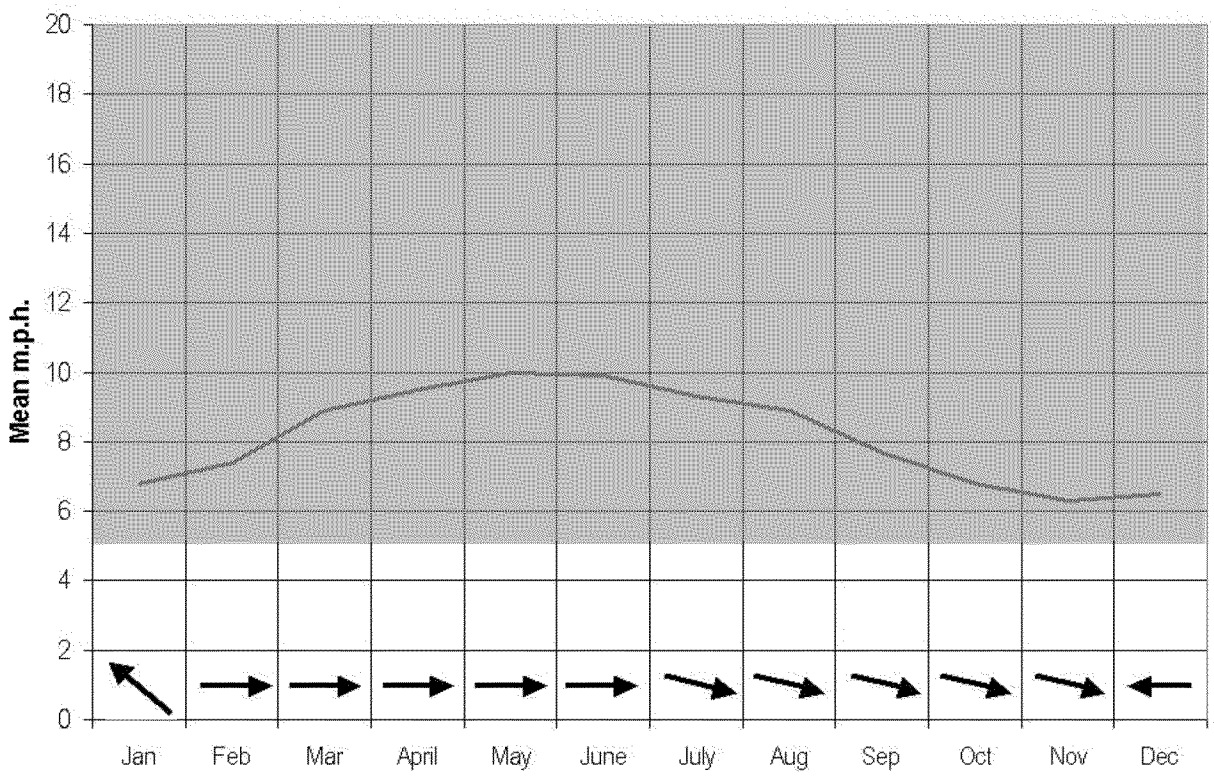


Extra-Terrestrial Radiation

TO BE REPLACED Daily Mean ETR: 2493



Wind Speed



Prevailing Wind Direction
Summer: WNW
Winter: E / W

Natural Ventilation is most effective when wind speed is 5 mph or greater.

California Climate Zone 4

Reference City: San Jose
Latitude: 37.35 N
Longitude: 121.9 W
Elevation: 70 ft

Basic Climate Conditions

	(F)
Summer Temperature Range	23
Record High Temperature (2000)	109
Record Low Temperature (1990)	19

Design Day Data

Winter	99%	34		
	97.5%	36		
Summer				
	1%:	85	MCWB	66
	2.5%:	81	MCWB	65

Climatic Design Priorities

Winter: Insulate
Reduce Infiltration
Passive Solar
Summer: Shade
Allow natural ventilation
Distribute Thermal Mass
Use Evaporative Cooling

Title 24 Requirements

Package	C	D
Ceiling Insulation	R38	R30
Wood Frame Walls	R25	R13
Glazing U-Value	0.38	0.67
Maximum Total Area	14%	20%

Climate

The Central Coastal Range is inland of the coast but has some ocean influence which keeps temperatures from hitting more extreme highs and lows. This zone covers many microclimates from northern to southern parts of the state. The reference city is in the northern-most part of the zone.

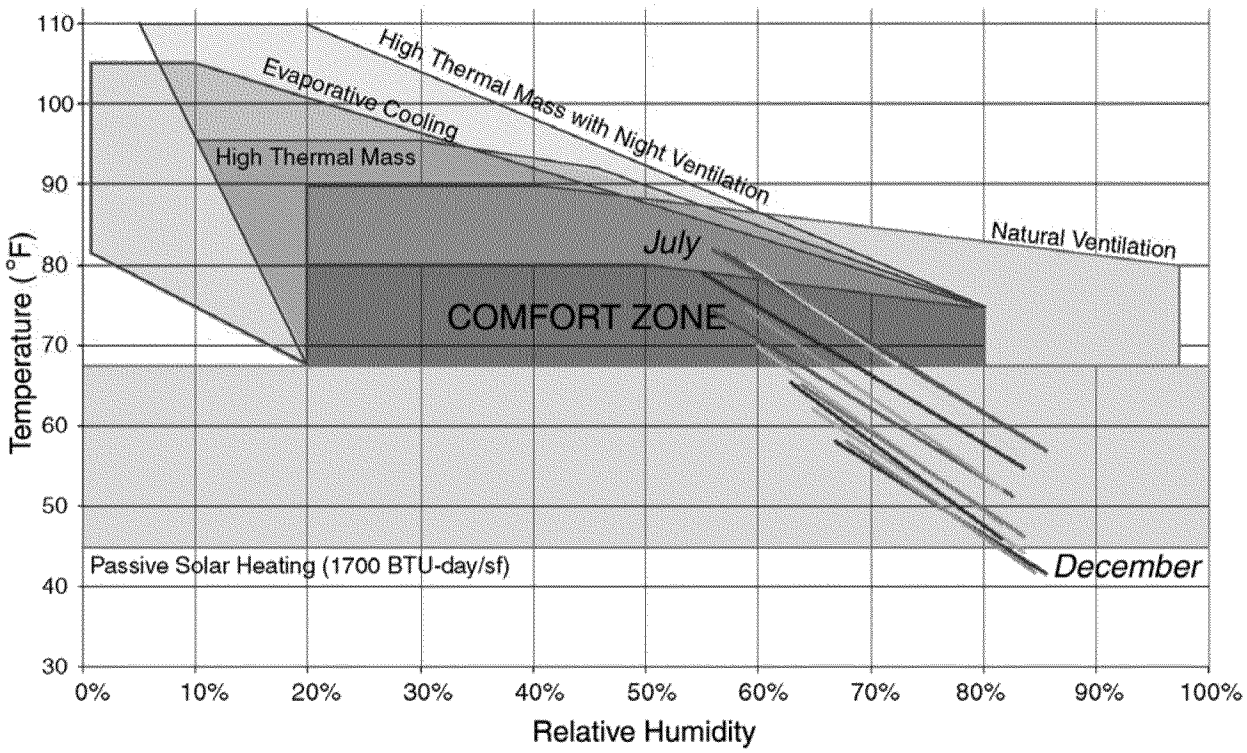
	San Jose	Gilroy	Sunnyvale	Paso Robles
HDD	2335	2278	2643	2934
CDD	574	913	220	956

HDD = Heating Degree Days (base 65F)
CDD = Cooling Degree Days

Seasons are sharply defined. Summers are hot and dry with a large daily temperature swing. Summers are hot enough that cooling is necessary. Winters are cool but not severe. Heating is necessary on many days in the winter.

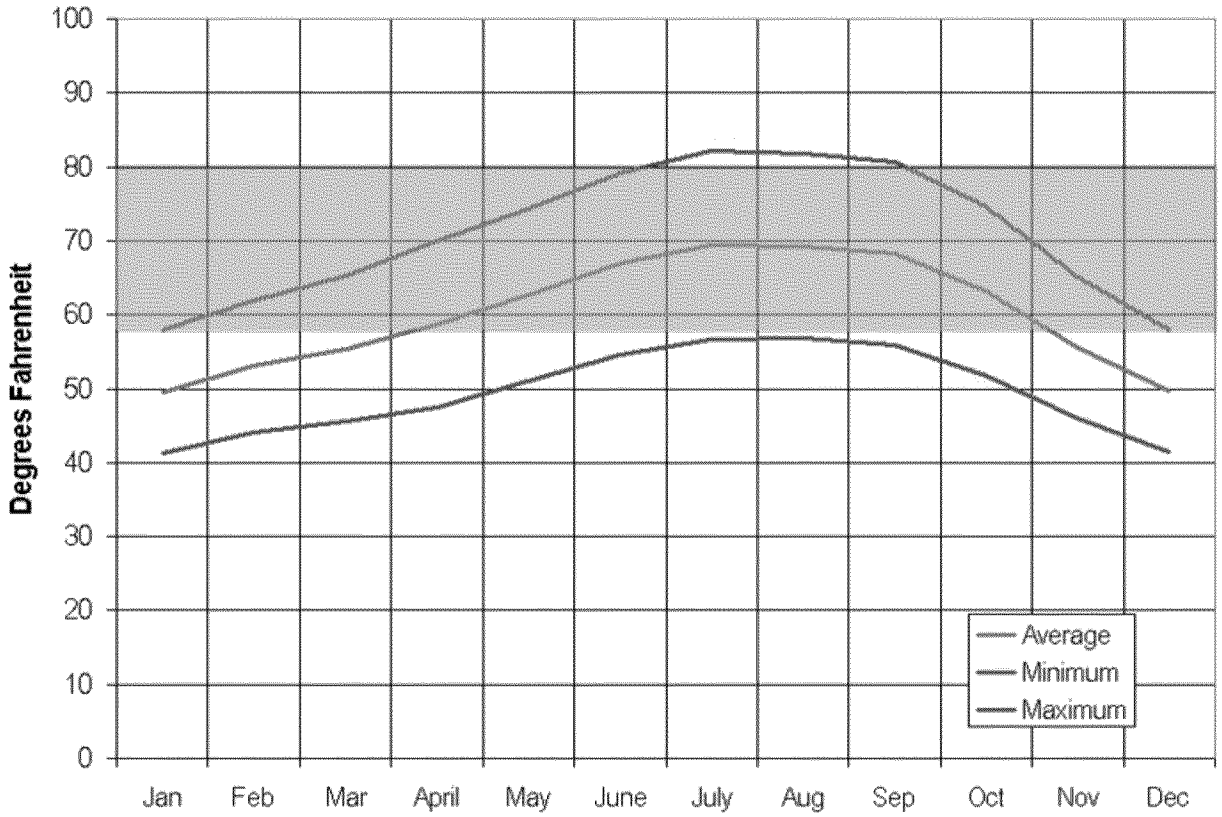
Days are typically clear with the coastal range blocking much of the fog and high winds.

Bioclimatic Chart

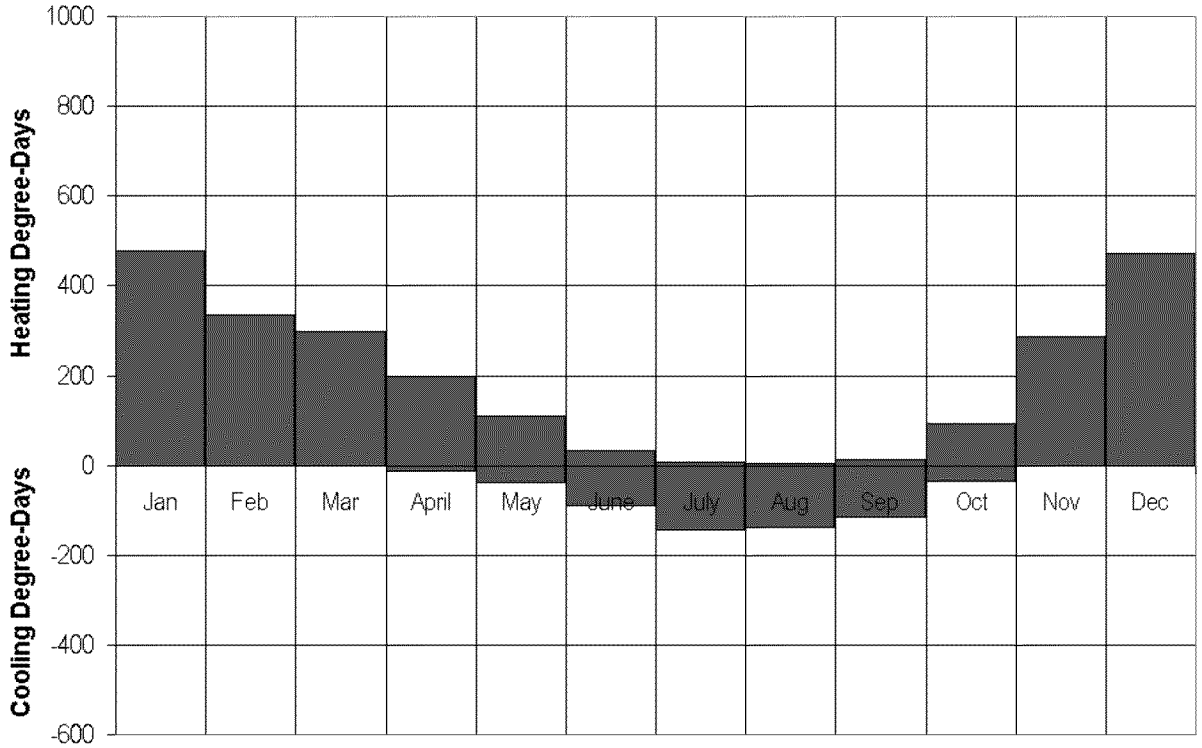


Temperature

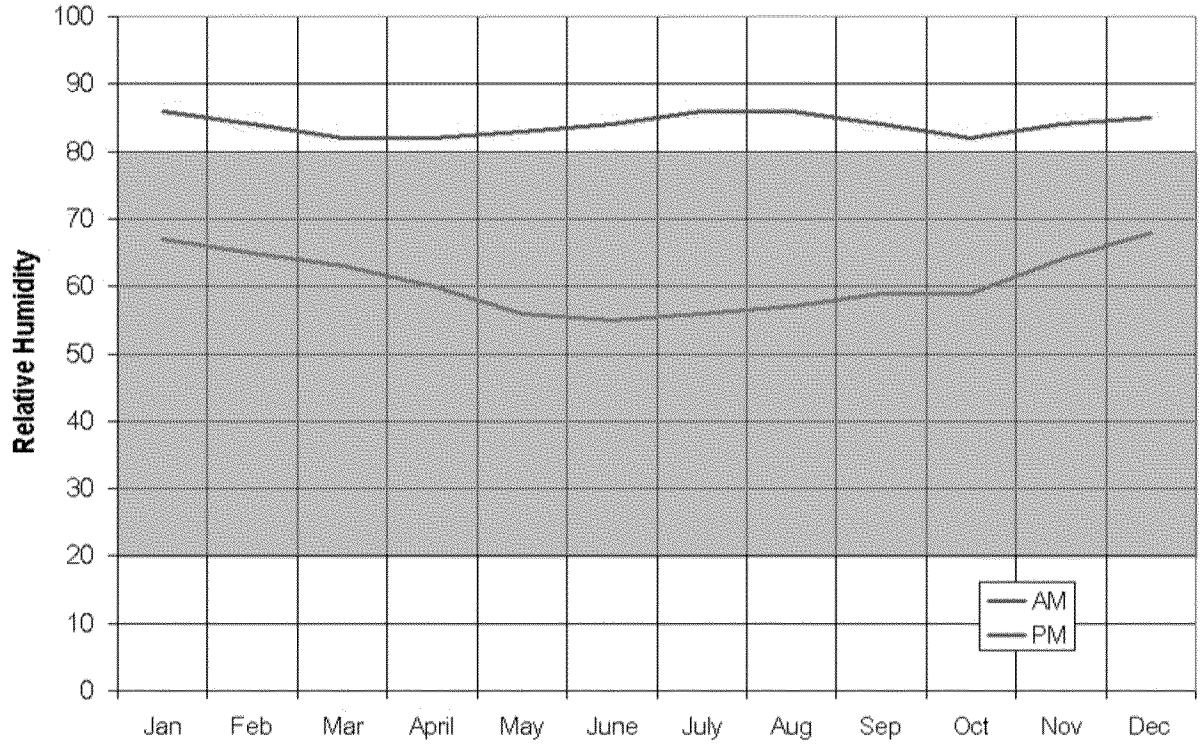
(Typical Comfort Zone: 68-80°F)



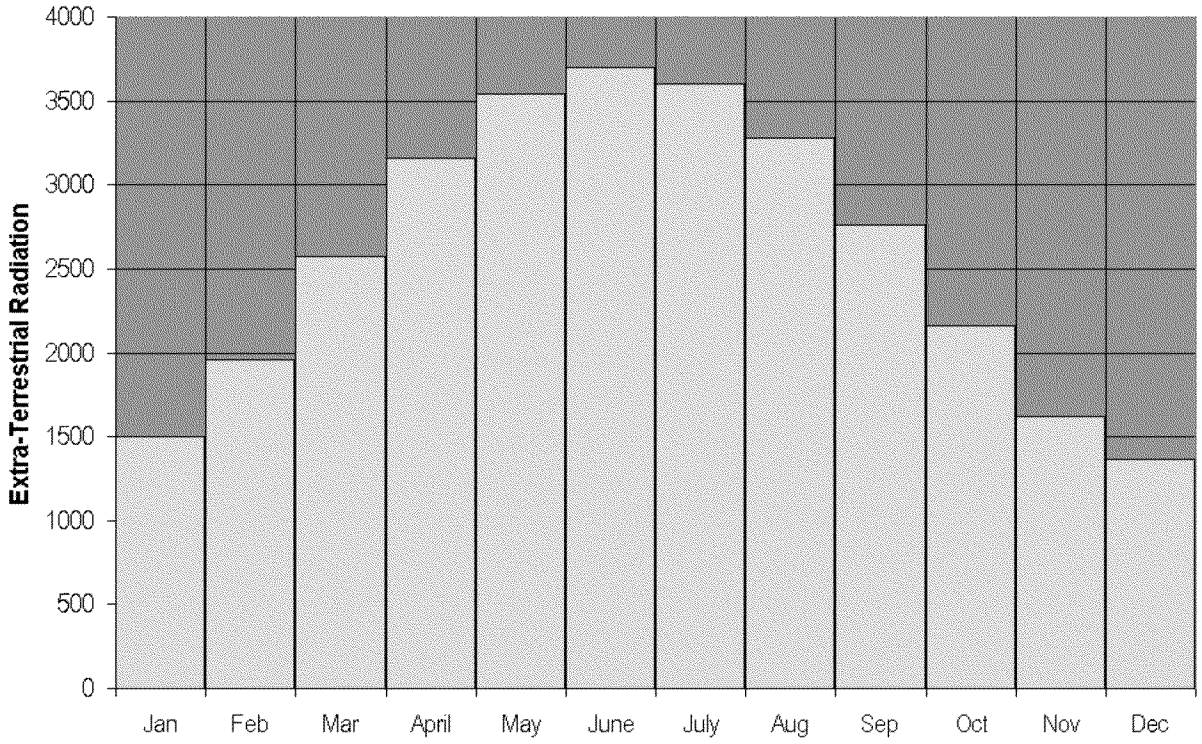
Degree Day
(Base 65°)



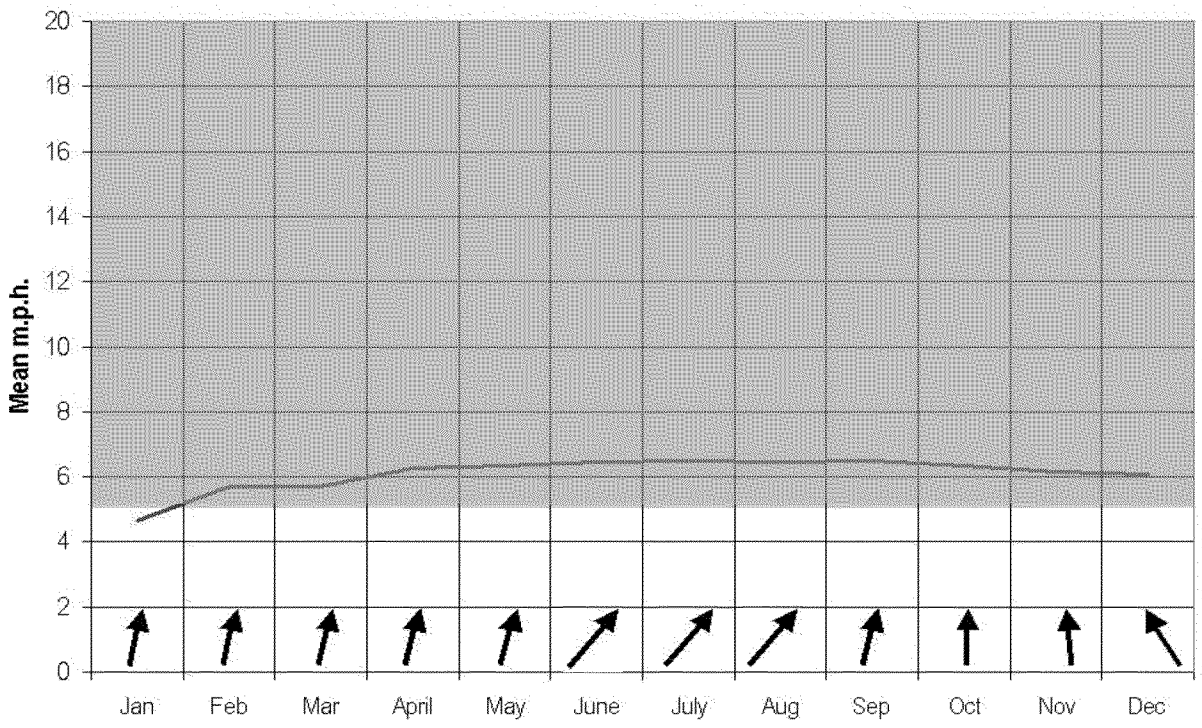
Relative Humidity
(Typical Comfort Zone: 20-80%)



Extra-Terrestrial Radiation Daily Mean ETR: 2602



Wind Speed



Prevailing Wind Direction
Summer: NNW
Winter: SE

Natural Ventilation is most effective when wind speed is 5 mph or greater.

California Climate Zone 5

Reference City: Santa Maria
Latitude: 34.93 N
Longitude: 120.42 W
Elevation: 230 ft

Basic Climate Conditions

	(F)
Summer Temperature Range	22
Record High Temperature (1987)	108
Record Low Temperature (1976)	20

Design Day Data

Winter	99%	31		
	97.5%	33		
Summer				
	1%:	89	MCWB	68
	2.5%:	76	MCWB	63

Climatic Design Priorities

Winter: Insulate
Reduce Infiltration
Passive Solar
Summer: Shade
Allow natural ventilation
Distribute Thermal Mass

Title 24 Requirements

Package	*C*	*D*
Ceiling Insulation	R38	R30
Wood Frame Walls	R25	R13
Glazing U-Value	0.42	0.67
Maximum Total Area	16%	20%

Climate

Climate Zone 5 is situated along the coast where ocean temperatures are warmer due to the southern latitude.

Summers are warm with afternoon winds blowing until sunset, which naturally cools the region. The air is usually moist. Fog and cloud cover commonly blocks the sun in the morning and evenings.

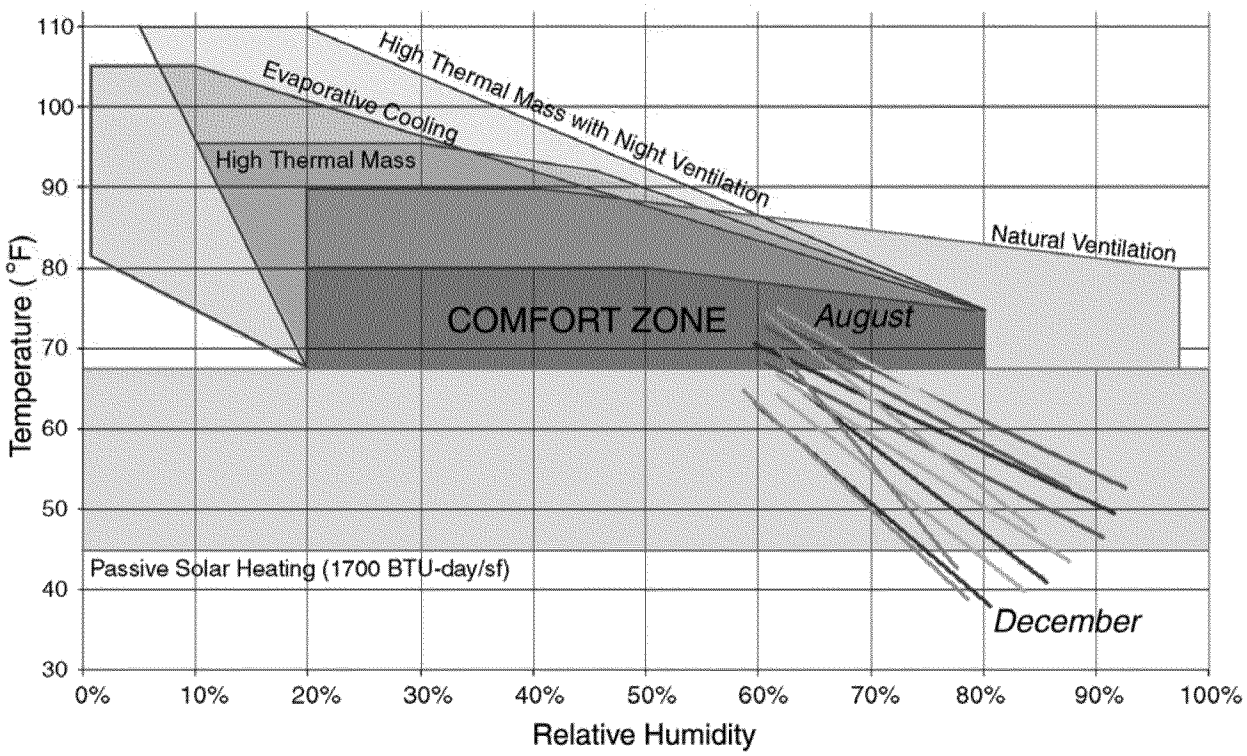
Winters are cold but not severe enough to frost. The coolest parts of this region are the valley floors, canyons, and land troughs.

	Santa Maria	*San Luis Obispo*	*Lompoc*	*Pismo Beach*
HDD	2844	2954	2266	2552
CDD	456	894	332	173

HDD = Heating Degree Days (base 65F)
CDD = Cooling Degree Days

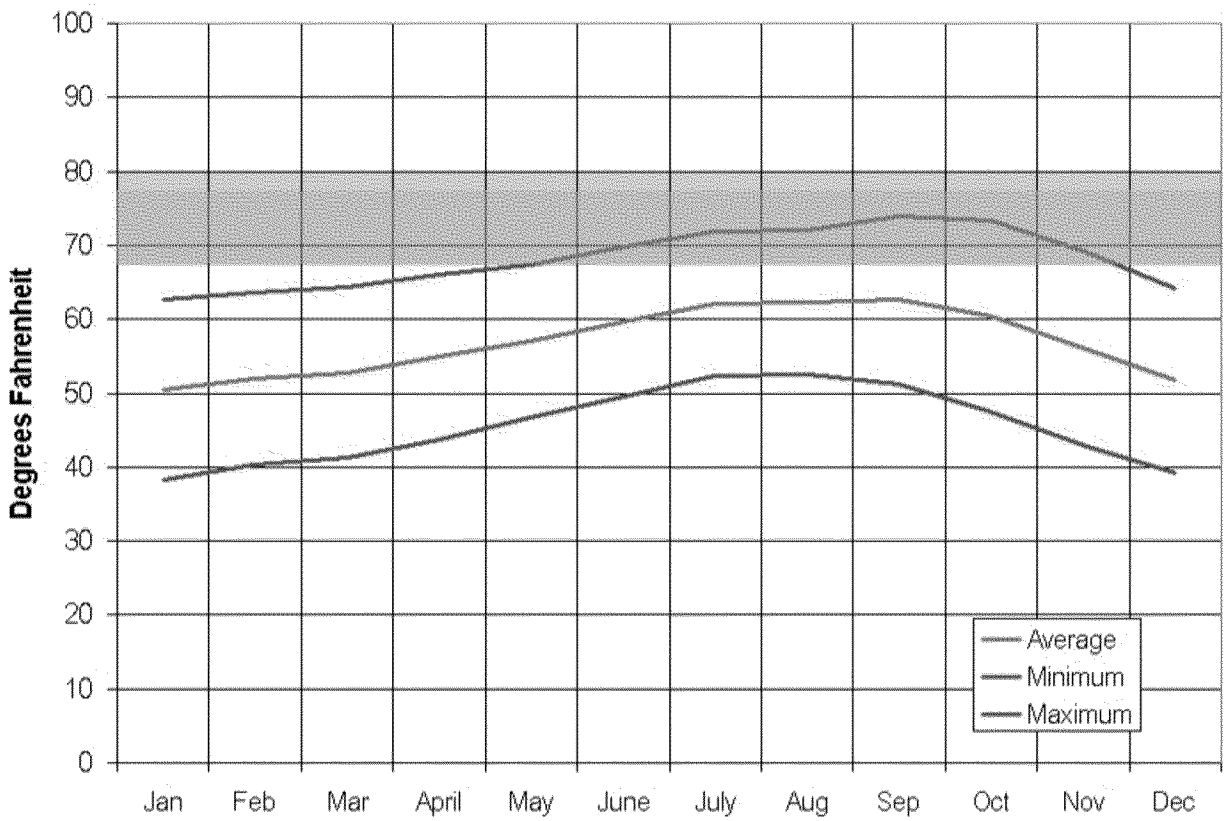
The further inland the location, the fewer HDD and more CDD can be expected. Climate Zone 5 comes close to comfort standards, meaning little cooling is needed and heat is only necessary for part of the day, even in the winter. The mildness of the weather in Zone 5 is reflected in the fact that it is one of the lowest energy consuming climates.

Bioclimatic Chart

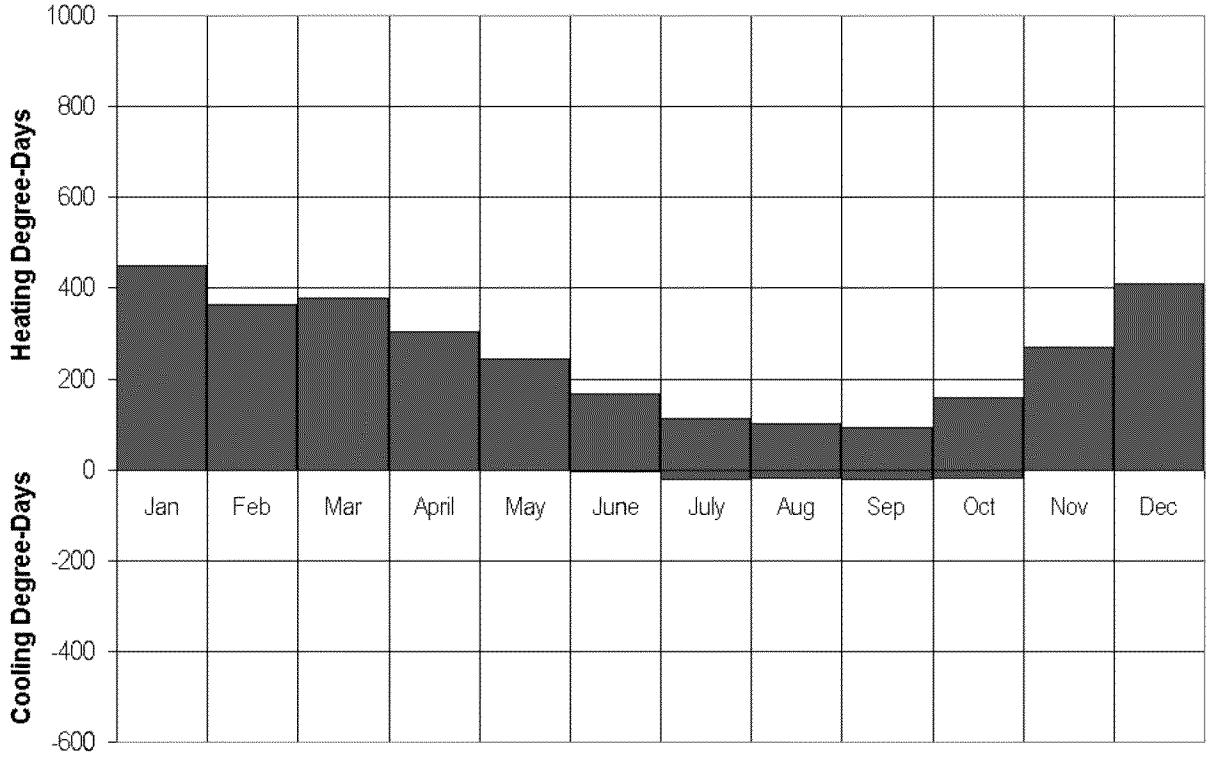


Temperature

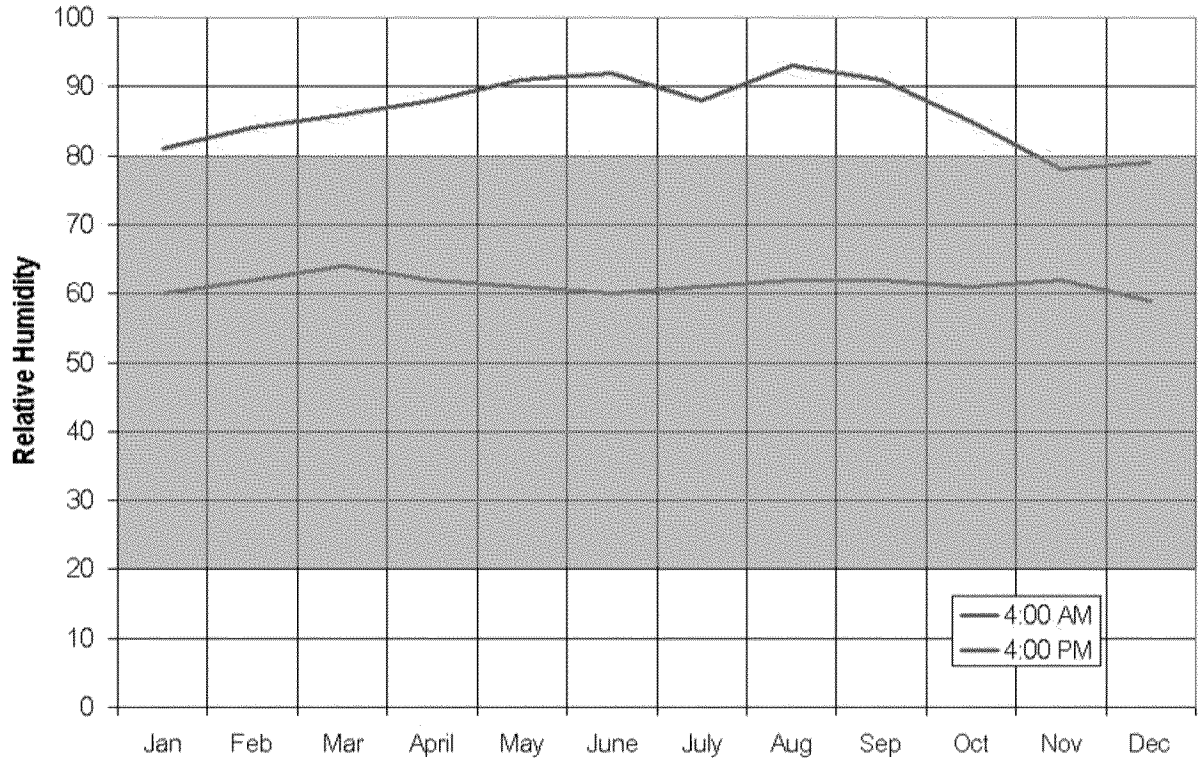
(Typical Comfort Zone: 68-80°F)



Degree Day
(Base 65°)

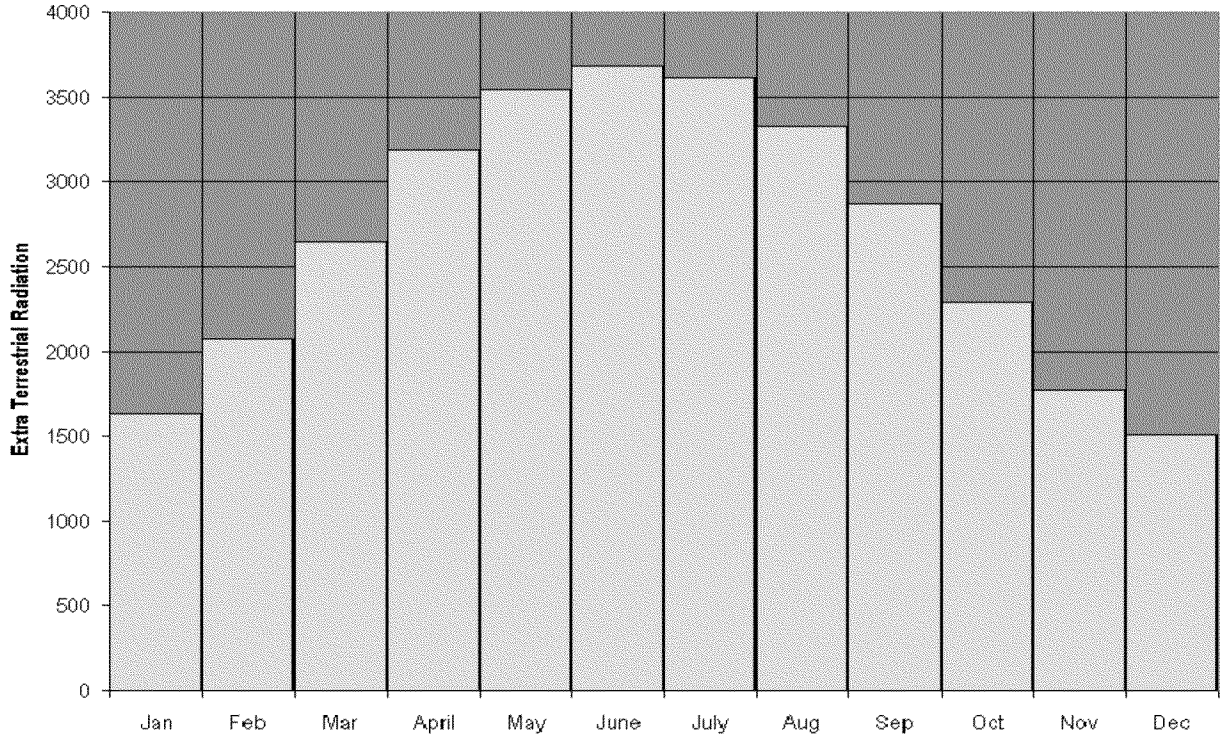


Relative Humidity
(Typical Comfort Zone: 20-80%)

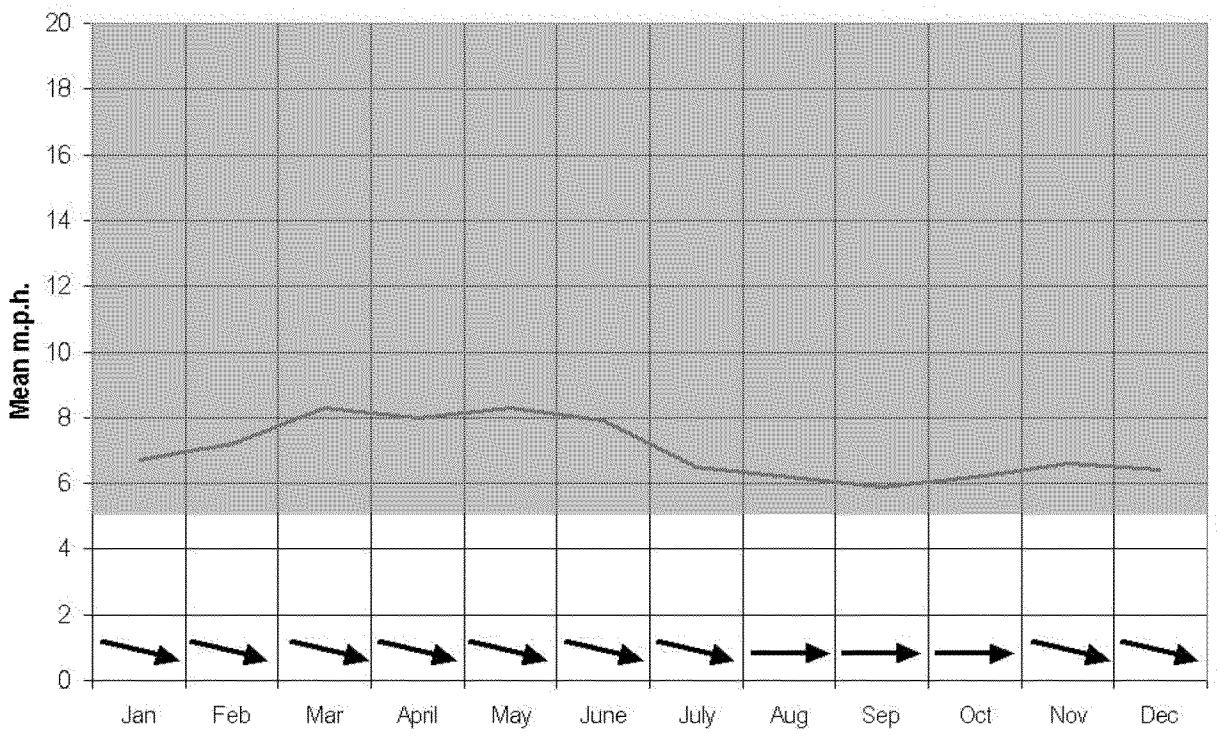


Extra-Terrestrial Radiation

Daily Mean ETR: 2679



Wind Speed



Prevailing Wind Direction

Summer: WNW
Winter: E

Natural Ventilation is most effective when wind speed is 5 mph or greater.

California Climate Zone 6

Reference City: Los Angeles (LAX)
Latitude: 33.93 N
Longitude: 118.4 W
Elevation: 110 ft

Basic Climate Conditions

	(F)
Summer Temperature Range	15
Record High Temperature (1963)	110
Record Low Temperature (1949)	27

Design Day Data

Winter	99%	41		
	97.5%	43		
Summer	*Mare Island*			
	1%:	83	MCWB	68
	2.5%:	80	MCWB	66

Climatic Design Priorities

Winter: Insulate
Reduce Infiltration
Passive Solar
Summer: Shade
Allow natural ventilation
Distribute Thermal Mass

Title 24 Requirements

Package	*C*	*D*
Ceiling Insulation	R38	R30
Wood Frame Walls	R21	R13
Glazing U-Value	0.42	0.67
Maximum Total Area	14%	20%

Climate

Climate Zone 6 includes the beaches at the foot of the southern California hills, as well as several miles of inland area where hills are low or nonexistent. The Pacific Ocean is relatively warm in these longitudes and keeps the climate very mild. Most of the rain falls during the warm, mild winters.

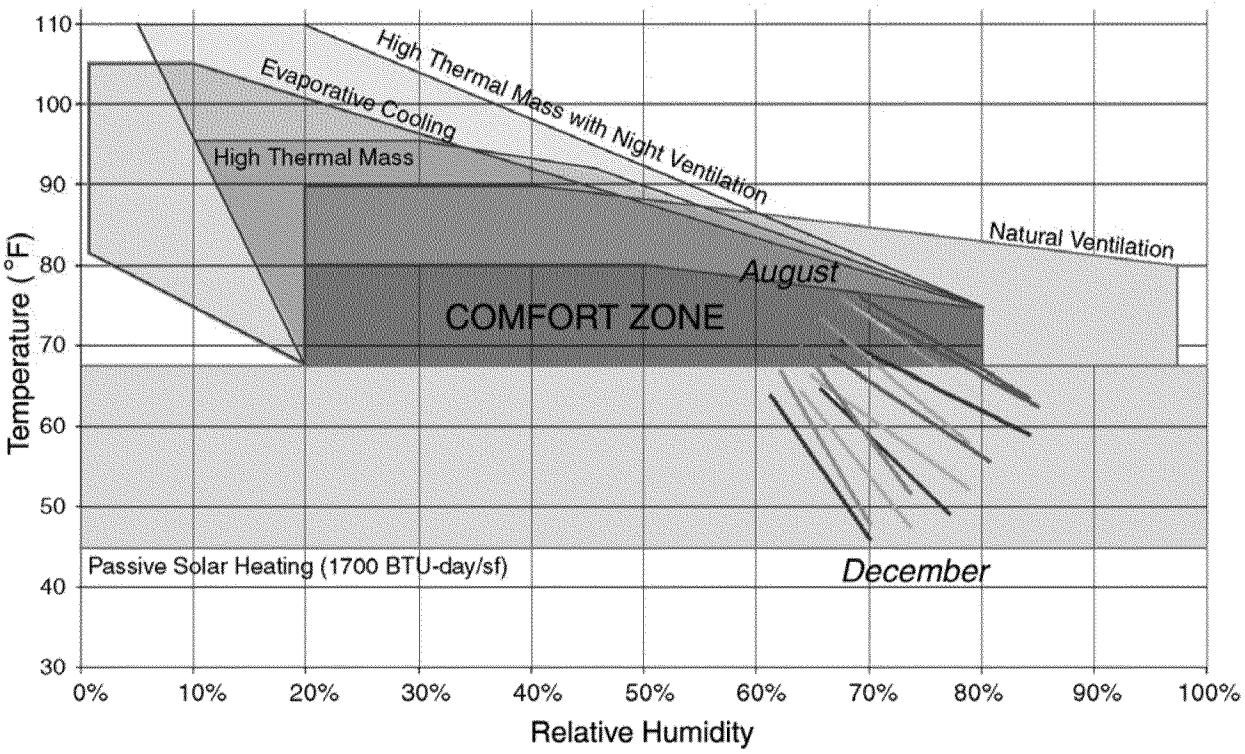
	Santa Barbara	*LAX*	*Long Beach*	*Torrance*
HDD	1902	1458	1430	742
CDD	470	727	1201	568

HDD = Heating Degree Days (base 65F)
CDD = Cooling Degree Days

Summers are pleasantly cooled by winds from the ocean. Although these offshore winds bring high humidity, comfort is maintained because of the low temperatures. Occasionally the wind reverses and brings hot, dry desert air.

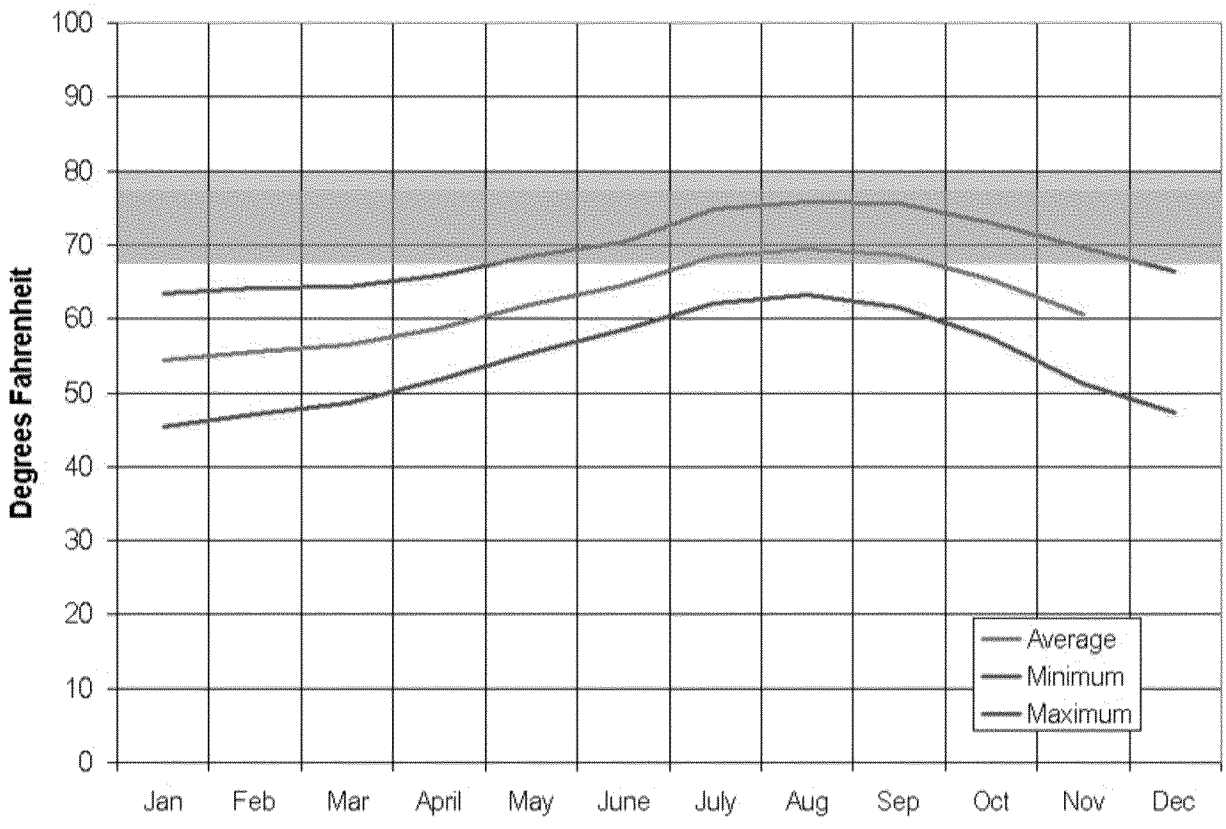
There is a sharp increase in temperature and decrease in humidity as one leaves the coast. Sunshine is plentiful all year, so solar heating, especially for hot water, is very advantageous. Climate Zone 6 is a very comfortable place to live and therefore requires the least energy of any region in California to achieve thermal comfort levels.

Bioclimatic Chart

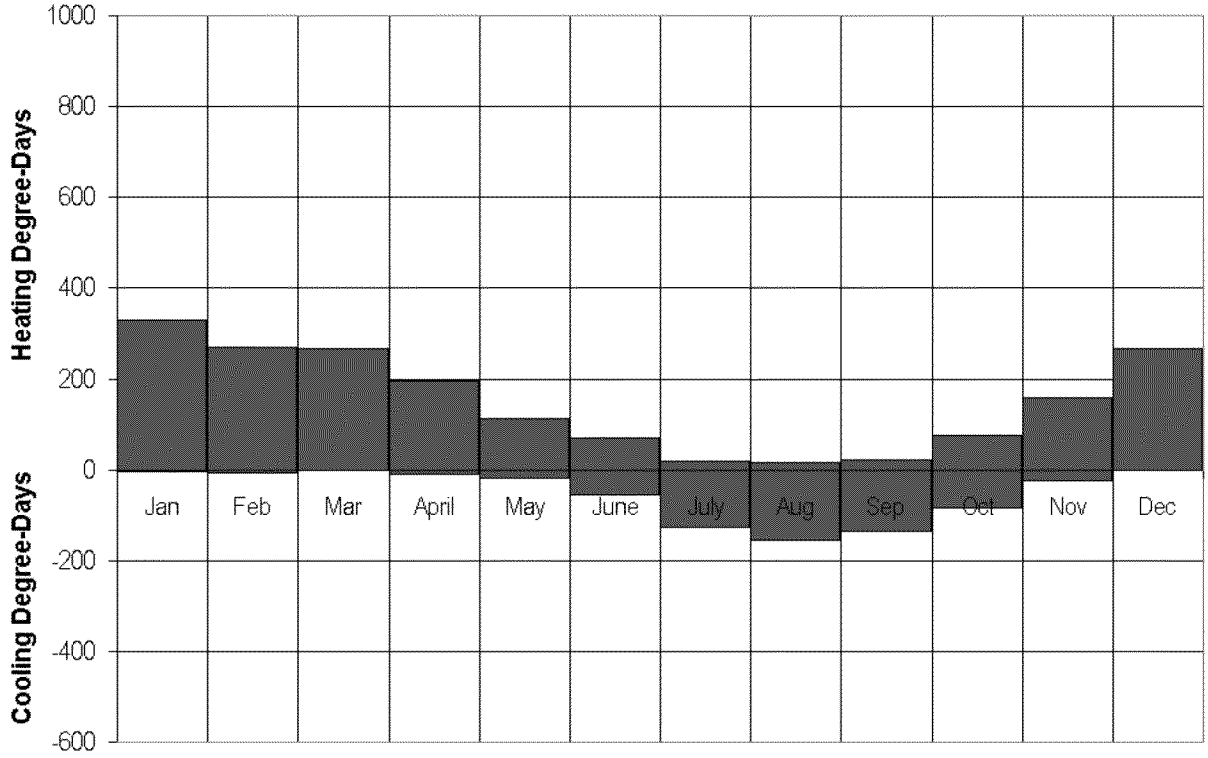


Temperature

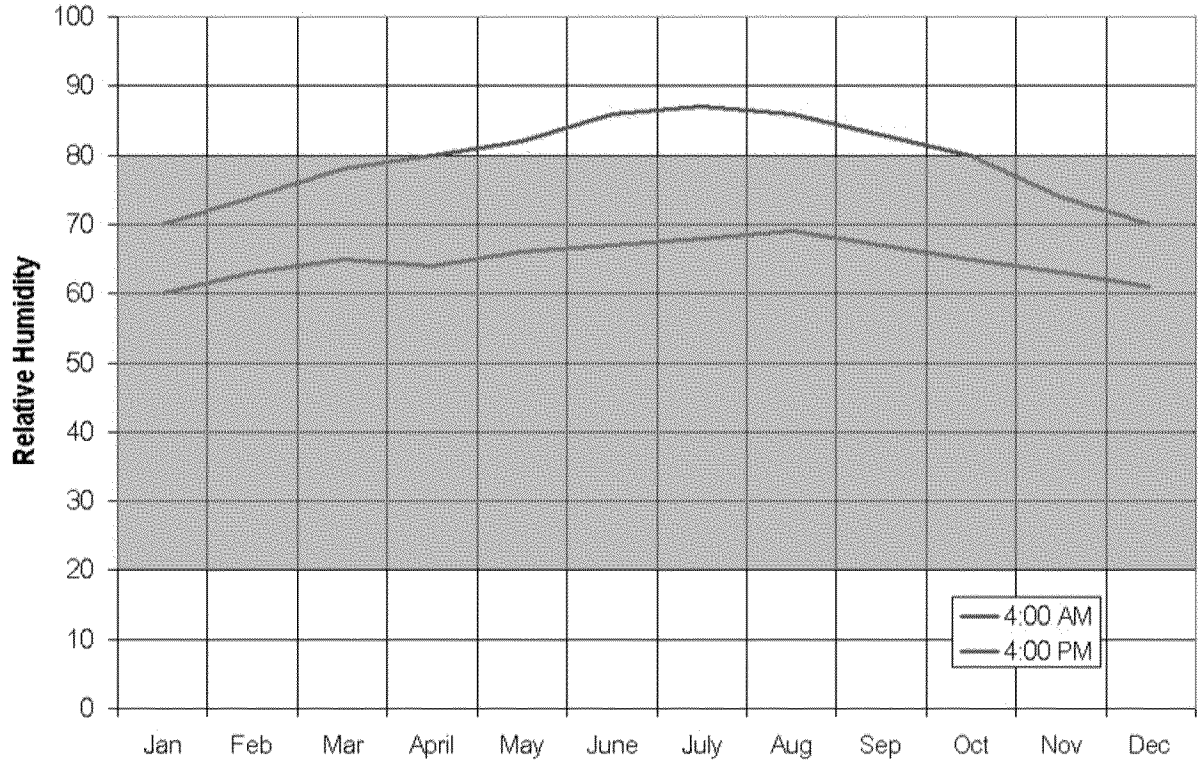
(Typical Comfort Zone: 68-80°F)



Degree Day
(Base 65°)

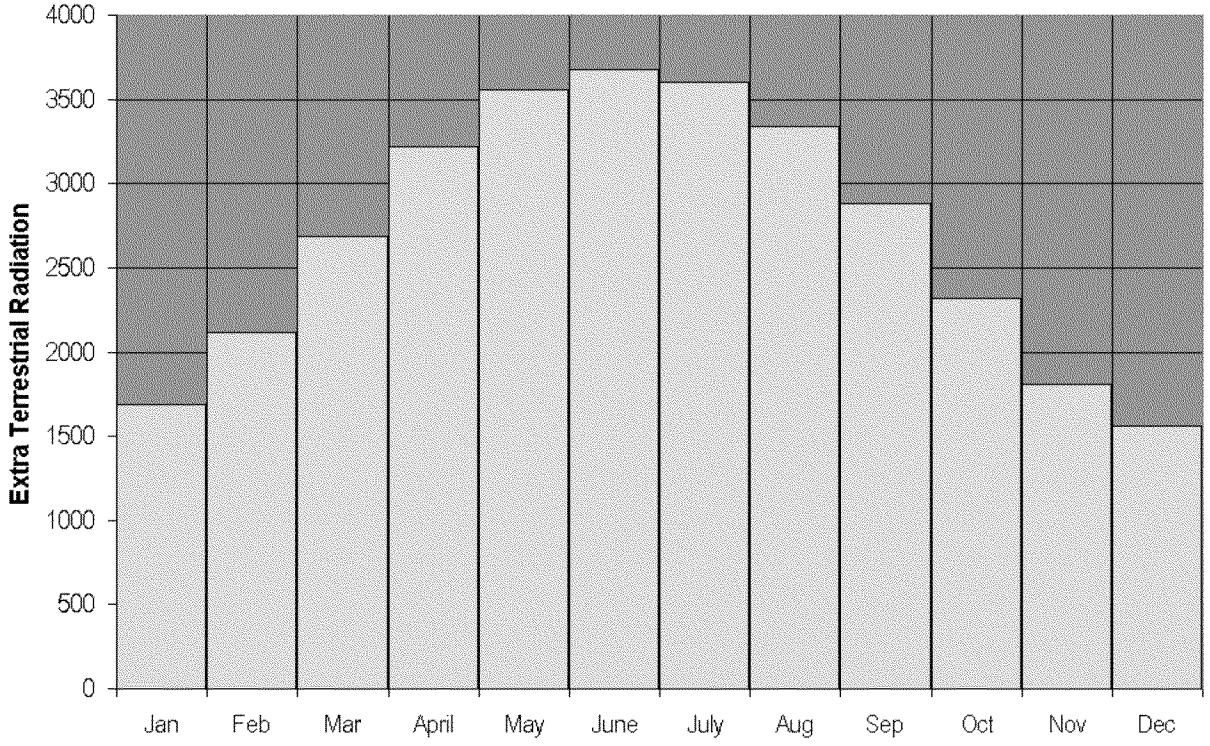


Relative Humidity
(Typical Comfort Zone: 20-80%)

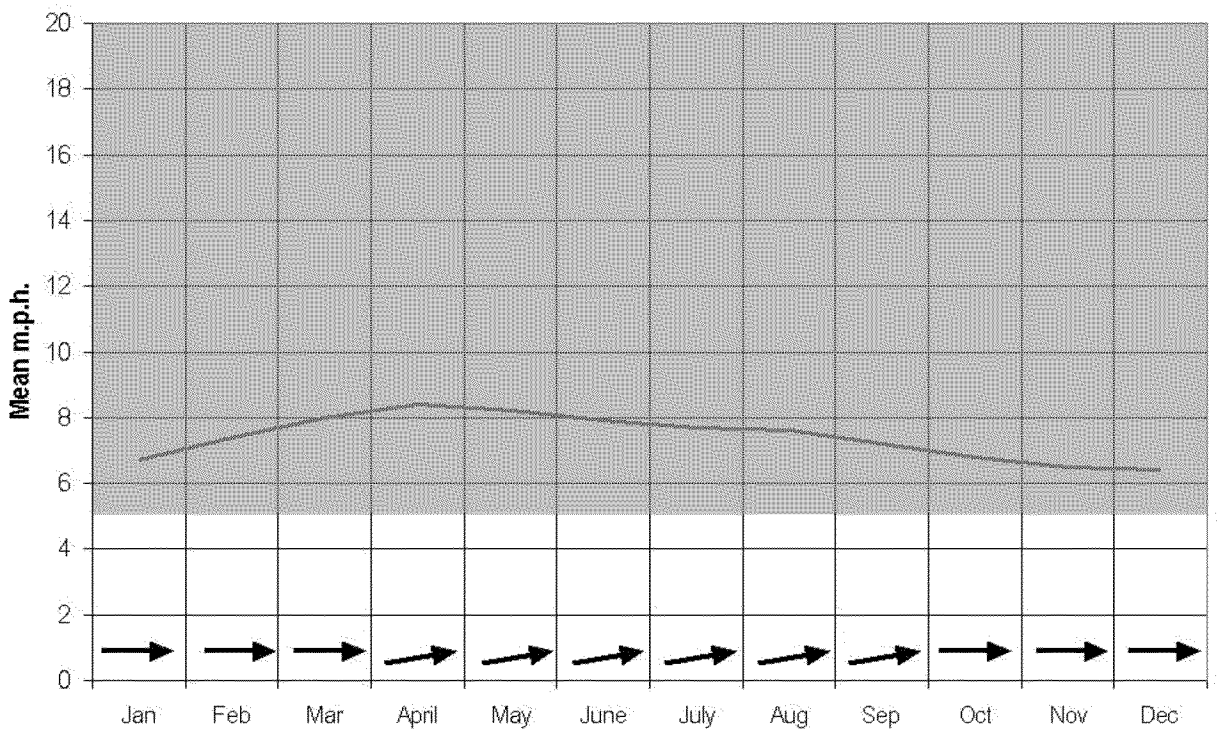


Extra-Terrestrial Radiation

Daily Mean ETR: 2704



Wind Speed



Prevailing Wind Direction

Summer: WSW
Winter: E

Natural Ventilation is most effective when wind speed is 5 mph or greater.

California Climate Zone 7

Reference City: San Diego
Latitude: 32.73 N
Longitude: 117.17 W
Elevation: 10 ft

Basic Climate Conditions

	(F)
Summer Temperature Range	14
Record High Temperature (1963)	111
Record Low Temperature (1949)	29

Design Day Data

Winter	99%	42		
	97.5%	44		
Summer				
	1%:	83	MCWB	69
	2.5%:	80	MCWB	69

Climatic Design Priorities

Winter: Insulate
Reduce Infiltration
Passive Solar
Summer: Shade
Allow natural ventilation
Distribute Thermal Mass

Title 24 Requirements

Package	*C*	*D*
Ceiling Insulation	R38	R30
Wood Frame Walls	R21	R13
Glazing U-Value	0.38	0.67
Maximum Total Area	14%	20%

Climate

Climate Zone 7 is the southernmost coastal region of California. The warm ocean water and latitude make this climate very mild. The temperature of the ocean water affects the air temperature over it, and this in turn moderates temperatures over the coastal strip.

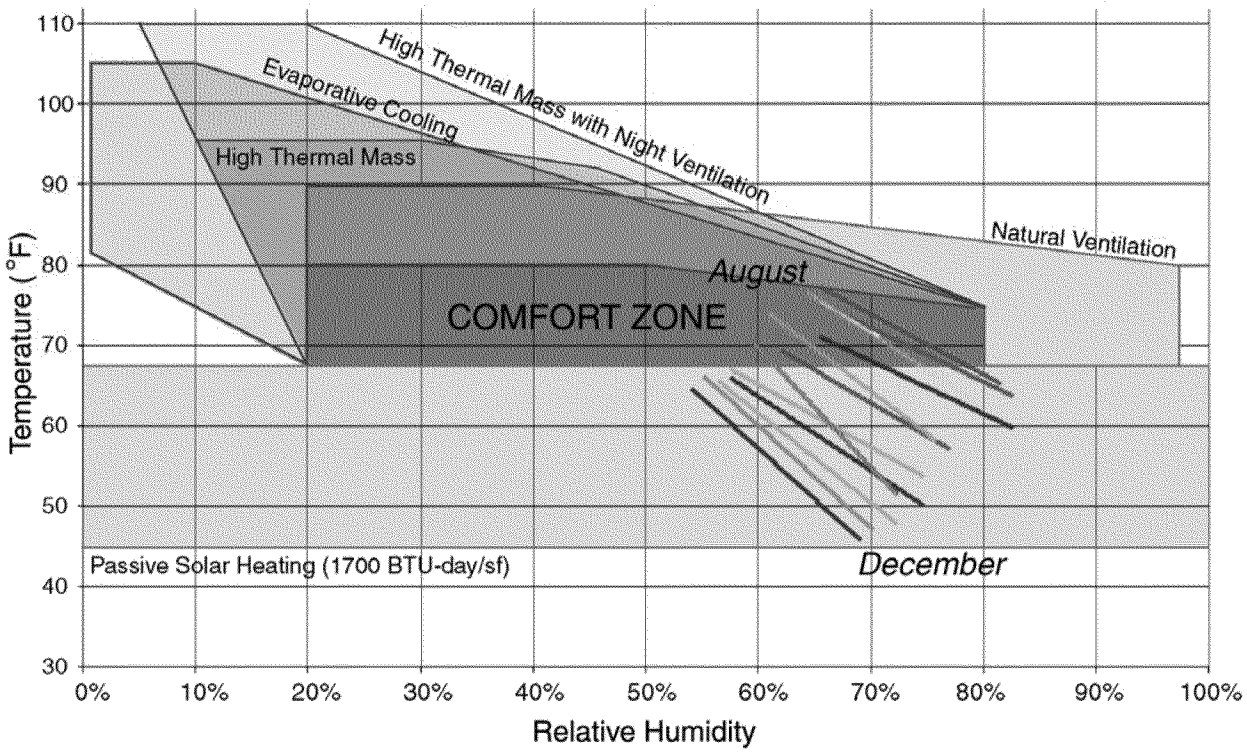
The ocean influences the weather most of the time, however the wind changes sometimes, bringing in the hot and extremely drying Santa Ana winds. The weather in the summer is warm and comfortable, and hot enough that cooling is necessary on some days.

	Oceanside	*Chula Vista*	*San Diego*	*La Mesa*
HDD	2009	1321	1256	1400
CDD	505	862	984	1110

HDD = Heating Degree Days (base 65F)
CDD = Cooling Degree Days

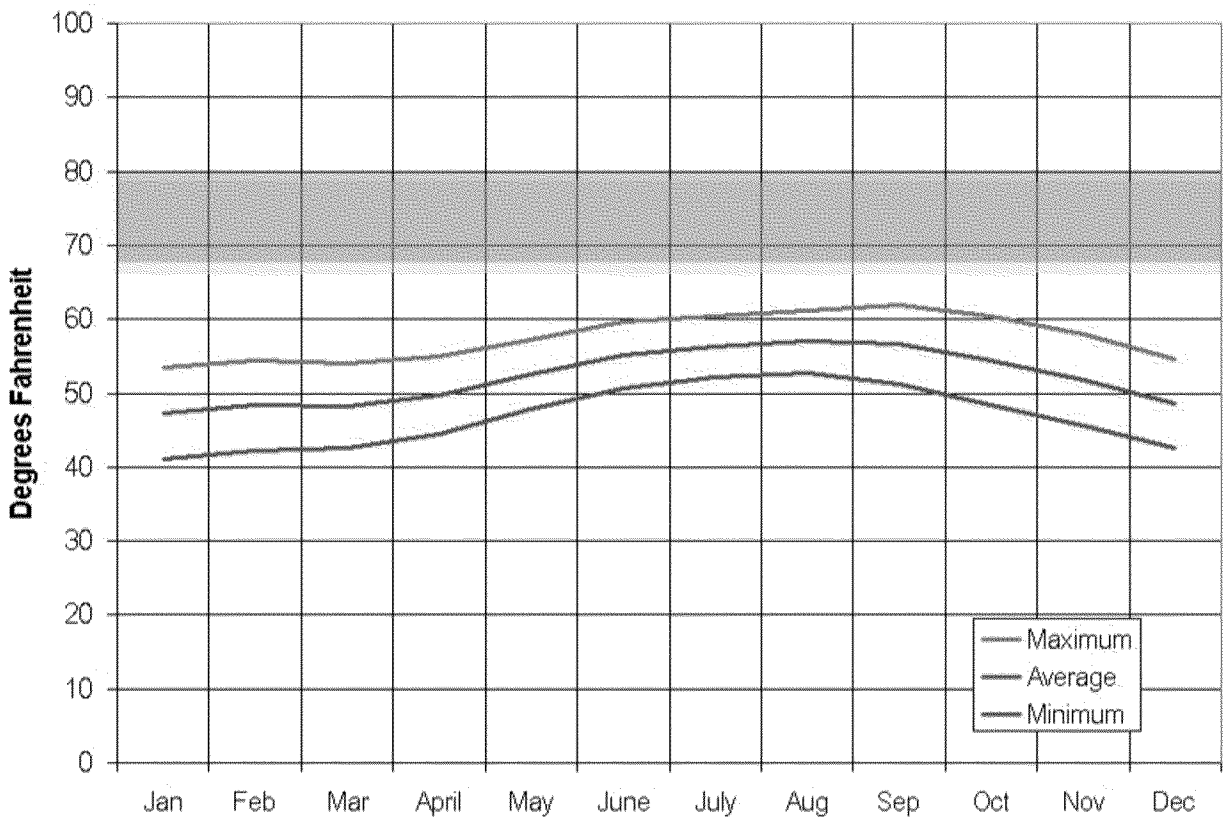
However, daily high fogs naturally cool the area at night. The winters are cool and heating is necessary sometimes. The weather and comfort standards in this region are in concurrence as shown by the low consumption of energy use.

Bioclimatic Chart

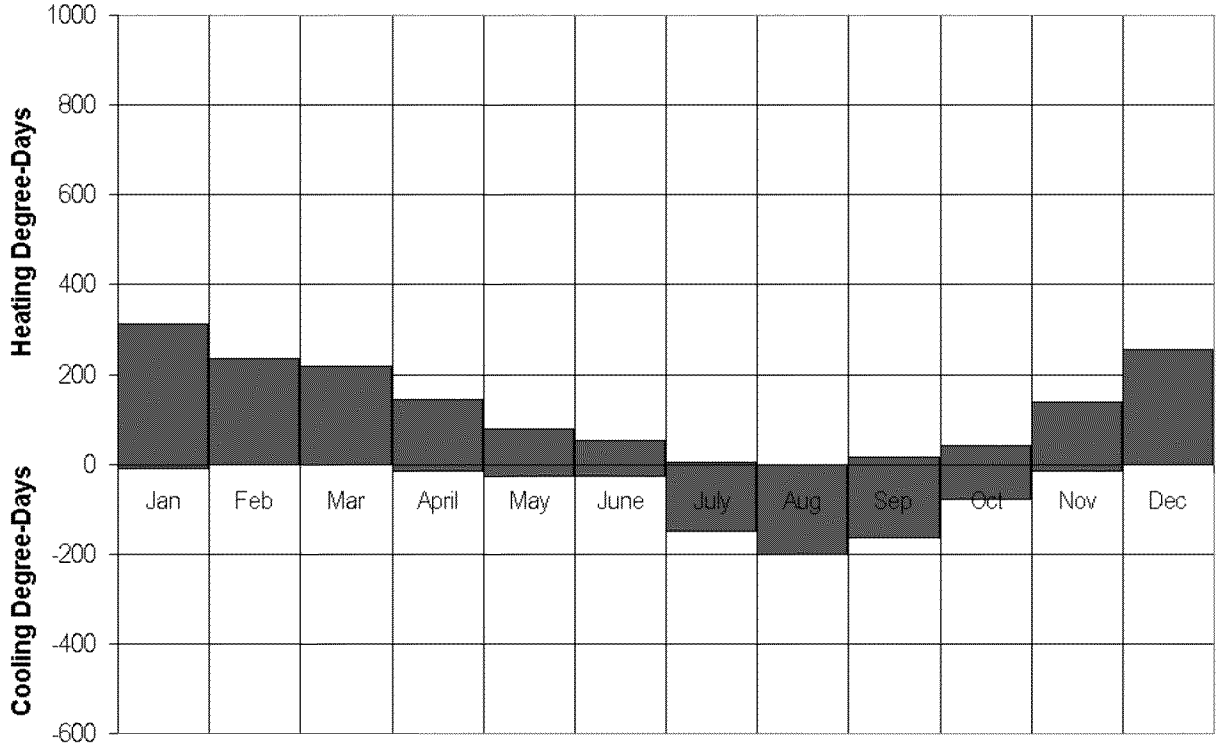


Temperature

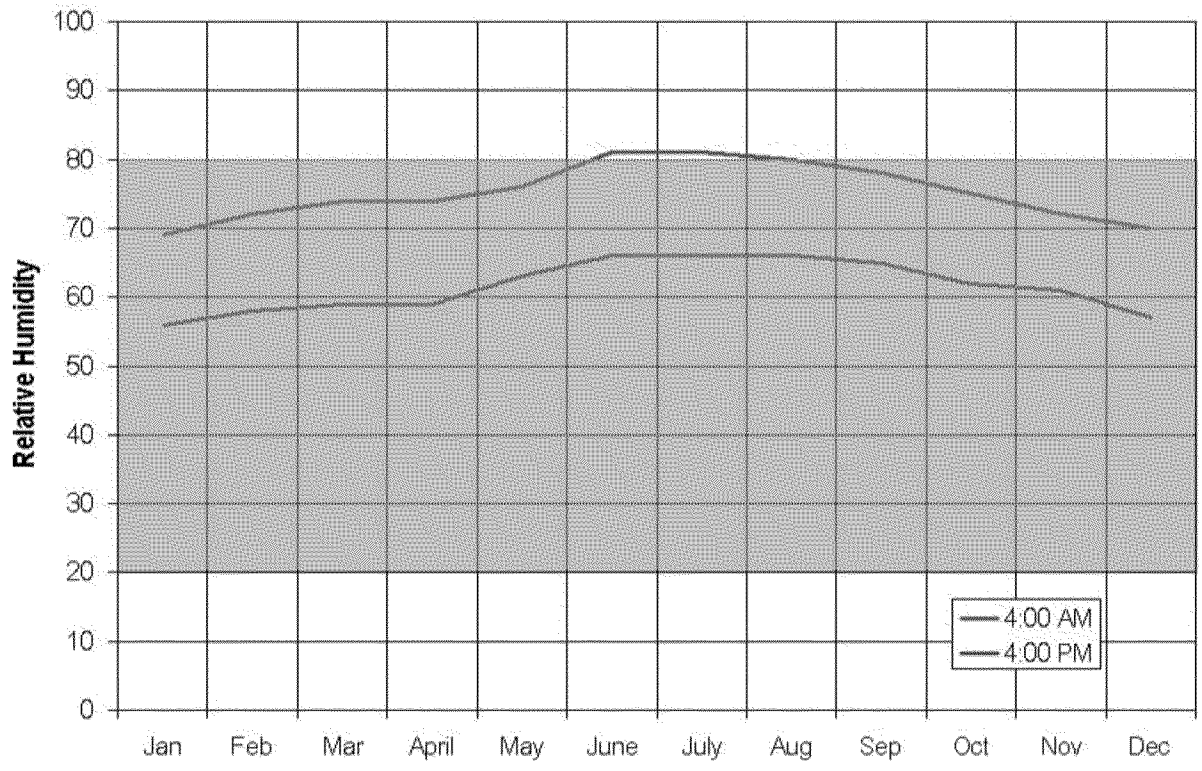
(Typical Comfort Zone: 68-80°F)



Degree Day
(Base 65°)

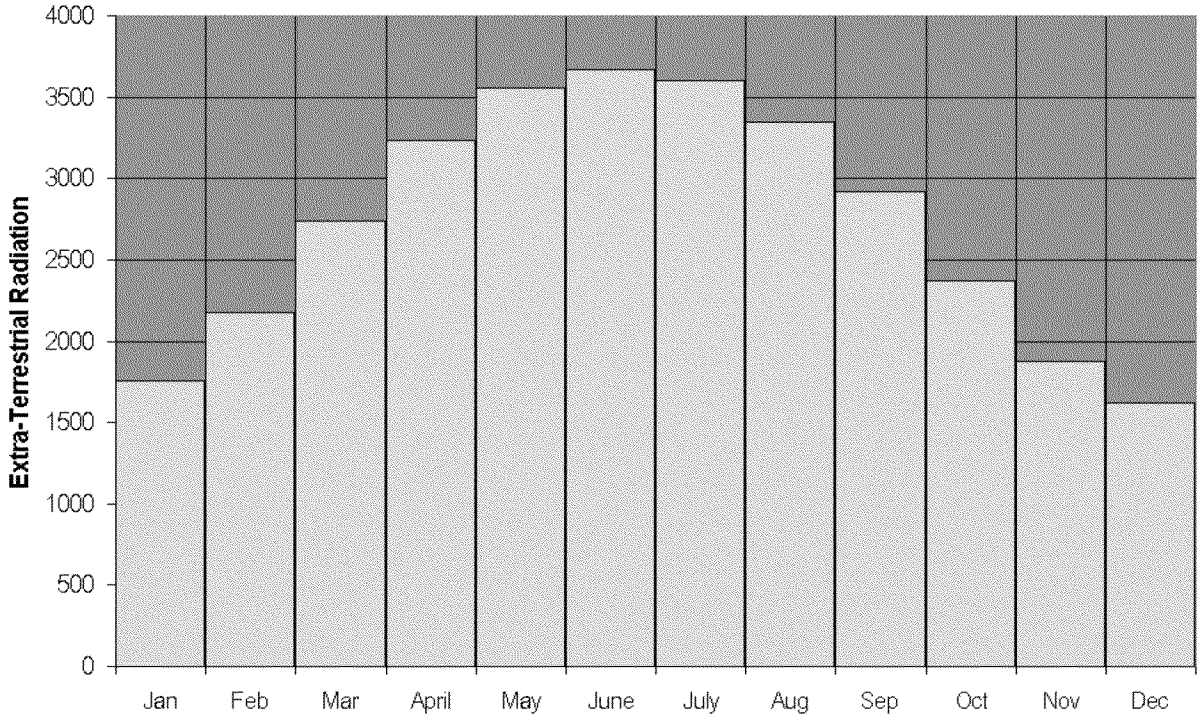


Relative Humidity
(Typical Comfort Zone: 20-80%)

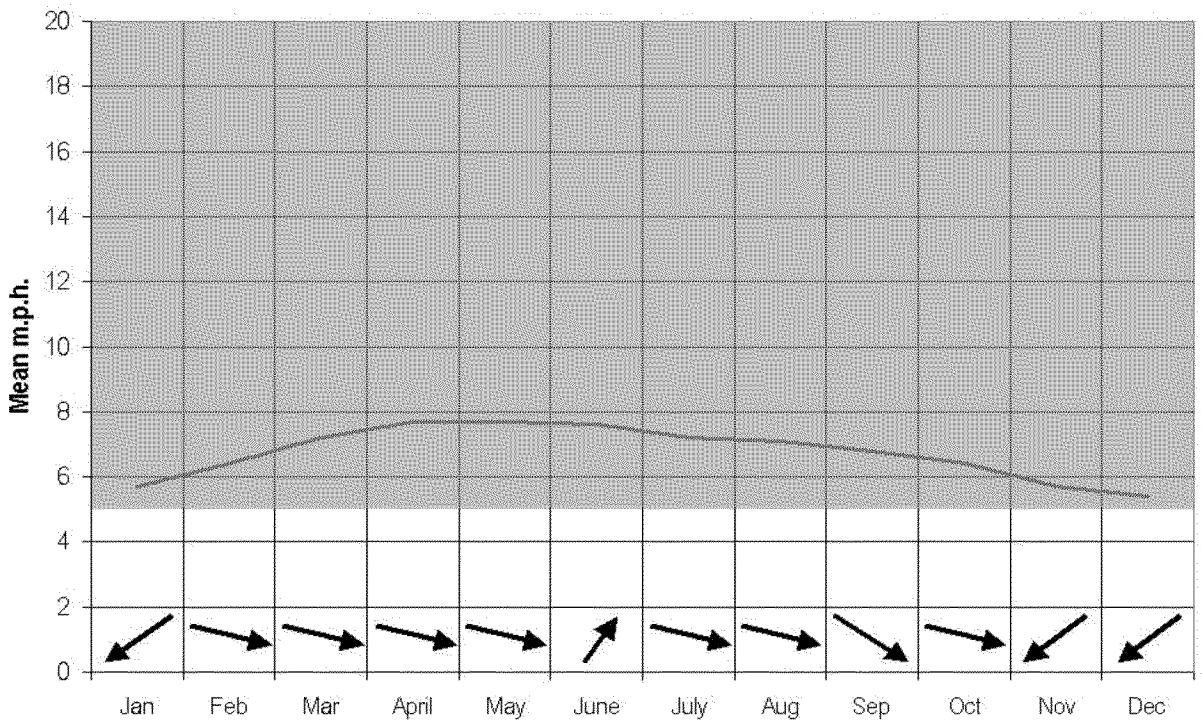


Extra-Terrestrial Radiation

Daily Mean ETR: 2739



Wind Speed



Prevailing Wind Direction

Summer: WNW
Winter: NE

Natural Ventilation is most effective when wind speed is 5 mph or greater.

California Climate

Zone 8

Reference City: Long Beach
Latitude: 33.82 N
Longitude: 118.15 W
Elevation: 30 ft

Basic Climate Conditions

	(F)
Summer Temperature Range	15
Record High Temperature (1961)	111
Record Low Temperature (1963)	25

Design Day Data

Winter	99%	41		
	97.5%	43		
Summer	*Mare Island*			
	1%:	83	MCWB	68
	2.5%:	80	MCWB	68

Climatic Design Priorities

Winter: Insulate
Reduce Infiltration
Passive Solar
Summer: Shade
Allow natural ventilation
Distribute Thermal Mass

Title 24 Requirements

Package	*C*	*D*
Ceiling Insulation	R38	R30
Wood Frame Walls	R21	R13
Glazing U-Value	0.38	0.67
Maximum Total Area	14%	20%

Climate

Though inland from the coast, Zone 8 is still influenced by marine air. The ocean influence controls temperature keeping it from being more extreme.

Since this zone is not directly on the coast the temperatures in the summer are warmer, and in the winter, cooler. Cooling and heating are necessary in this climate to achieve comfort standards.

	Long Beach	*Anaheim*	*Tustin*	*El Toro*
HDD	1430	1286	1794	1413
CDD	1201	1294	1102	691

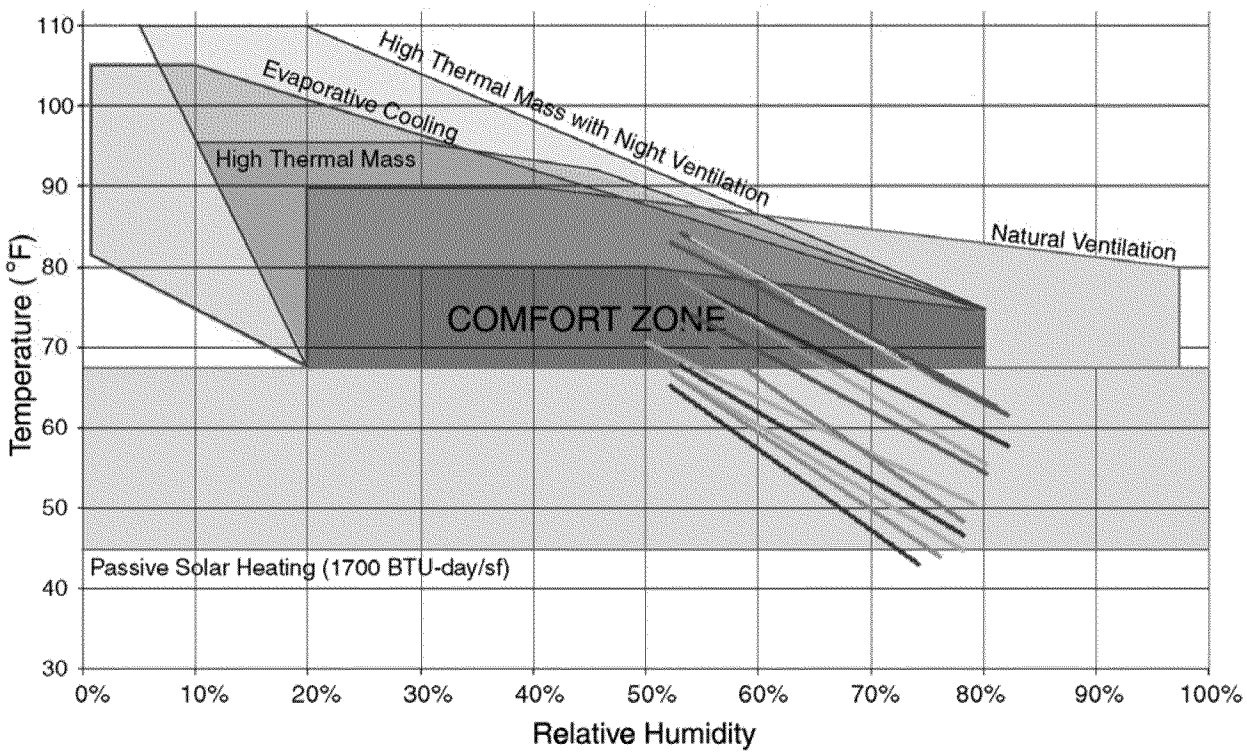
HDD = Heating Degree Days (base 65F)
CDD = Cooling Degree Days

Most of the rain falls in the winter and frosts are not a threat. Coldest temperatures are experienced in the canyons and near canyon mouths.

This are is ideal for growing subtropical plants, such as the avocado. Winters are not cold enough to grow apples, peaches or pears.

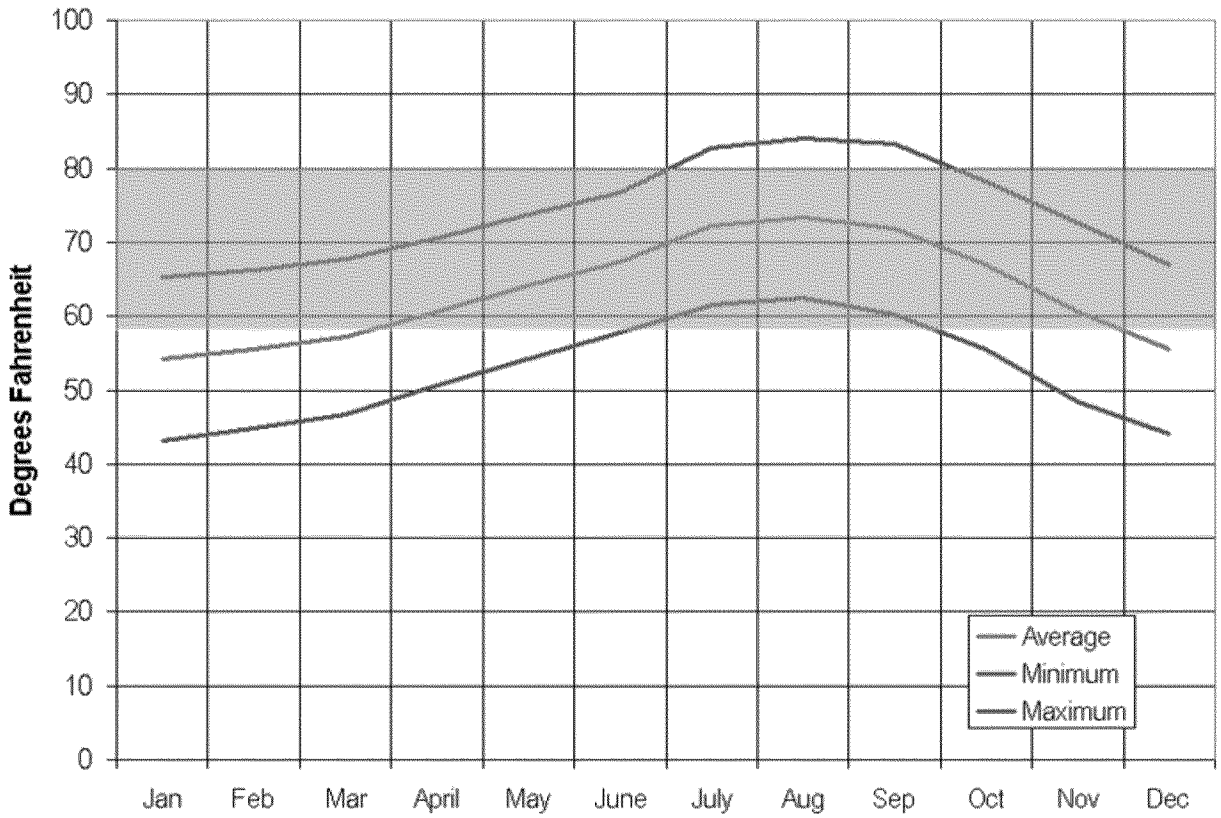
Sunshine is plentiful in this region since it is far from coastal daily fog.

Bioclimatic Chart

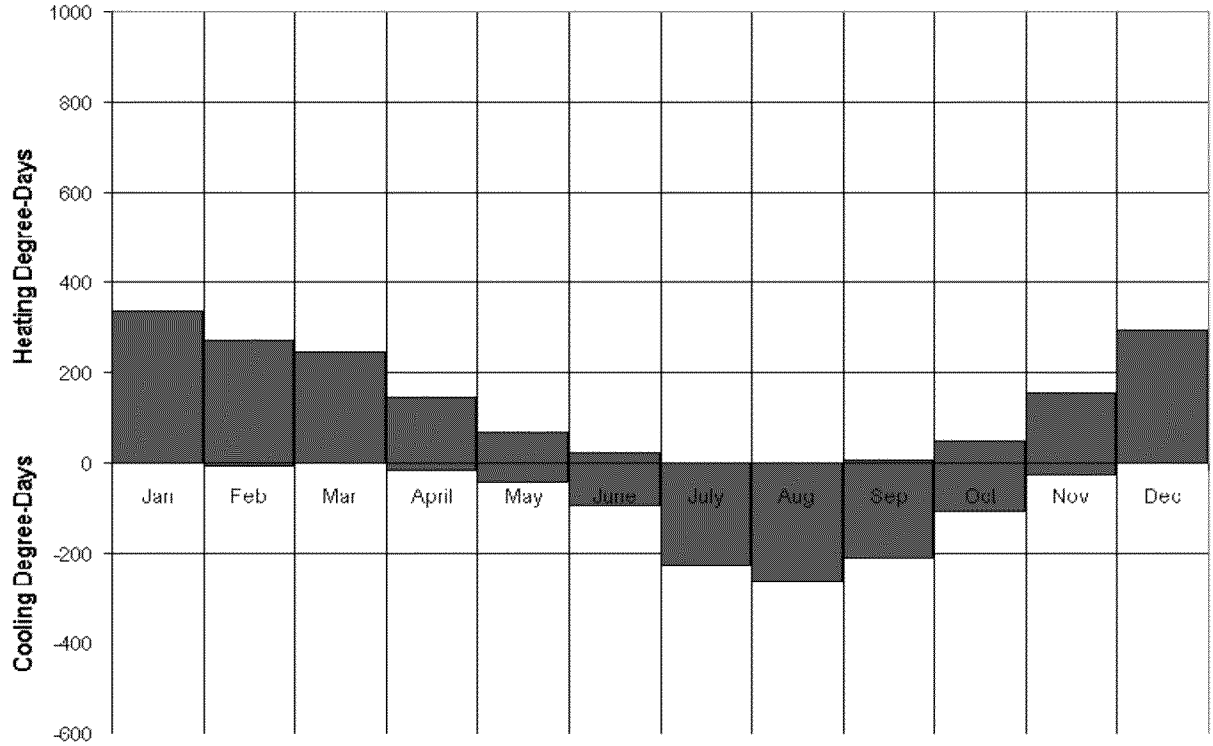


Temperature

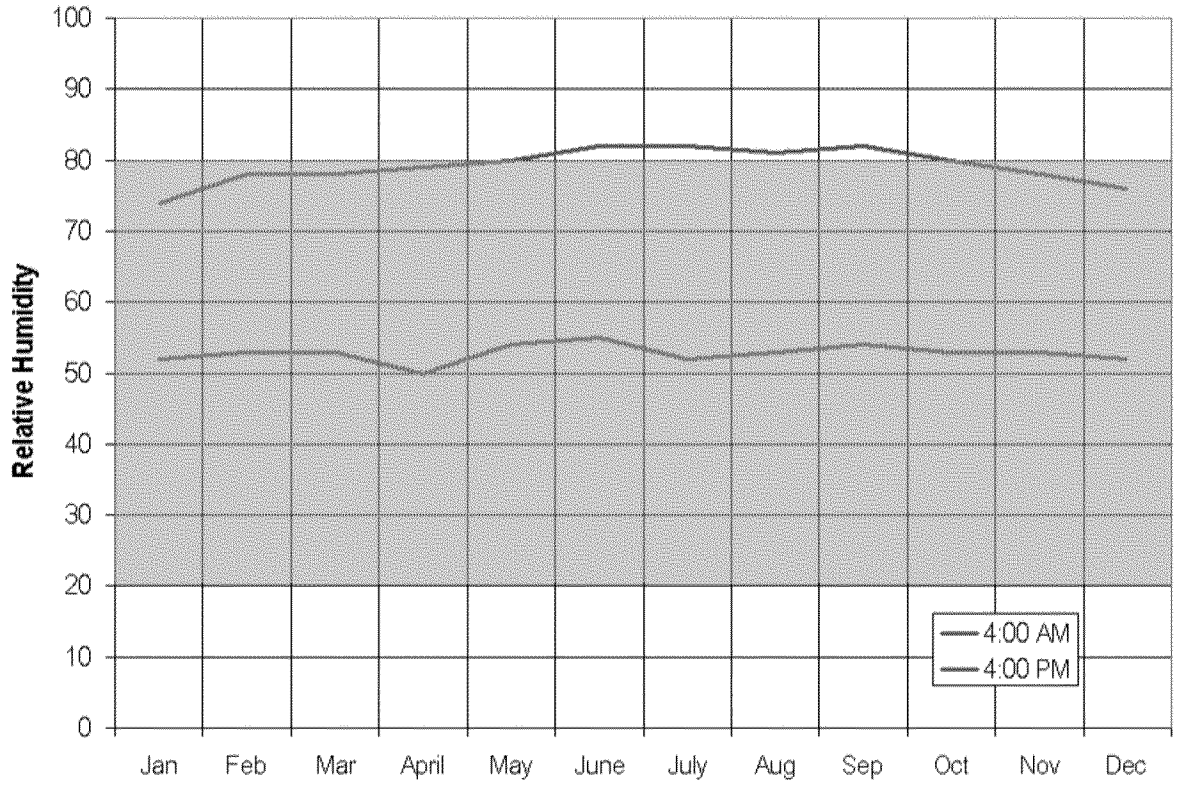
(Typical Comfort Zone: 68-80°F)



Degree Day
(Base 65°)

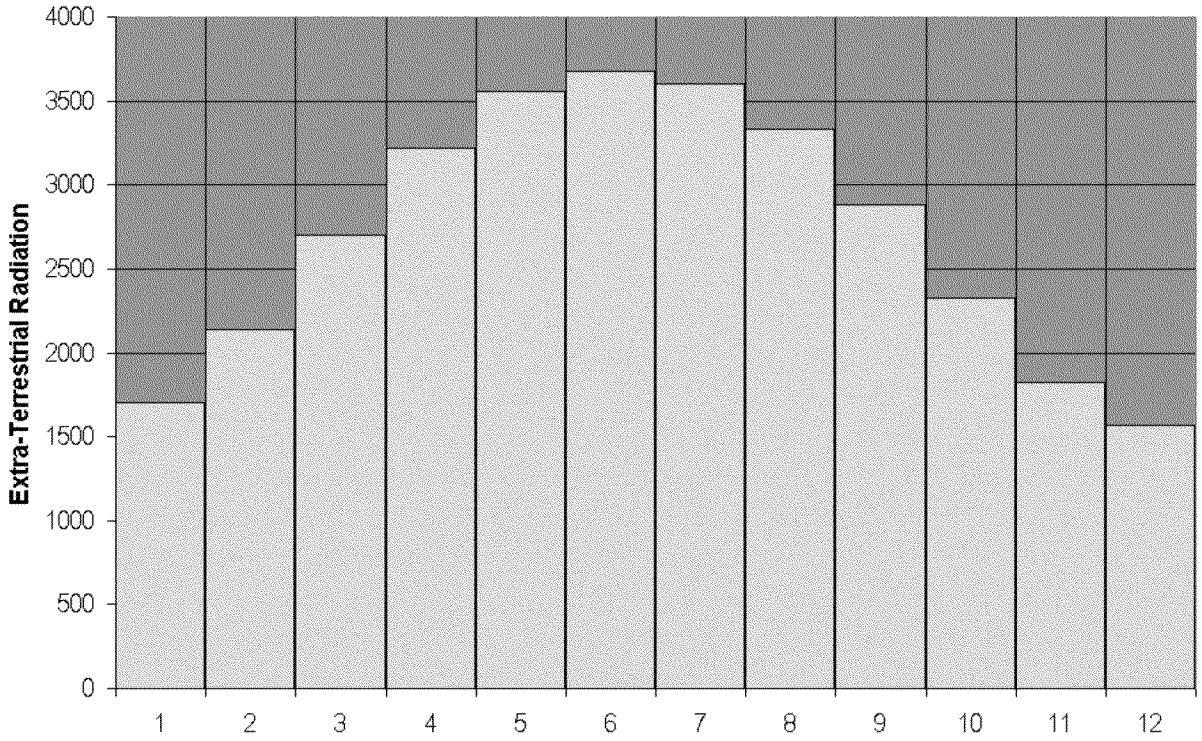


Relative Humidity
(Typical Comfort Zone: 20-80%)

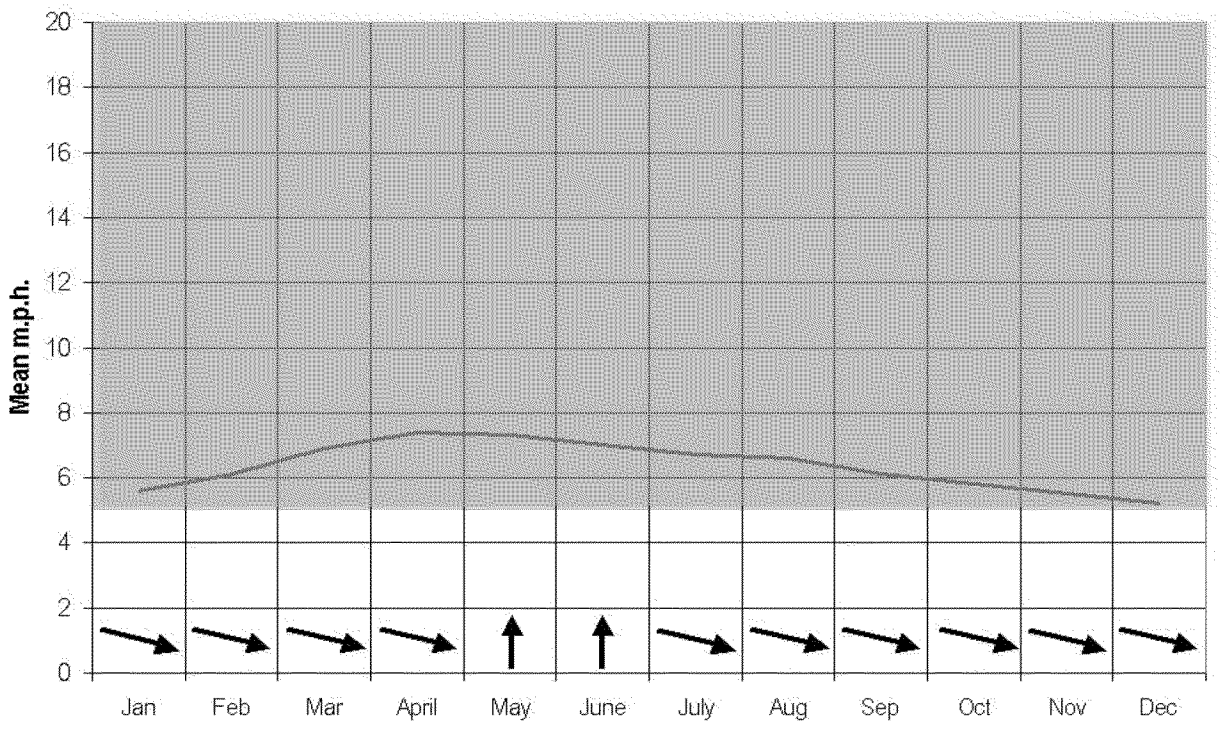


Extra-Terrestrial Radiation

Daily Mean ETR: 2712



Wind Speed



Prevailing Wind Direction

Summer: WSW
Winter: E

Natural Ventilation is most effective when wind speed is 5 mph or greater.

California Climate Zone 9

Reference City: Los Angeles (Civic Center)
Latitude: 34.05 N
Longitude: 118.23 W
Elevation: 270 ft

Basic Climate Conditions

	(F)
Summer Temperature Range	19
Record High Temperature (1955)	110
Record Low Temperature (1949)	28

Design Day Data

Winter	99%	37		
	97.5%	40		
Summer				
	1%:	93	MCWB	70
	2.5%:	89	MCWB	70

Climatic Design Priorities

Winter: Insulate
Reduce Infiltration
Passive Solar
Summer: Shade
Use Evaporative Cooling
Distribute Thermal Mass

Title 24 Requirements

Package	*C*	*D*
Ceiling Insulation	R38	R30
Wood Frame Walls	R21	R13
Glazing U-Value	0.38	0.67
Maximum Total Area	14%	20%

Bioclimatic Chart

Climate

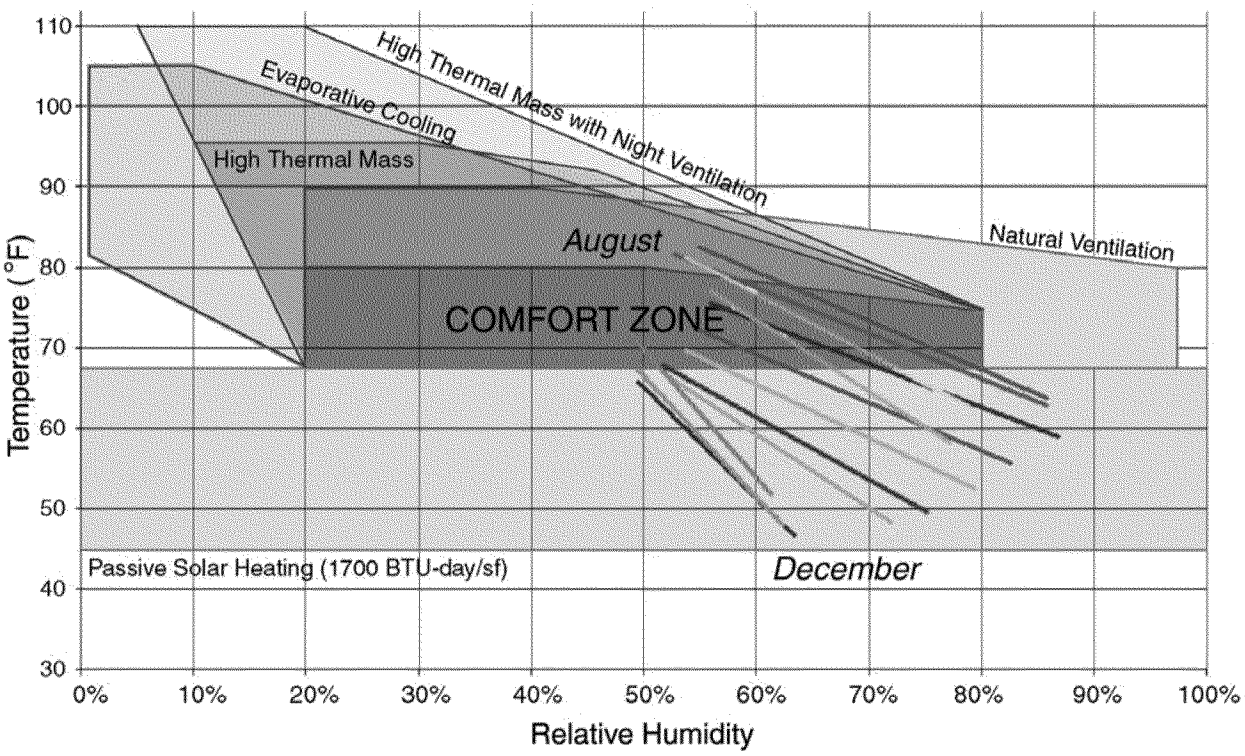
Both coastal and interior weather influences the Southern Californian inland valley climate zone. The inland winds bring hot and dry air, and marine air brings cool and moist air.

This area is famous for growing citrus because the summers are hot and winters never frost. This area has as many HDD as CDD.

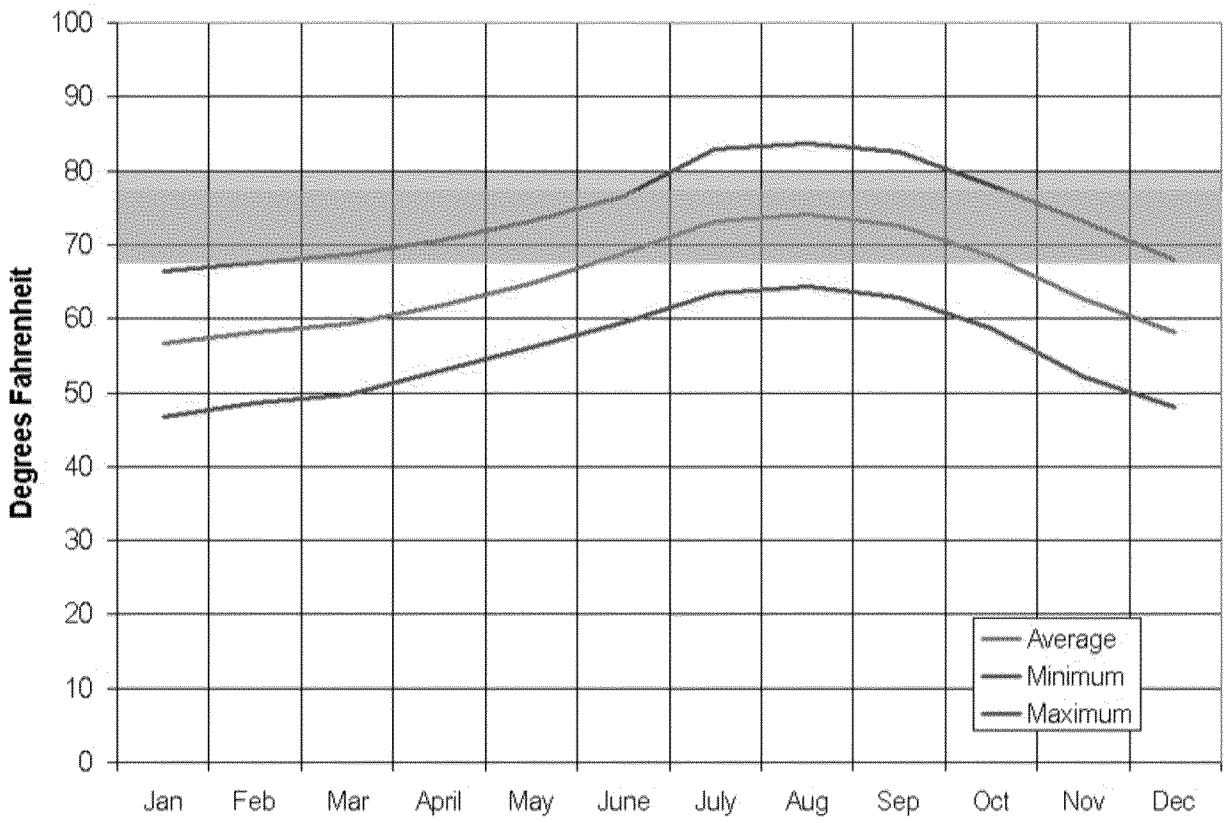
	LA Civic Center	*Pasa-dena*	*Burbank*	*Pomona*
HDD	1154	1398	1575	1713
CDD	1537	1558	1455	1273

HDD = Heating Degree Days (base 65F)
CDD = Cooling Degree Days

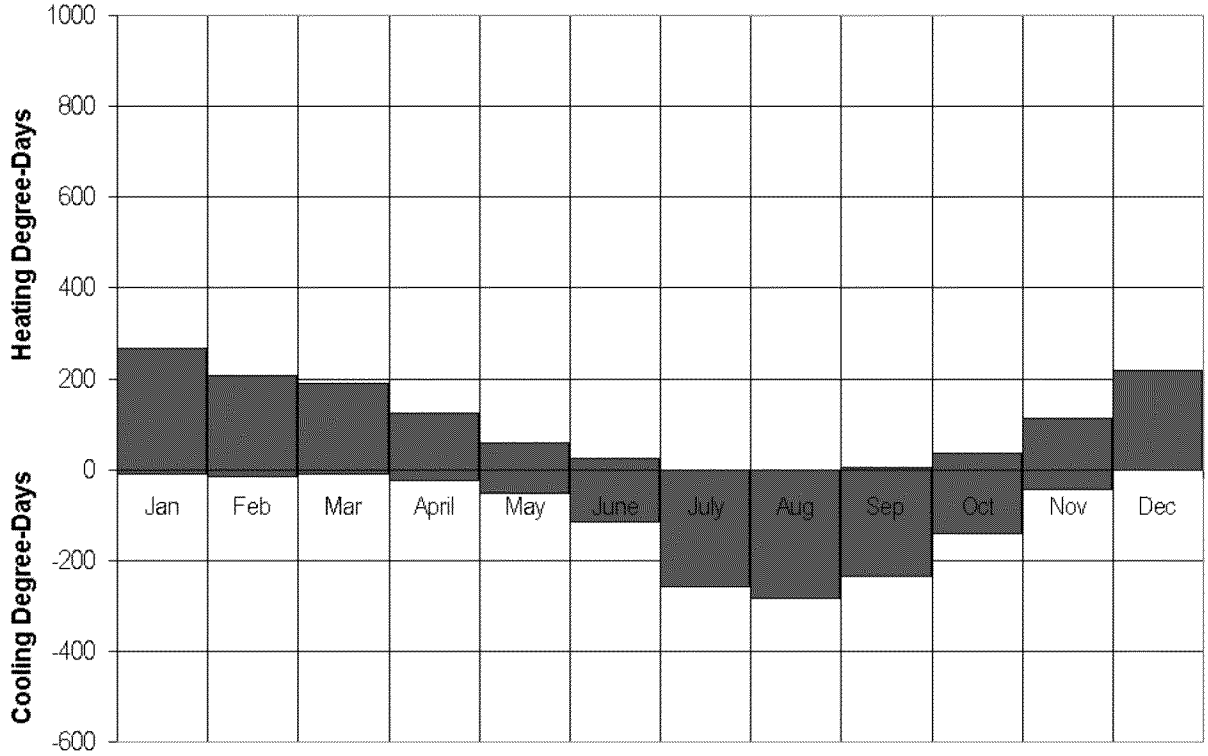
Compared to the coast, summers are warmer and winters are cooler. Rain falls in the winter averaging around 2" per month between November and April. More than 50% of the time skies are clear or partly cloudy.



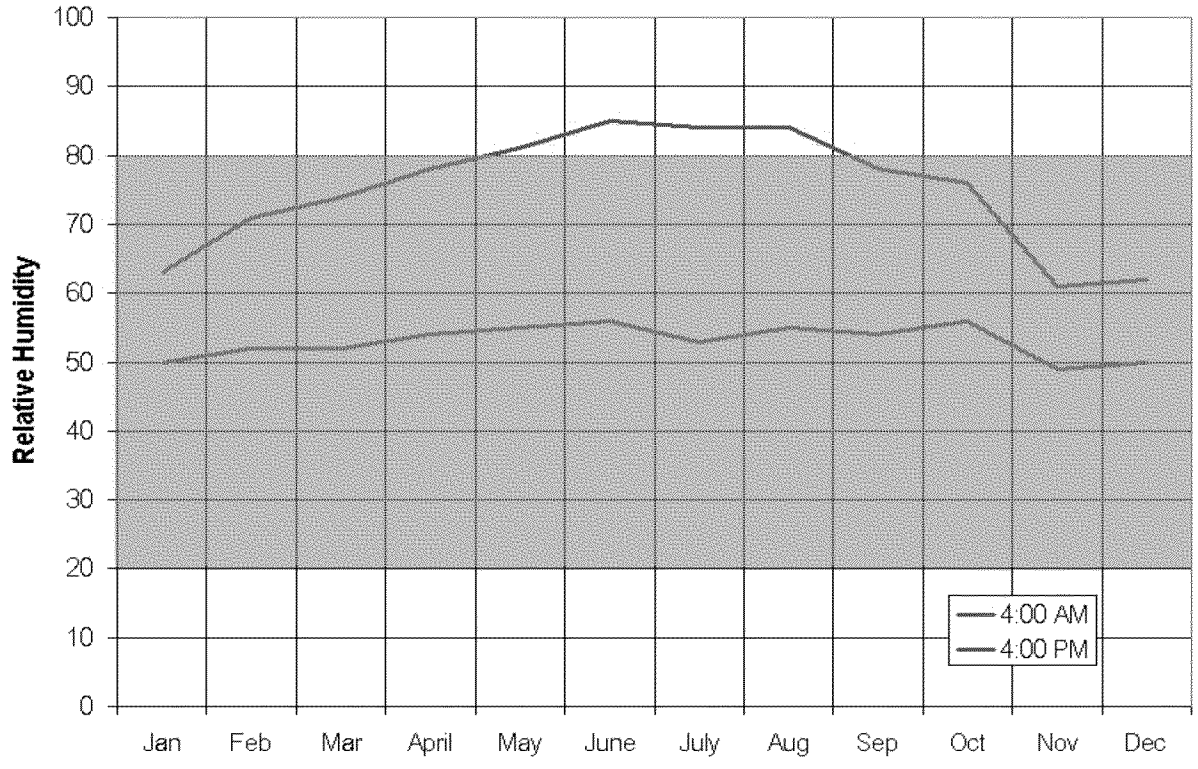
Temperature
(Typical Comfort Zone: 68-80°F)



Degree Day
(Base 65°)

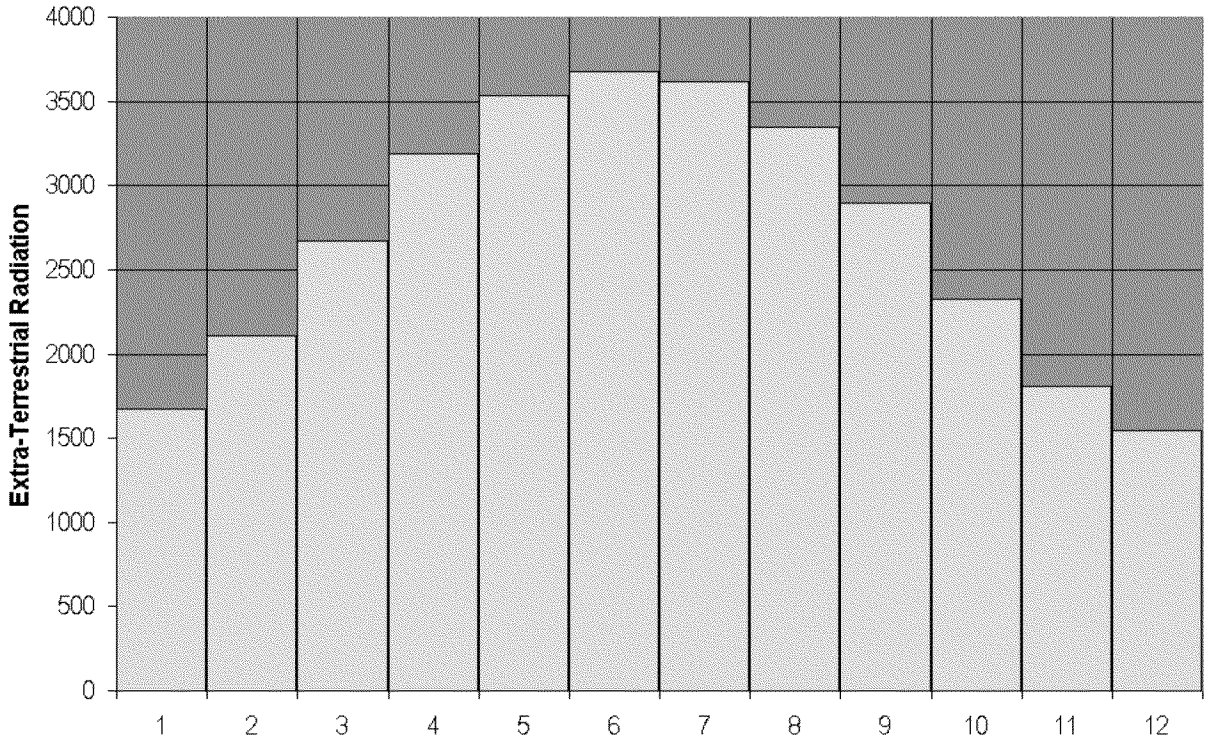


Relative Humidity
(Typical Comfort Zone: 20-80%)

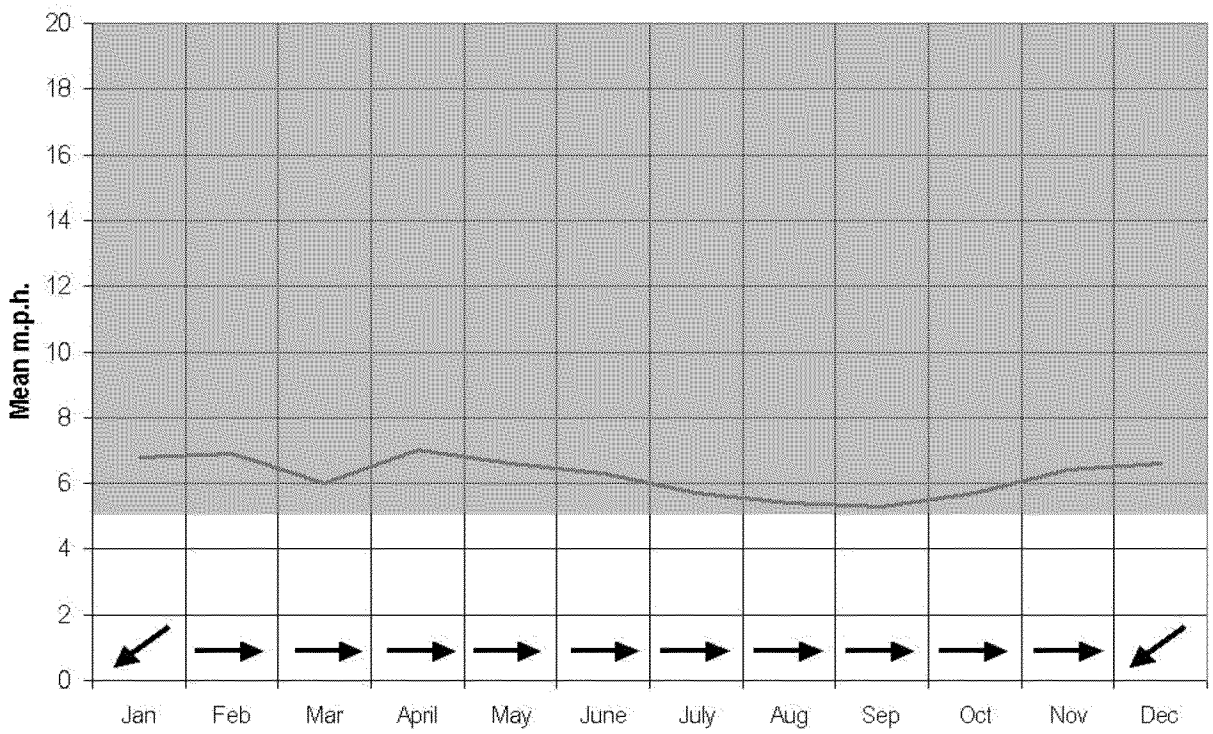


Extra-Terrestrial Radiation

Daily Mean ETR: 2699



Wind Speed



Prevailing Wind Direction

Summer: NW
Winter: NW

Natural Ventilation is most effective when wind speed is 5 mph or greater.

California Climate

Zone 10

Reference City: Riverside
Latitude: 33.95 N
Longitude: 117.38 W
Elevation: 840 ft

Basic Climate Conditions

	(F)
Summer Temperature Range	32
Record High Temperature (1934)	116
Record Low Temperature (1950)	19

Design Day Data

Winter	99%	29		
	97.5%	32		
Summer				
	1%:	100	MCWB	68
	2.5%:	98	MCWB	68

Climatic Design Priorities

Winter: Insulate
Reduce Infiltration
Passive Solar
Summer: Shade
Allow natural ventilation
Distribute Thermal Mass

Title 24 Requirements

Package	*C*	*D*
Ceiling Insulation	R49	R30
Wood Frame Walls	R25	R13
Glazing U-Value	0.38	0.57
Maximum Total Area	16%	20%

Climate

The Southern California interior valleys are hilly and effected by thermal belts. Hilltops and valleys get more cold in the winter (with the possibility of frost) and warmer in the summer than the slopes and hillsides from which cold air drains.

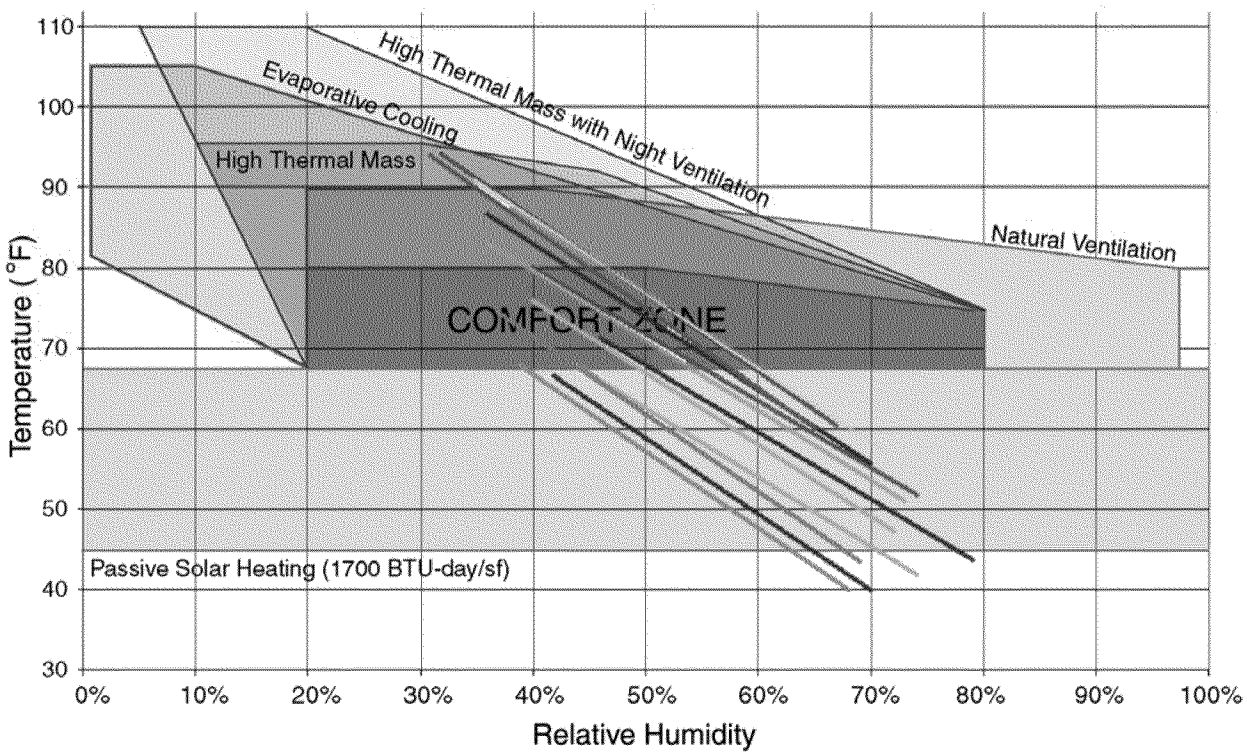
This climate is little influenced by the ocean. The days are quite sunny with most of the rain falling in the winter.

	Red-lands	*El Cajon*	*River-side*	*San Berna-dino*
HDD	1904	1560	1678	1599
CDD	1714	1371	1456	1937

HDD = Heating Degree Days (base 65F)
CDD = Cooling Degree Days

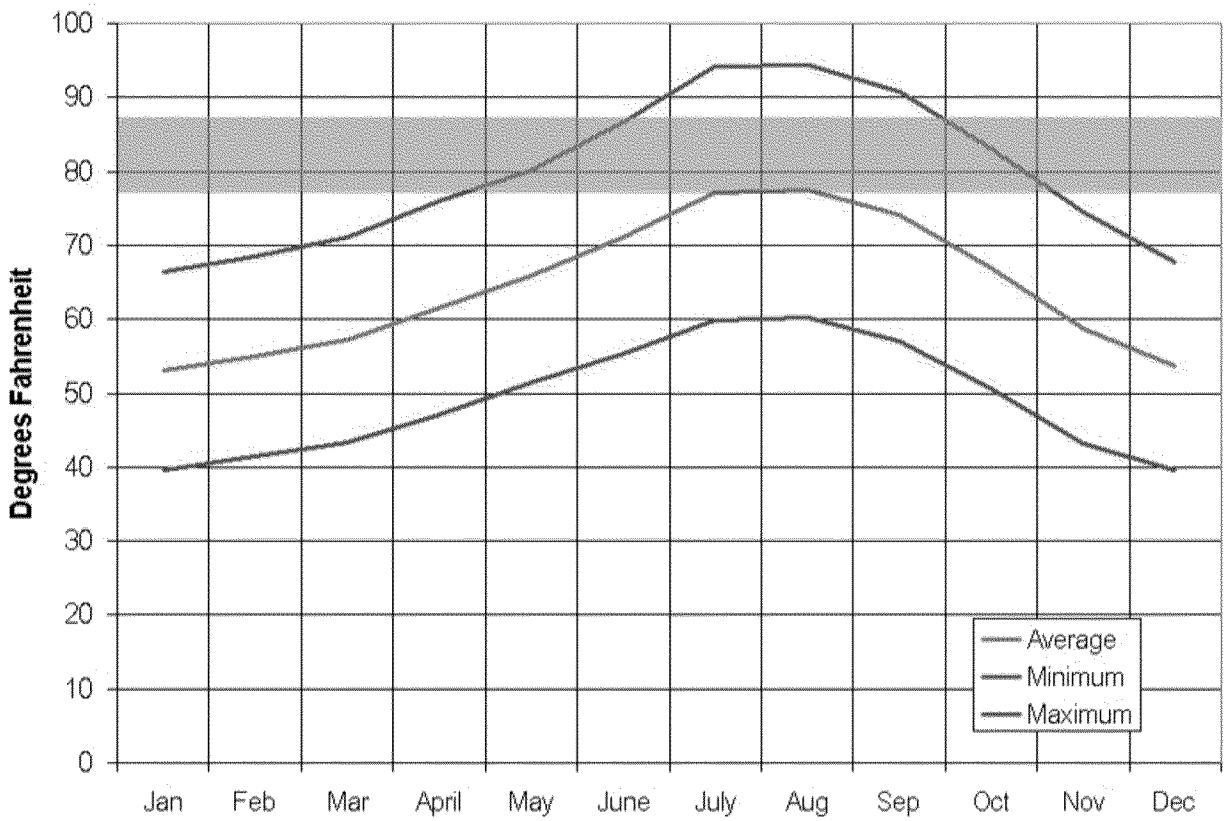
The temperature swing over the year is more extreme, with hotter summers and colder winters than the coastal climates to its west. Cooling and heating is necessary to maintain thermal comfort.

Bioclimatic Chart

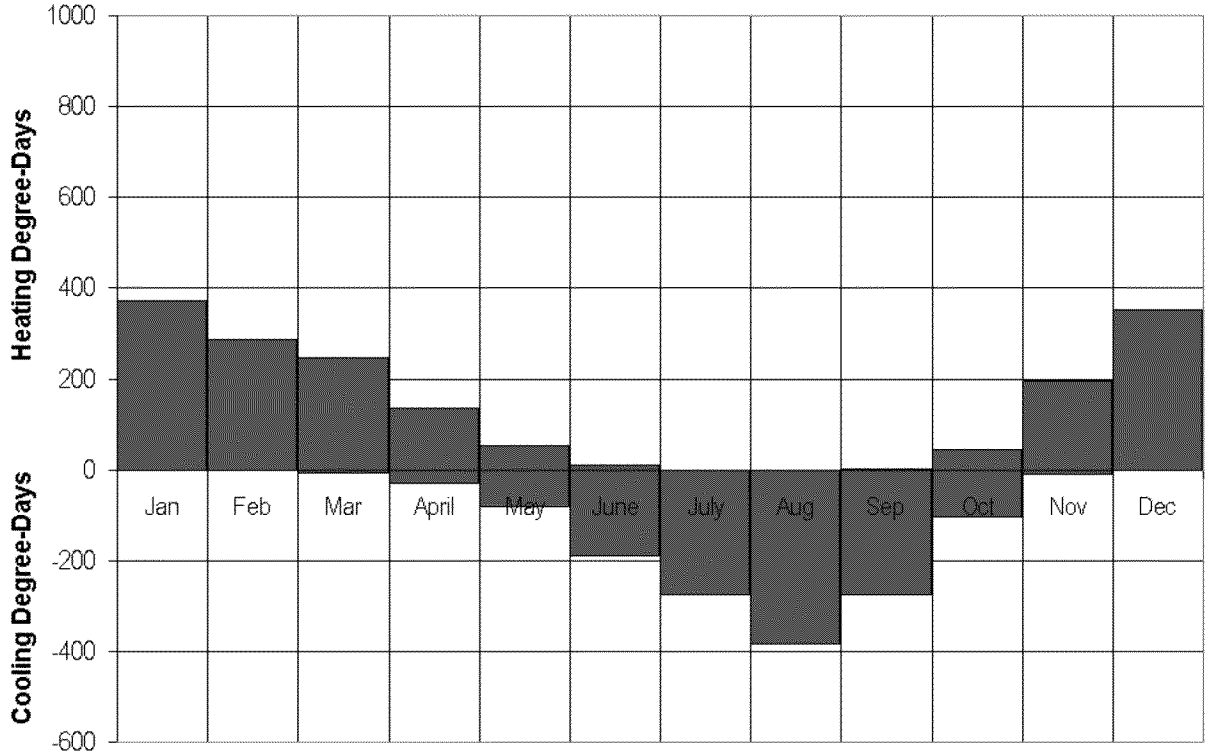


Temperature

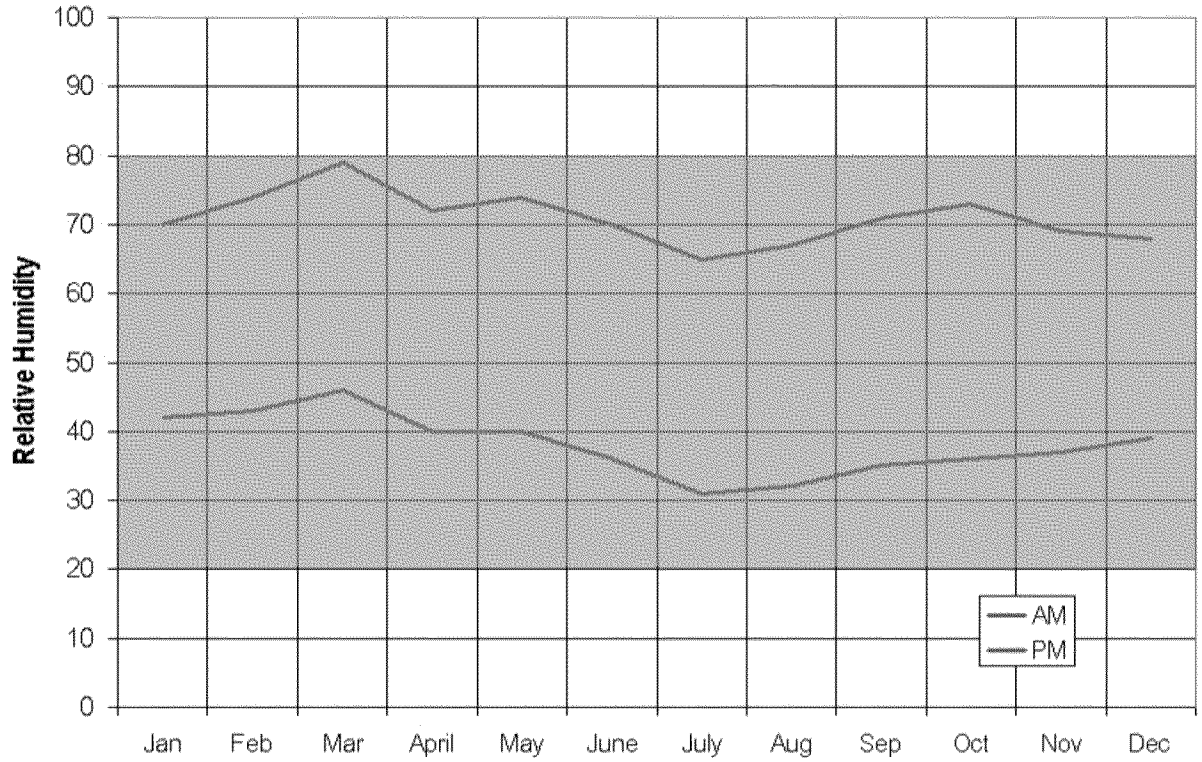
(Typical Comfort Zone: 68-80°F)



Degree Day
(Base 65°)

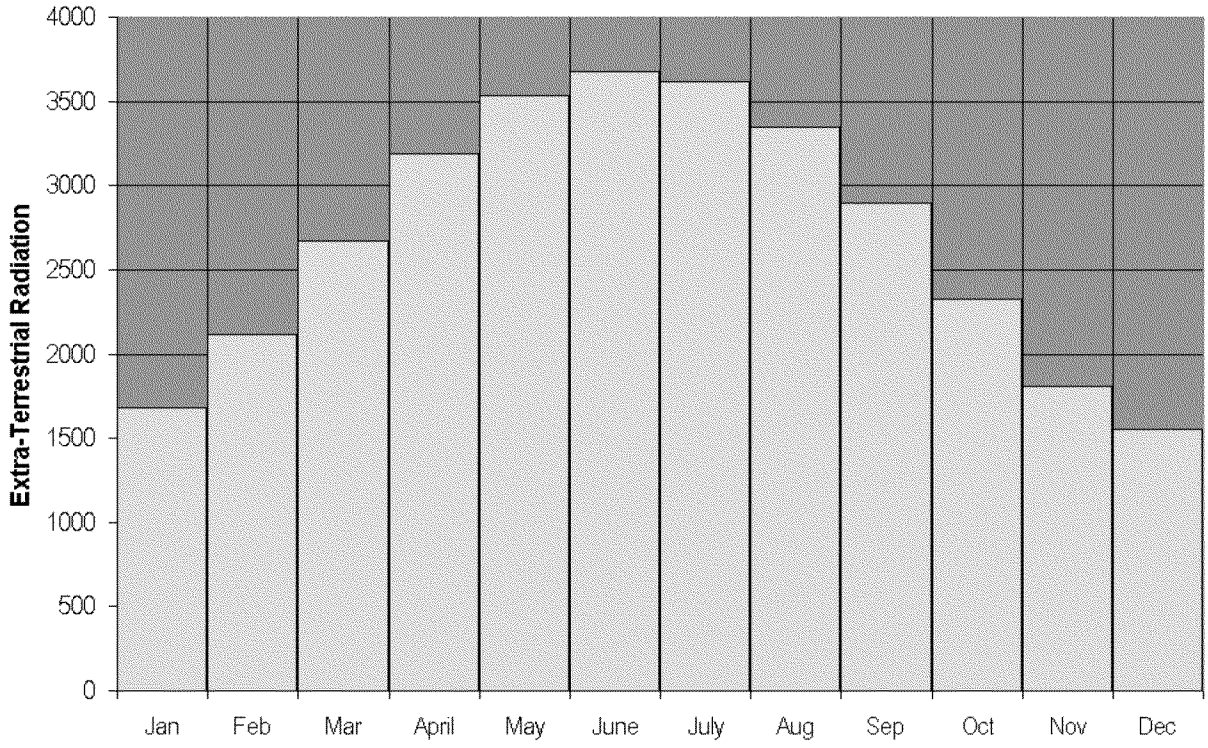


Relative Humidity
(Typical Comfort Zone: 20-80%)

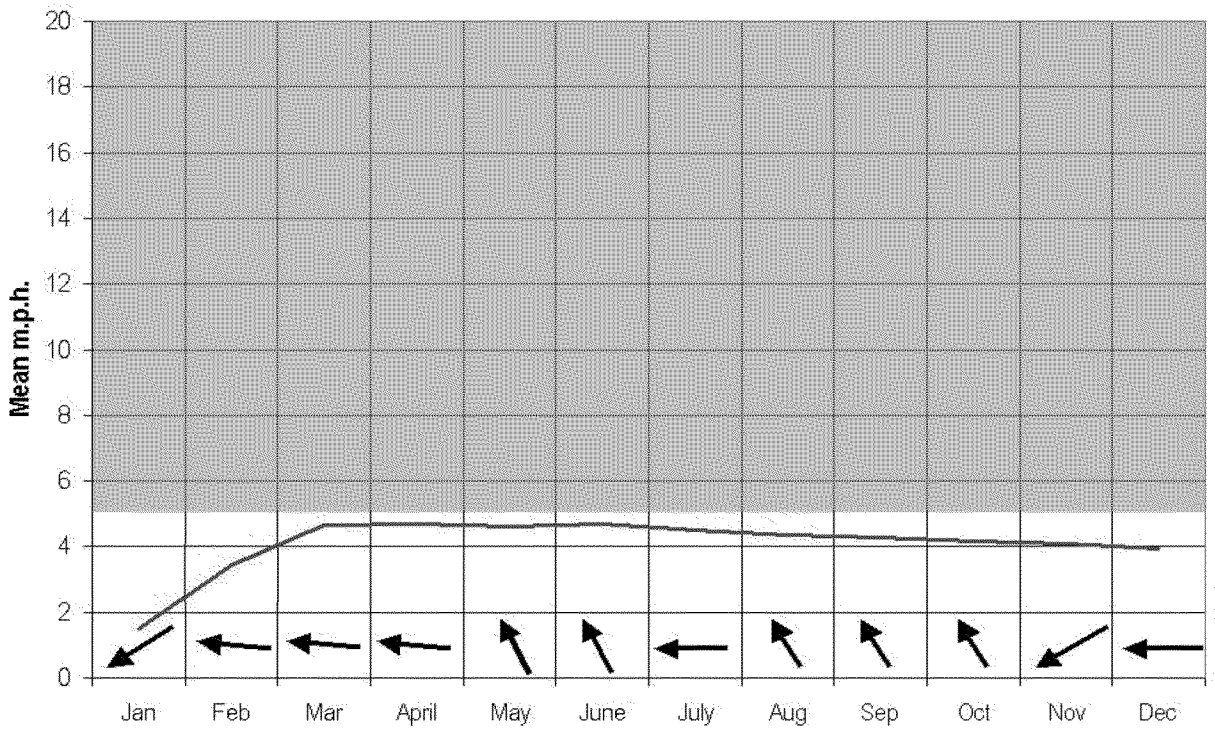


Extra-Terrestrial Radiation

Daily Mean ETR: 2701



Wind Speed



Prevailing Wind Direction

Summer: SE
Winter: E

Natural Ventilation is most effective when wind speed is 5 mph or greater.

California Climate Zone 11

Reference City: Red Bluff
Latitude: 40.09 N
Longitude: 122.15 W
Elevation: 342 ft

Basic Climate Conditions

	(F)
Summer Temperature Range	32
Record High Temperature (1978)	119
Record Low Temperature (1975)	20

Design Day Data

Winter	99%	29		
	97.5%	31		
Summer				
	1%:	105	MCWB	68
	2.5%:	102	MCWB	67

Climatic Design Priorities

Winter: Insulate
Reduce Infiltration
Passive Solar
Summer: Shade
Use Evaporative Cooling
Use High Thermal Mass with Night Ventilation

Title 24 Requirements

Package	*C*	*D*
Ceiling Insulation	R49	R38
Wood Frame Walls	R29	R19
Glazing U-Value	0.38	0.57
Maximum Total Area	16%	20%

Climate

Climate Zone 11 is the northern California valley, south of the mountainous Shasta Region, east of the Coastal Range, and west of the Sierra Cascades.

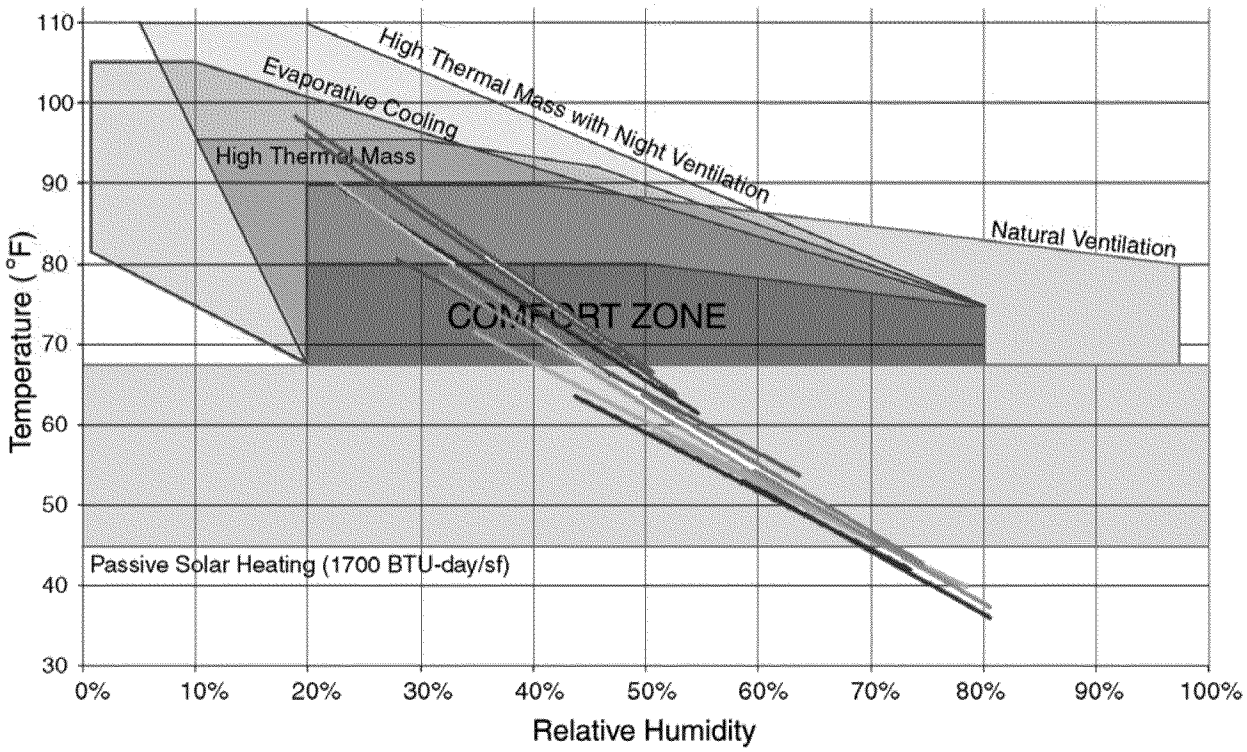
Seasons are sharply defined. Summer daytime temperatures are high, sunshine is almost constant, and the air dry. Winters are very cold with piercing north winds, possibility of snow and thick Tule fog. Cold air rolls off the hillsides on winter nights and pools in the colder flatlands. Quite a bit of rain falls between October and March, as much as 4.75" per month.

	Red Bluff	*Auburn*	*Grass Valley*	*Marys-ville*
HDD	2688	3095	4287	2524
CDD	1904	1292	612	1607

HDD = Heating Degree Days (base 65F)
CDD = Cooling Degree Days

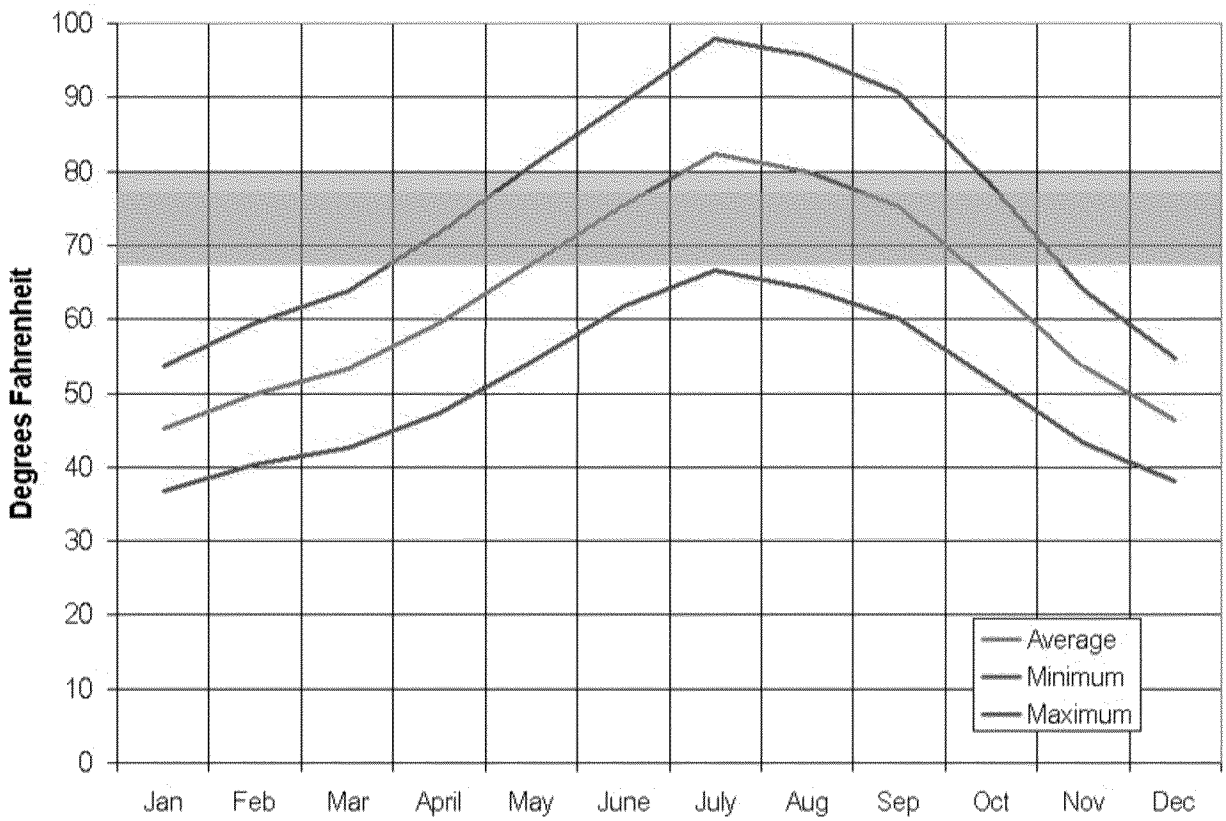
Because there is extreme weather, cooling and heating is necessary. Climate Zone 11 consumes a lot of energy consumption to meet comfort standards.

Bioclimatic Chart

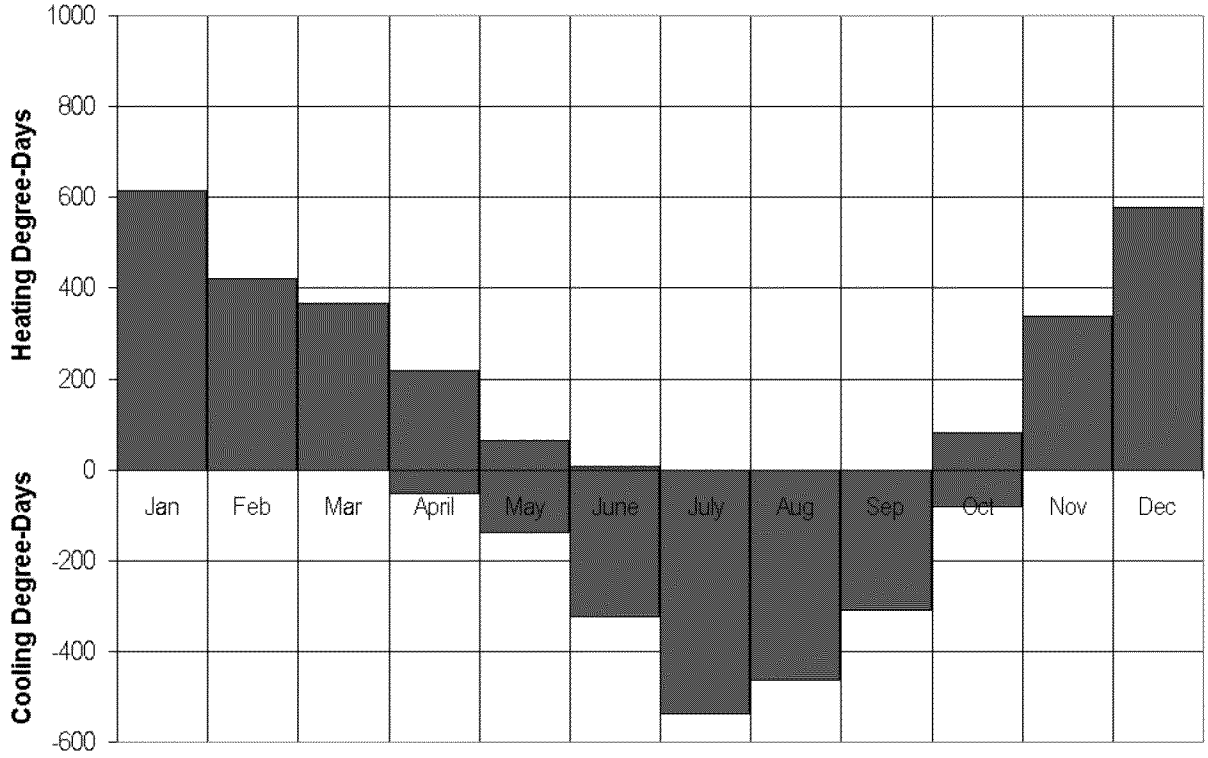


Temperature

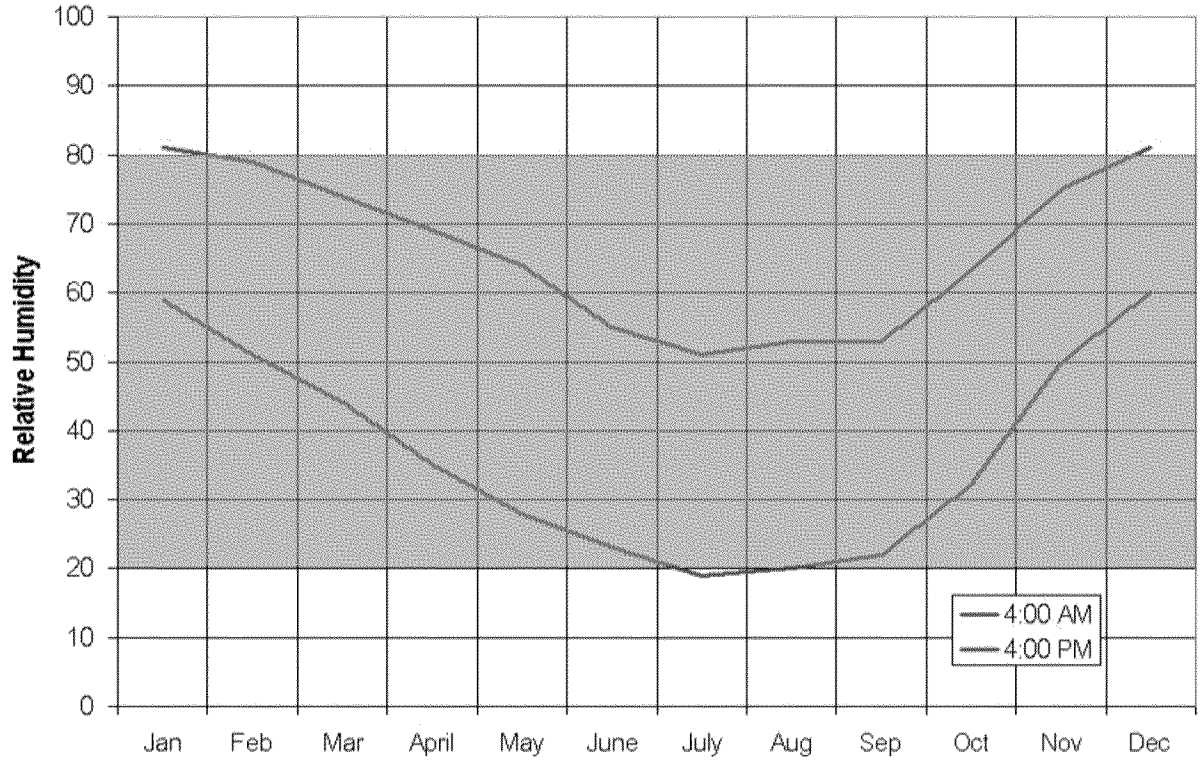
(Typical Comfort Zone: 68-80°F)



Degree Day
(Base 65°)

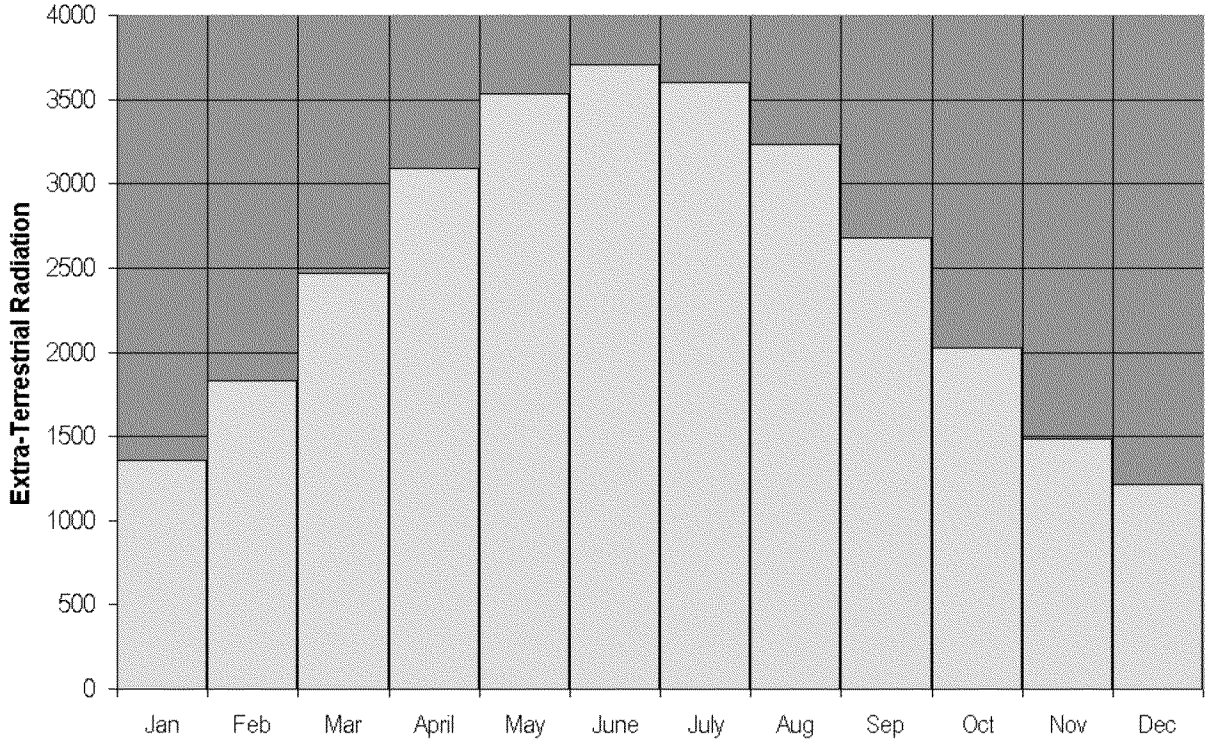


Relative Humidity
(Typical Comfort Zone: 20-80%)

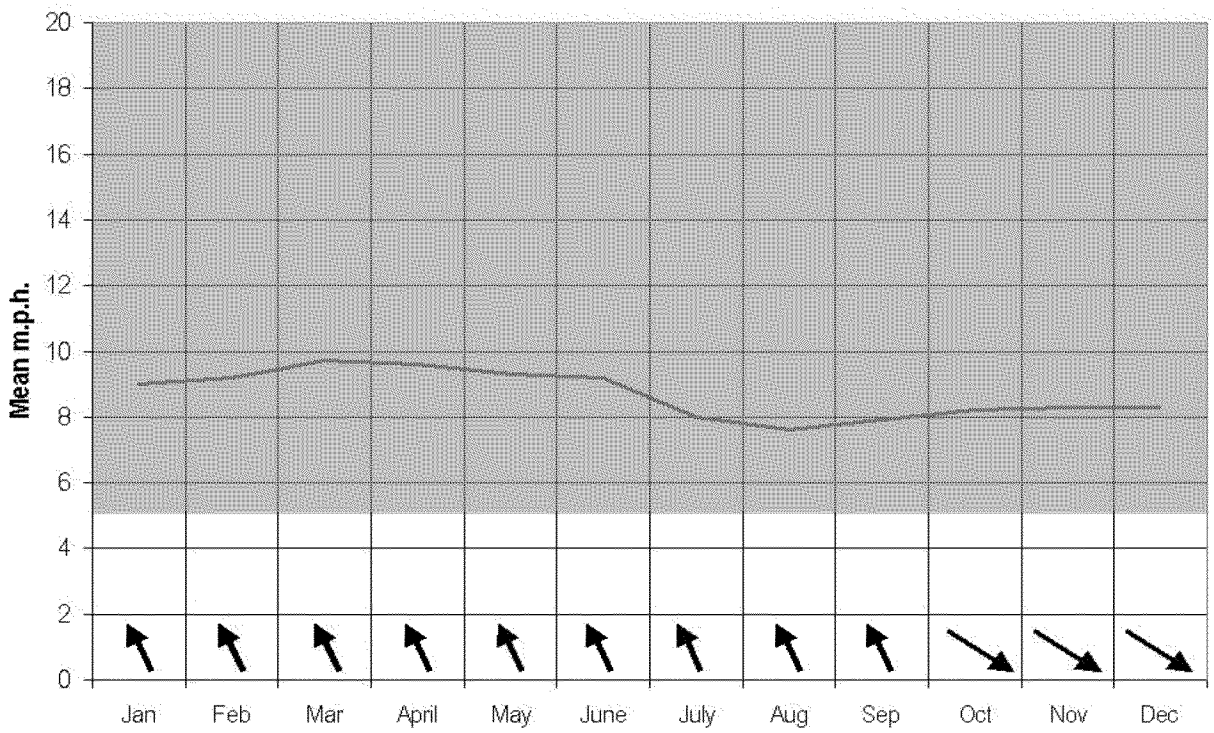


Extra-Terrestrial Radiation

Daily Mean ETR: 2519



Wind Speed



Prevailing Wind Direction
Summer: SSE
Winter: NW

Natural Ventilation is most effective when wind speed is 5 mph or greater.

California Climate

Zone 12

Reference City: Stockton
Latitude: 37.54 N
Longitude: 121.15 W
Elevation: 22 ft

Basic Climate Conditions

	(F)
Summer Temperature Range	35
Record High Temperature (1972)	114
Record Low Temperature (1963)	19

Design Day Data

Winter	99%	28		
	97.5%	30		
Summer				
	1%:	100	MCWB	69
	2.5%:	97	MCWB	68

Climatic Design Priorities

Winter: Insulate
Reduce Infiltration
Passive Solar
Summer: Shade
Use Evaporative Cooling
Use High Thermal Mass with Night ventilation

Title 24 Requirements

Package	*C*	*D*
Ceiling Insulation	R49	R38
Wood Frame Walls	R29	R19
Glazing U-Value	0.38	0.57
Maximum Total Area	16%	20%

Climate

This part of the Northern California Central Valley is situated just inland of the Bay Area. Parts of Contra Costa County east of the Caldecott Tunnel are also part of Zone 12.

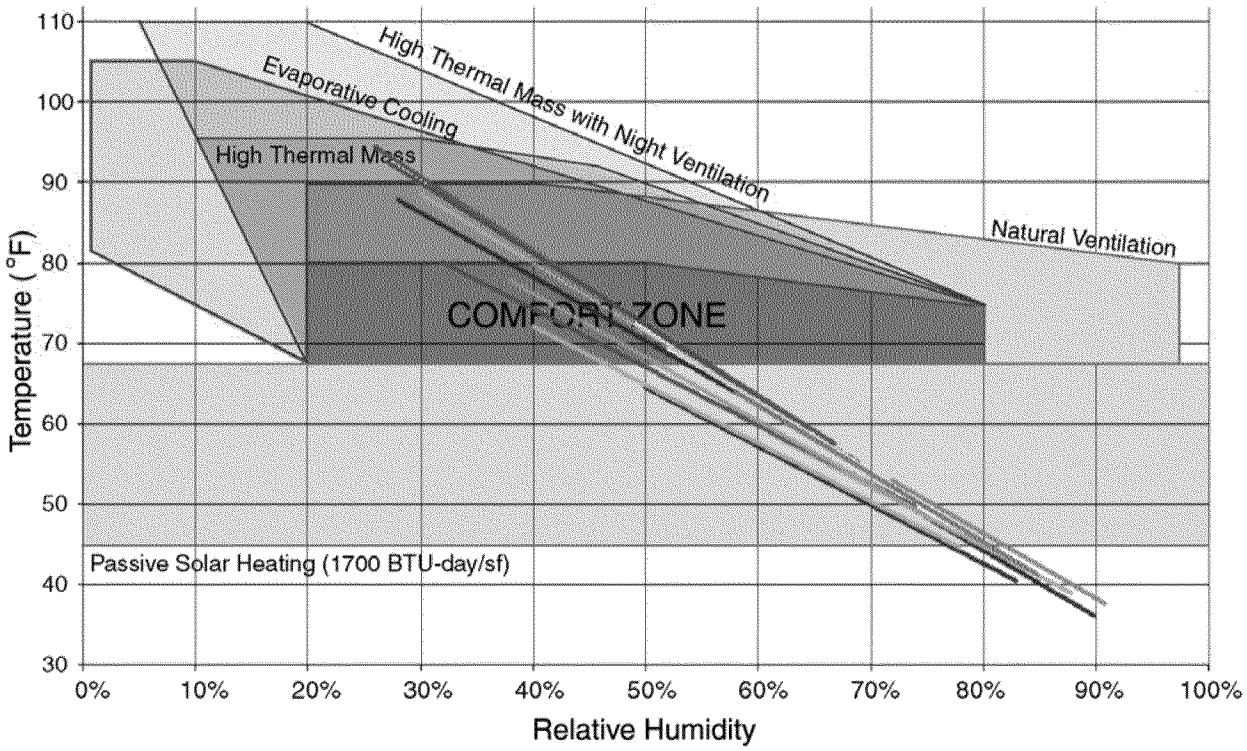
This climate zone experiences cooler winters and hotter summers than Climate Zone 3 (Bay Area). Winter rains fall from November to April. Tule fog is common in the winter east of Mount Diablo. Some lower areas receive frost on winter nights.

	Stockton	*Merced*	*Concord*	*Lafayette*
HDD	2702	2430	2751	2602
CDD	1470	995	860	1578

HDD = Heating Degree Days (base 65F)
CDD = Cooling Degree Days

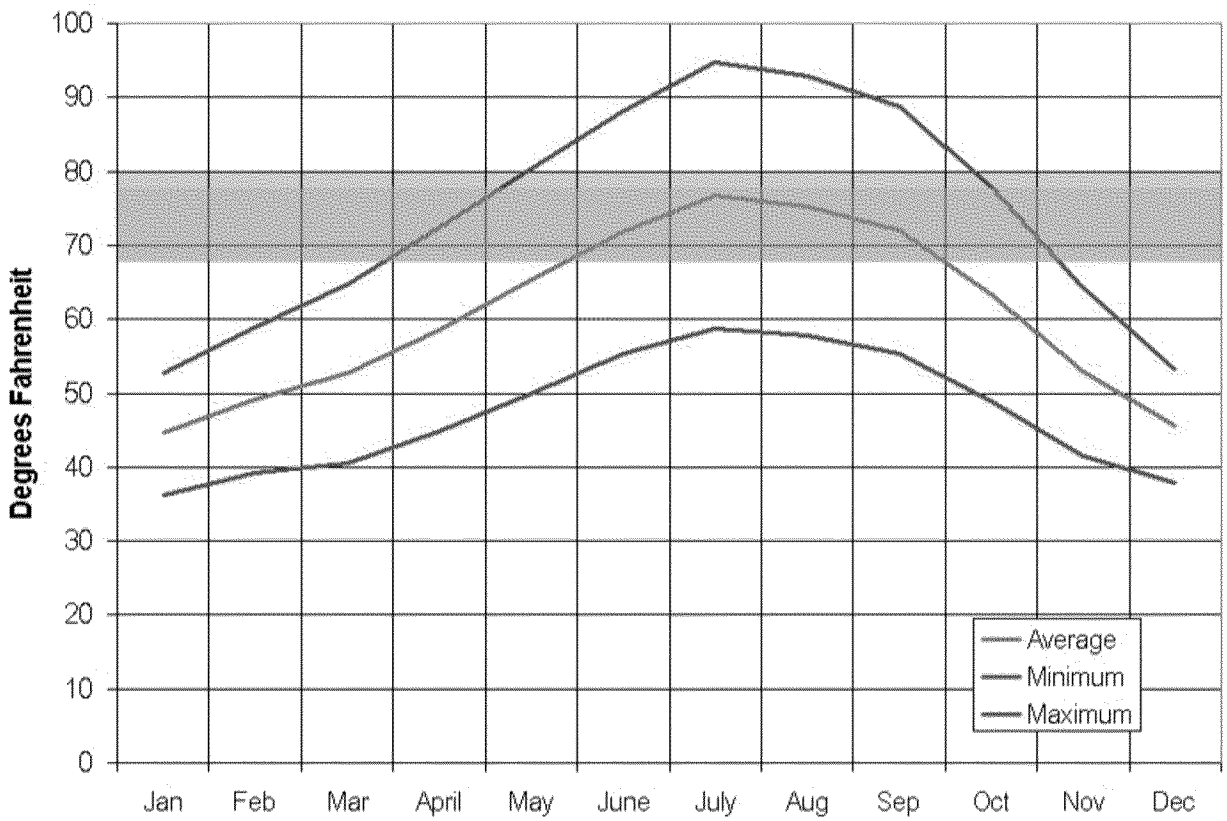
There are more HDD to design for than CDD. High temperatures are usually over 100F. While the marine air may influence temperatures in the areas closest to the Bay Area, the ocean influence is negligible on the hottest days when blinds blow off shore.

Bioclimatic Chart

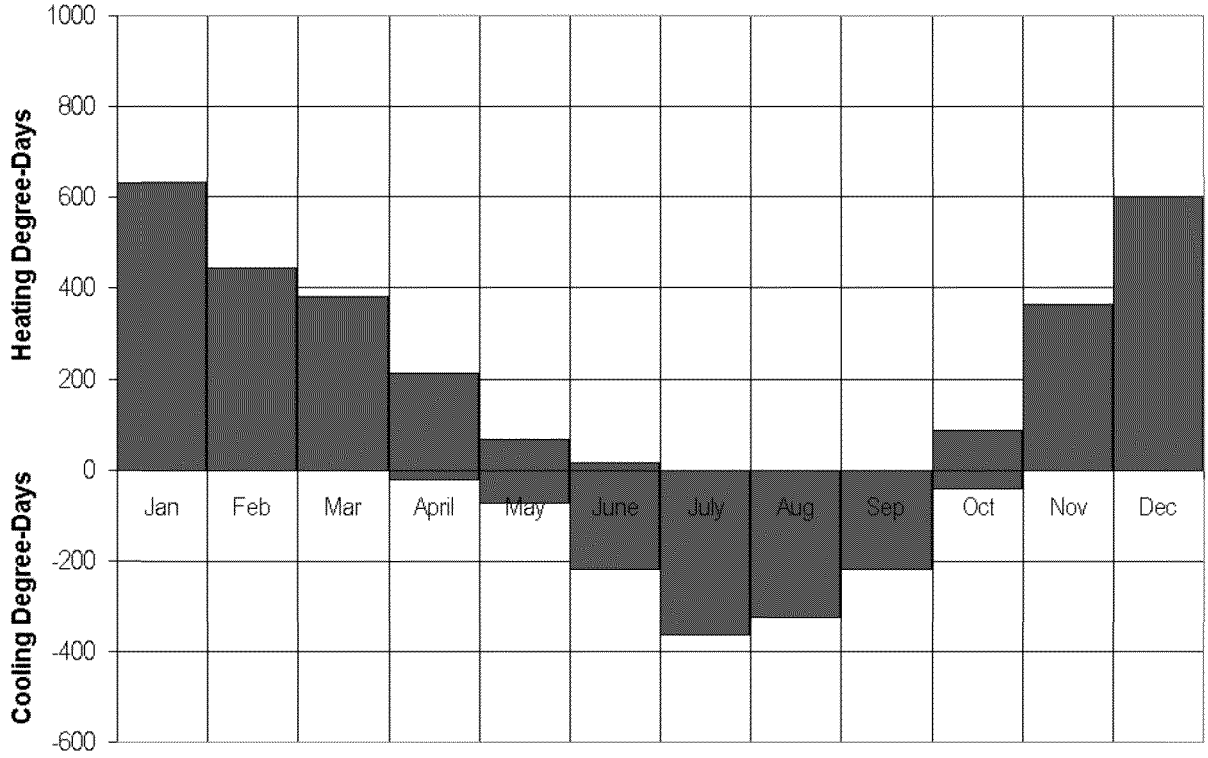


Temperature

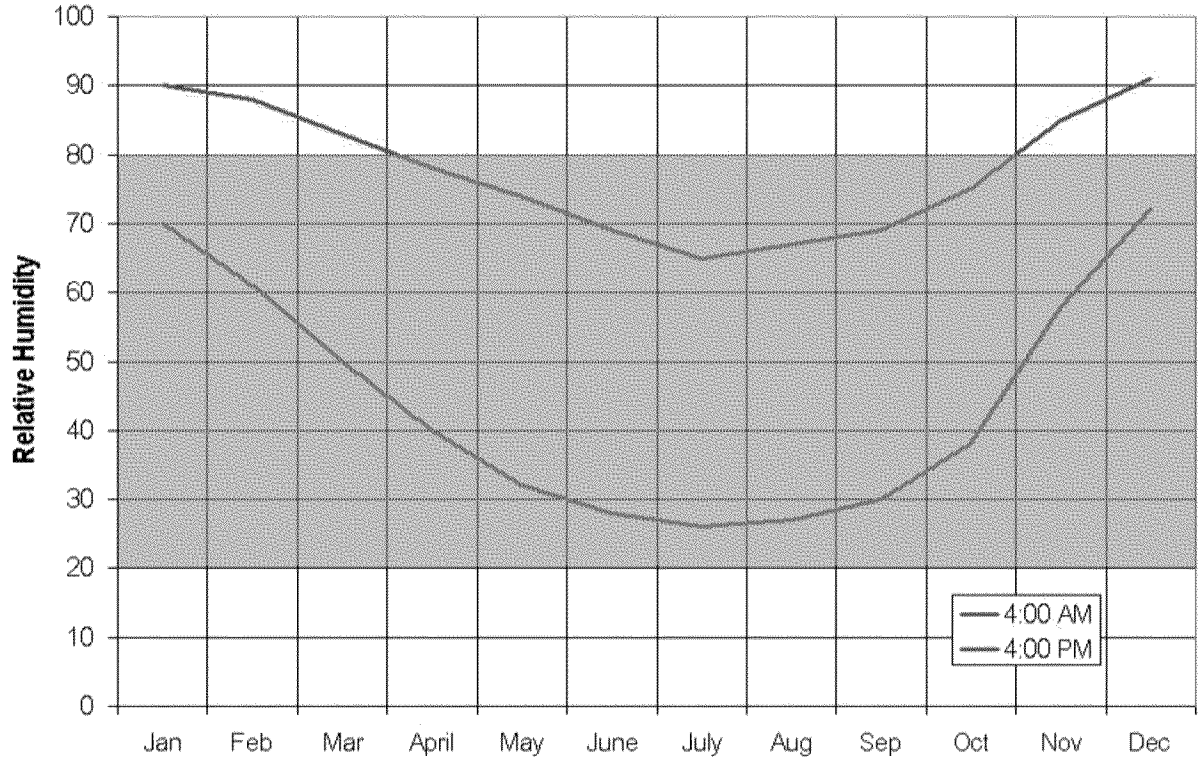
(Typical Comfort Zone: 68-80°F)



Degree Day
(Base 65°)

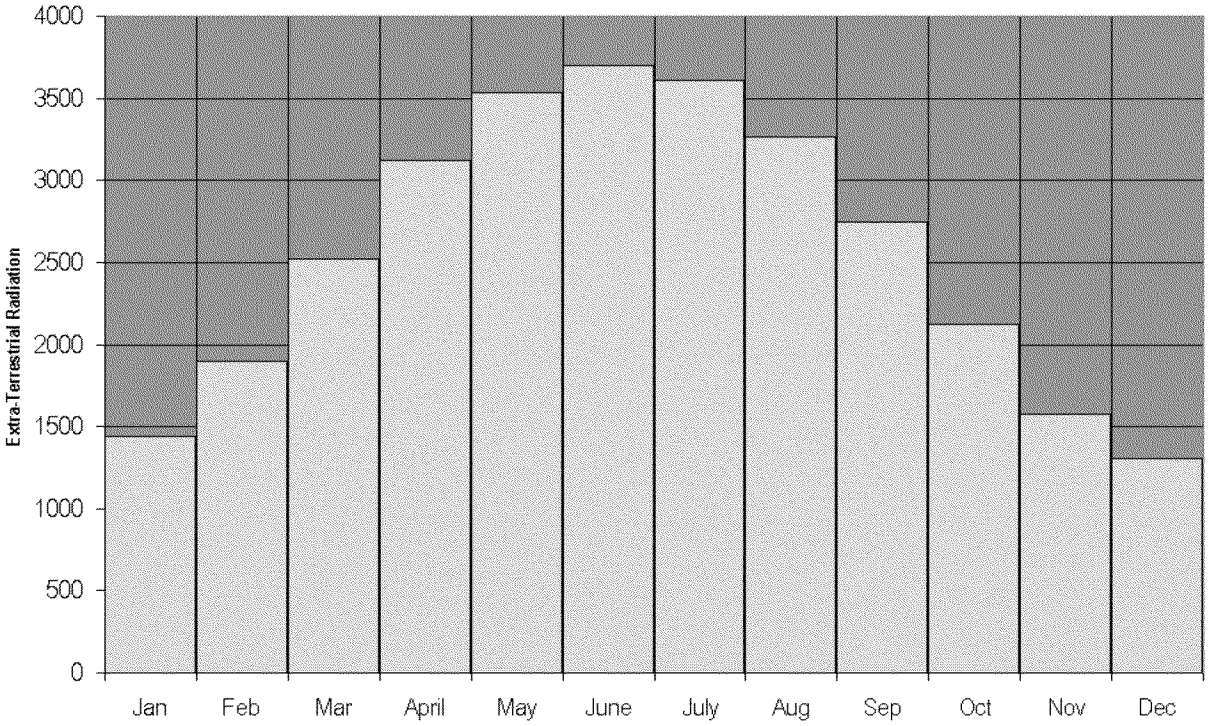


Relative Humidity
(Typical Comfort Zone: 20-80%)

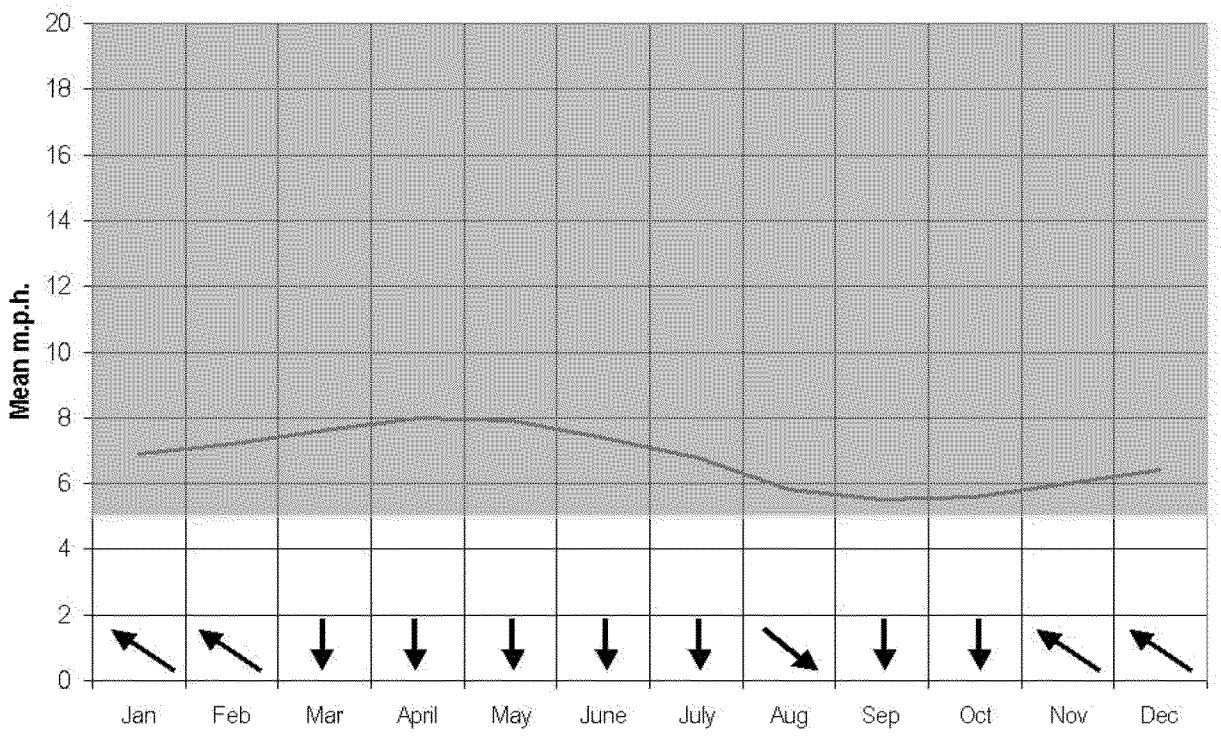


Extra-Terrestrial Radiation

Daily Mean ETR: 2570



Wind Speed



Prevailing Wind Direction

Summer: NW
Winter: WNW

Natural Ventilation is most effective when wind speed is 5 mph or greater.

California Climate

Zone 13

Reference City: Fresno
Latitude: 36.46 N
Longitude: 119.43 W
Elevation: 328 ft

Basic Climate Conditions

	(F)
Summer Temperature Range	34
Record High Temperature (1980)	111
Record Low Temperature (1963)	19

Design Day Data

Winter	99%	28		
	97.5%	30		
Summer				
	1%:	102	MCWB	70
	2.5%:	100	MCWB	69

Climatic Design Priorities

Winter: Insulate
Reduce Infiltration
Passive Solar
Summer: Shade
Use Evaporative Cooling
Use High Thermal Mass with Night ventilation

Title 24 Requirements

Package	*C*	*D*
Ceiling Insulation	R49	R38
Wood Frame Walls	R29	R19
Glazing U-Value	0.38	0.57
Maximum Total Area	16%	20%

Climate

California's Central Valley in this southern location is an ideal place to farm citrus trees. Summer daytime temperatures are high, sunshine is almost constant during growing season, and growing season is long.

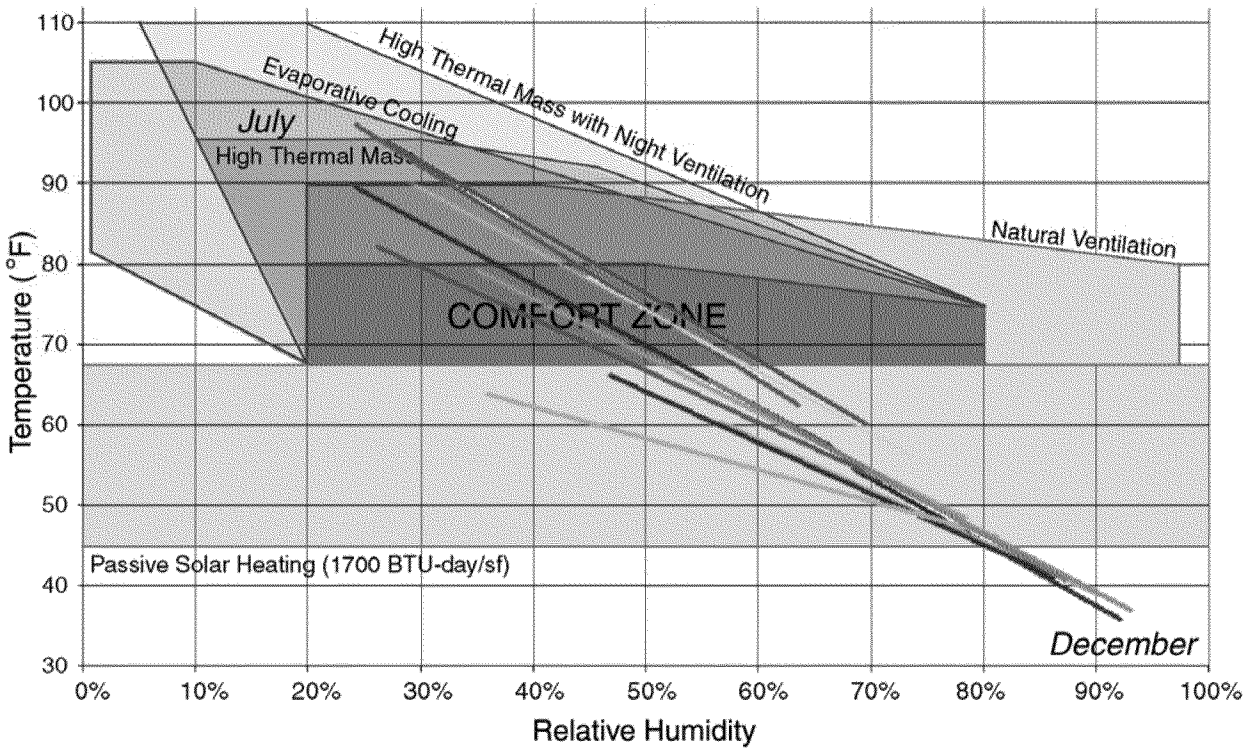
Summer humidity is higher here, than in other parts of the Central Valley, making cooling energy consumption higher in comparison. Winter rains fall between November and April on average 1.5"(+) per month. The winter cold can be quite intense, and piercing north winds can blow for several days at a time in the winter. Tule fog (extremely thick low fog) blankets the region for days in the winter.

	Fresno	*Bakers -field*	*Visalia*	*Porter- ville*
HDD	2702	2430	2588	2053
CDD	1470	995	1685	2246

HDD = Heating Degree Days (base 65F)
CDD = Cooling Degree Days

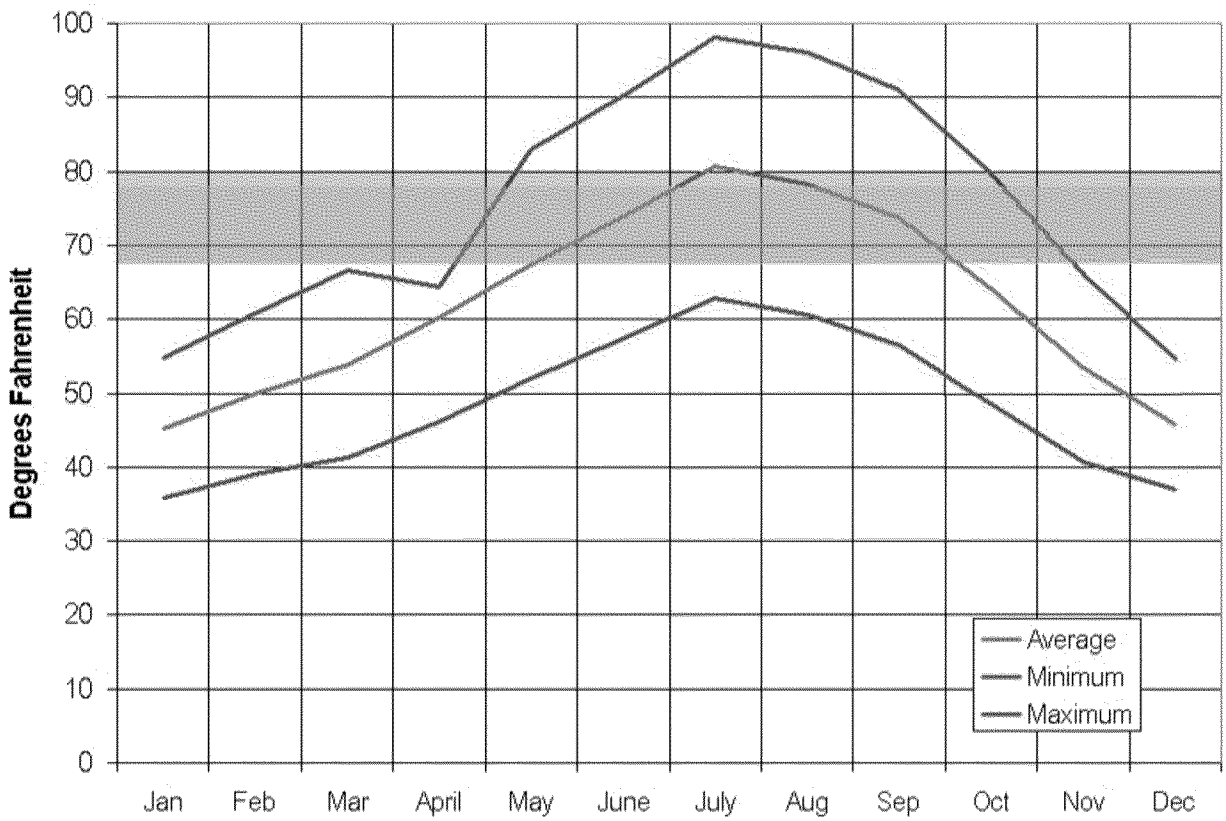
There are almost as many CDD as HDD in this high energy consuming Climate Zone 13.

Bioclimatic Chart

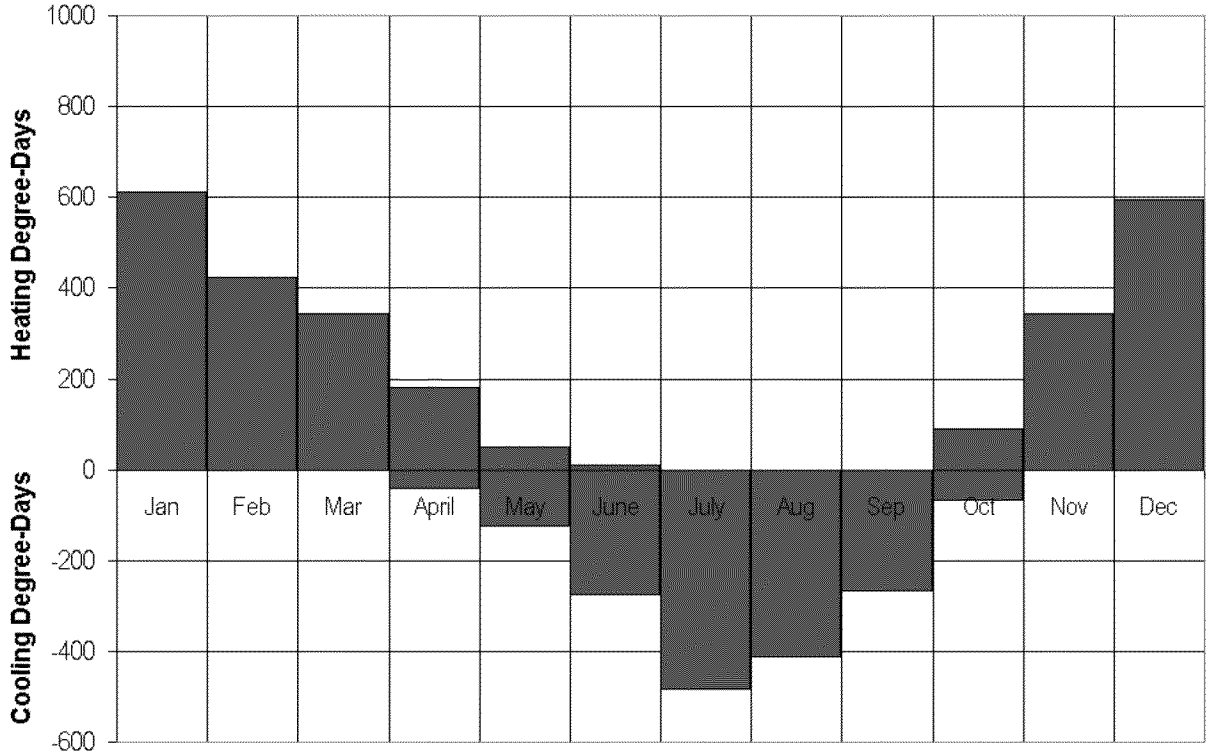


Temperature

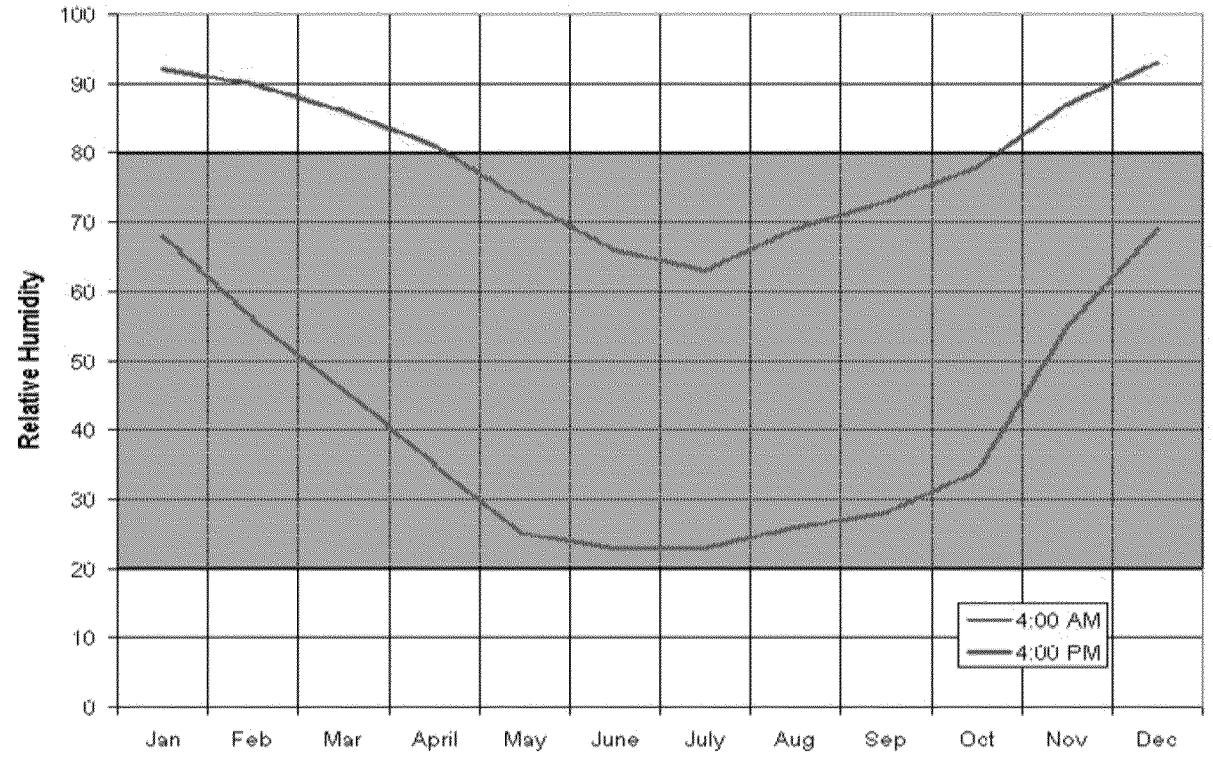
(Typical Comfort Zone: 68-80°F)



Degree Day
(Base 65°)

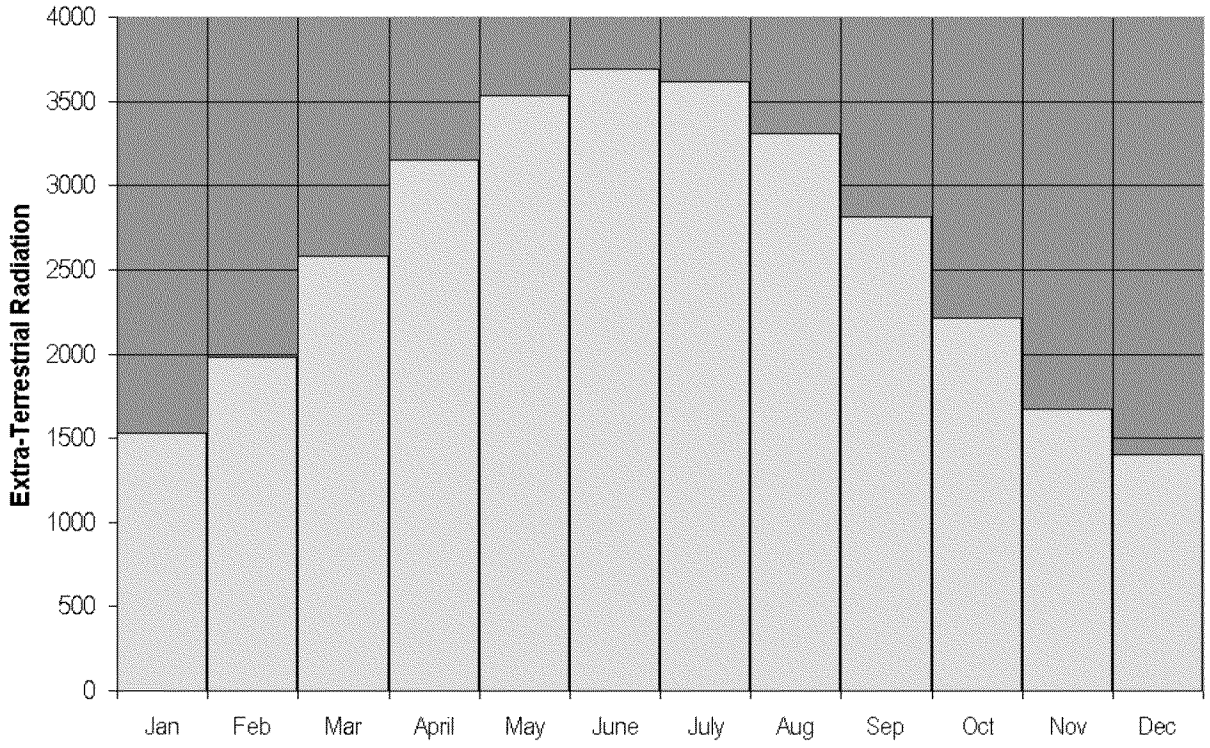


Relative Humidity
(Typical Comfort Zone: 20-80%)

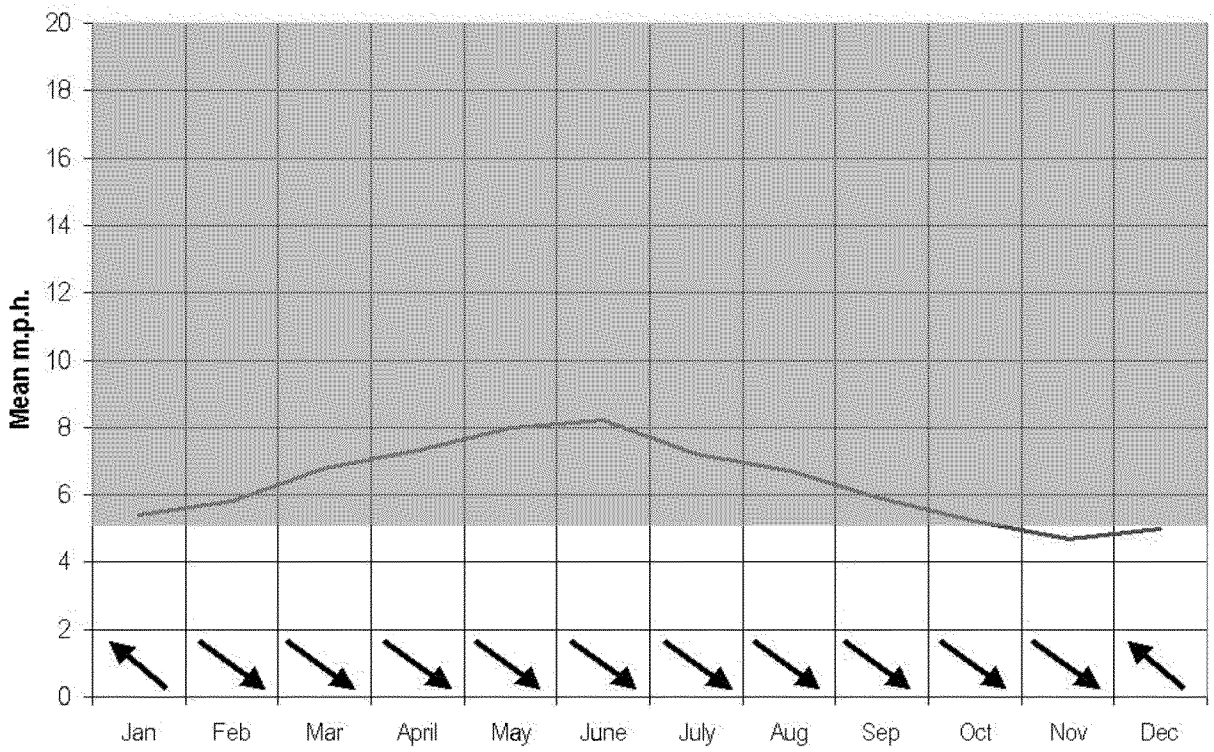


Extra-Terrestrial Radiation

Daily Mean ETR: 2594



Wind Speed



Prevailing Wind Direction

Summer: WNW
Winter: E

Natural Ventilation is most effective when wind speed is 5 mph or greater.

California Climate

Zone 14

Reference City: Barstow
Latitude: 35 N
Longitude: 116.47 W
Elevation: 1927 ft

Basic Climate Conditions

	(F)
Summer Temperature Range	30
Record High Temperature (1972)	116
Record Low Temperature (1963)	3

Design Day Data

Winter	99%	26		
	97.5%	29		
Summer				
	1%:	106	MCWB	68
	2.5%:	104	MCWB	68

Climatic Design Priorities

Winter: Insulate
Reduce Infiltration
Passive Solar
Summer: Shade
Use Evaporative Cooling
Use High Thermal Mass with Night ventilation

Title 24 Requirements

Package	*C*	*D*
Ceiling Insulation	R49	R38
Wood Frame Walls	R29	R21
Glazing U-Value	0.38	0.57
Maximum Total Area	14%	20%

Climate

The climate of this medium to high desert is similar to neighboring cold winter zone 16 and subtropical low desert zone 15. Here, the continental mass influences this interior climate more than the ocean.

Zone 14 Climate is characterized by wide swings in temperature, both between summer and winter and between day and night. Hot summer days are followed by cool nights; freezing nights are often followed by 60F days.

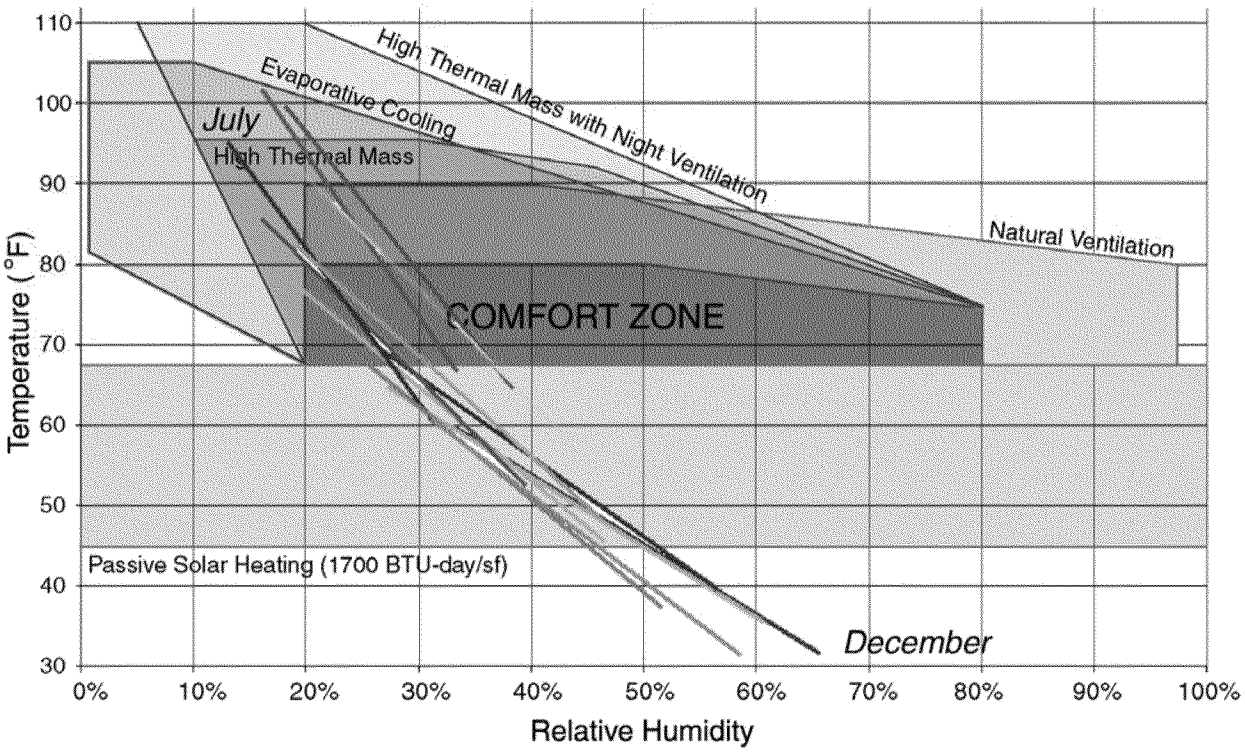
	Barstow	*Trona*	*Palmdale*	*Twenty-nine Palms*
HDD	2581	2492	2704	1910
CDD	4239	2922	1998	3064

HDD = Heating Degree Days (base 65F)
CDD = Cooling Degree Days

There are almost as many CDD as HDD. The hazards of this climate to plants are late spring frosts and desert winds.

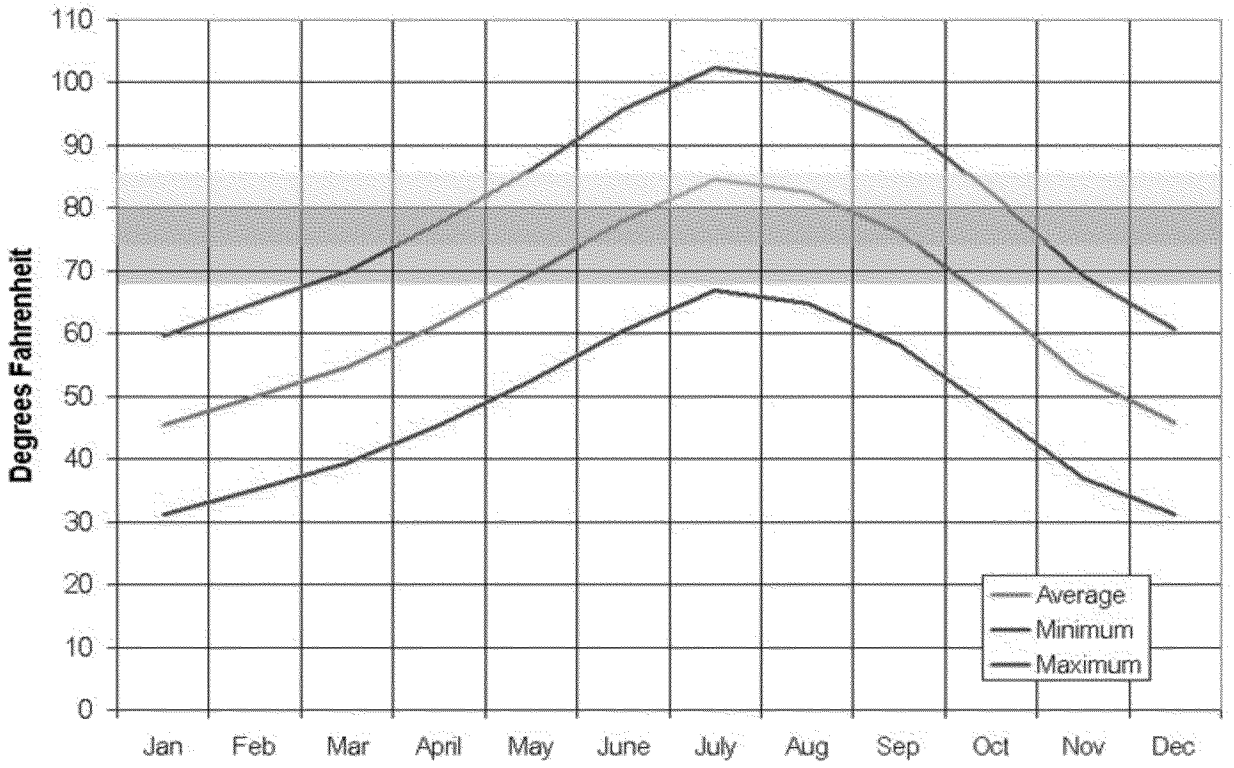
Summers are hot and dry. Does not rain (or snow) more than 1" per month. Winters are cold, especially on the slopes and hillsides where cold air drains off on winter nights. Zone 14 is a high energy-consuming climate, where cooling and heating is needed to maintain comfort.

Bioclimatic Chart

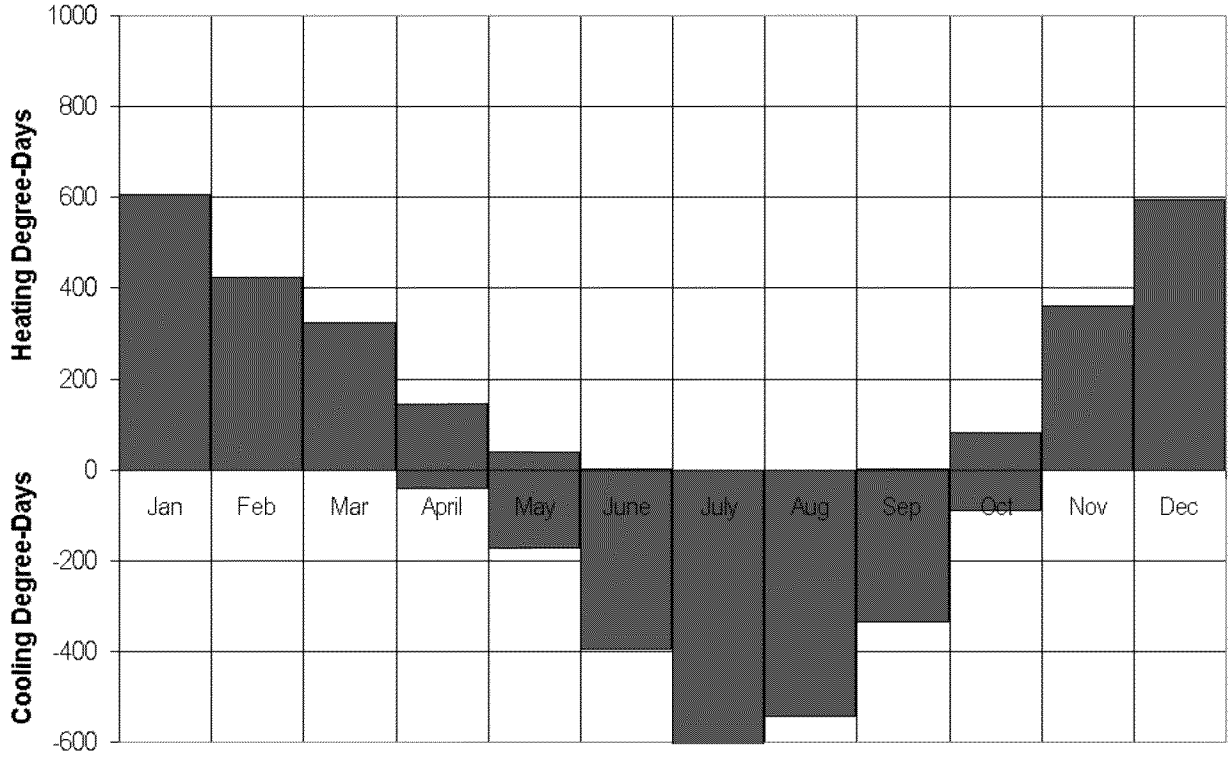


Temperature

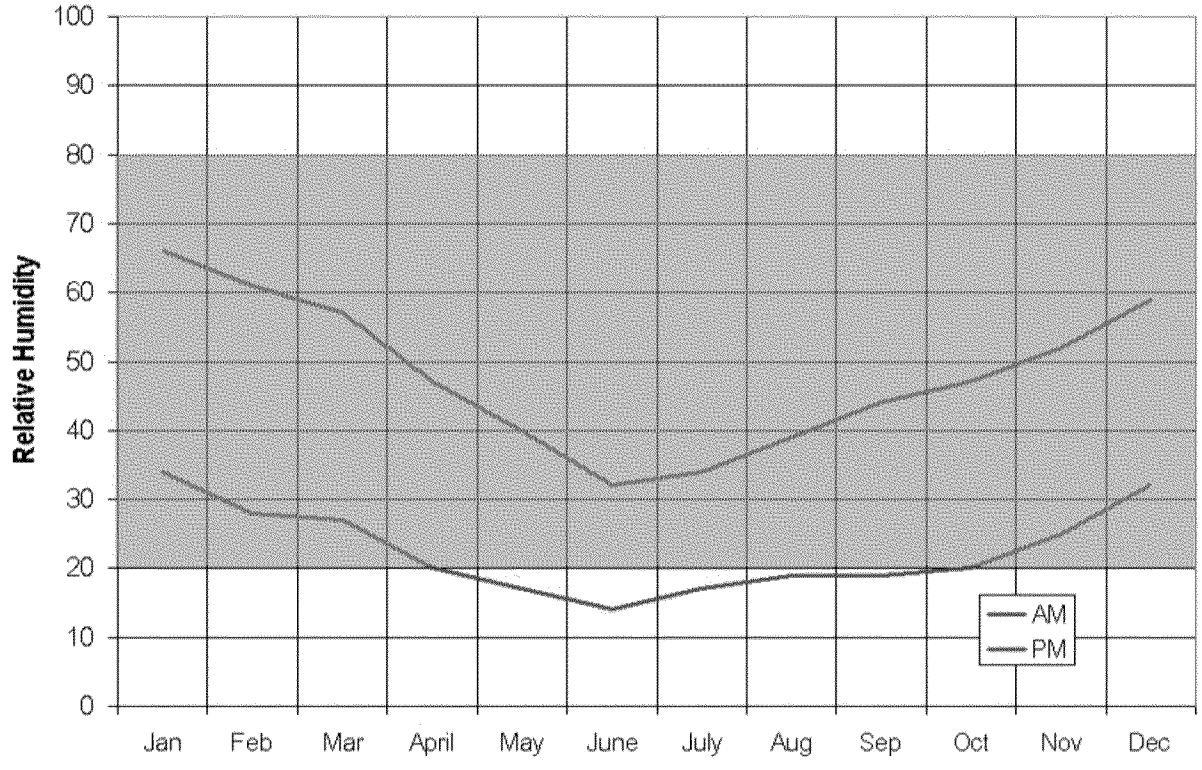
(Typical Comfort Zone: 68-80°F)



Degree Day
(Base 65°)

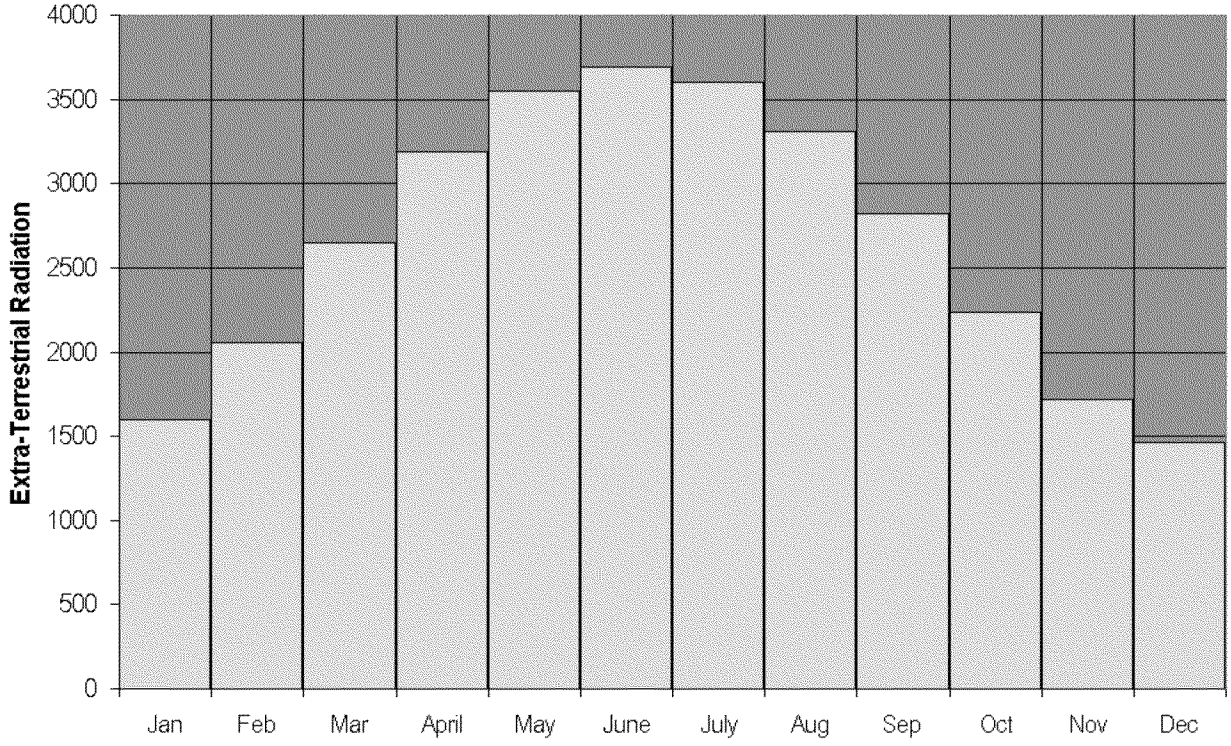


Relative Humidity
(Typical Comfort Zone: 20-80%)

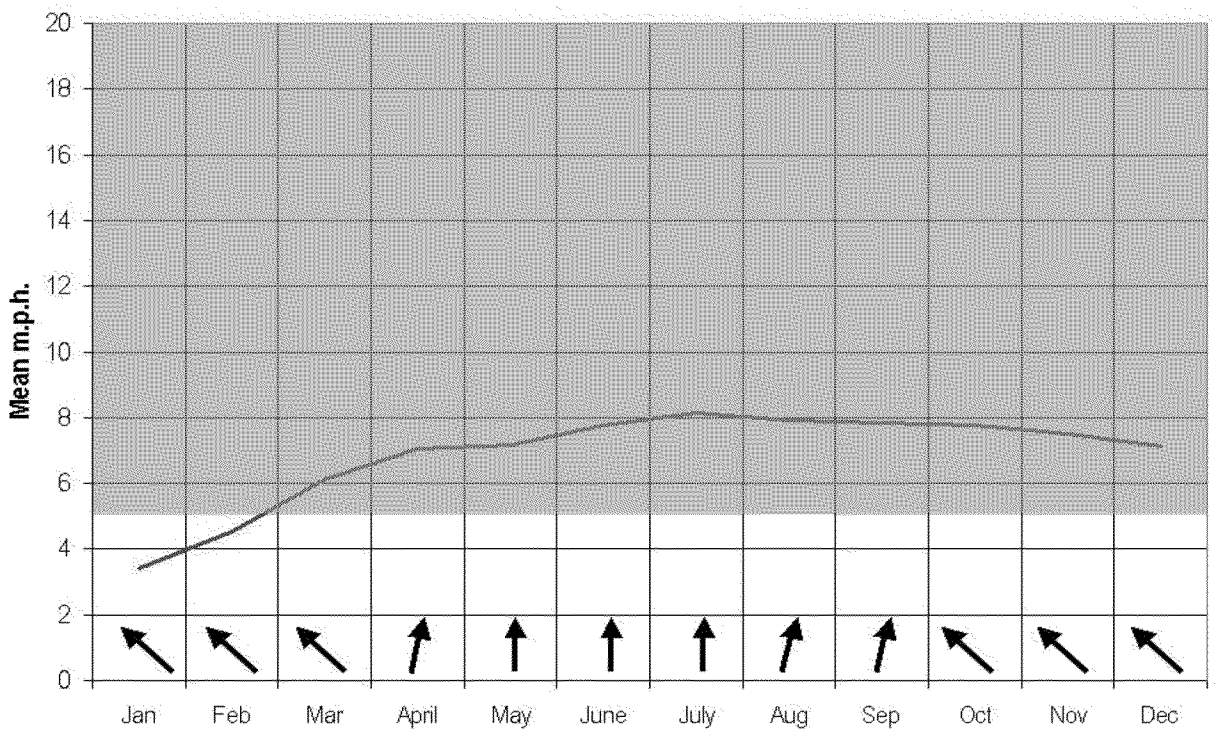


Extra-Terrestrial Radiation

Daily Mean ETR:2626



Wind Speed



Prevailing Wind Direction

Summer: W
Winter: WNW

Natural Ventilation is most effective when wind speed is 5 mph or greater.

California Climate Zone 15

Reference City: Brawley
Latitude: 32.95 N
Longitude: 115.55 W
Elevation: 0 ft

Basic Climate Conditions

	(F)
Summer Temperature Range	18
Record High Temperature (1950	122
Record Low Temperature (2000)	2

Design Day Data

	El Centro			
Winter	99%	35		
	97.5%	38		
Summer				
	1%:	112	MCWB	74
	2.5%:	110	MCWB	74

Climatic Design Priorities

Winter:	Insulate
	Reduce Infiltration
	Passive Solar
Summer:	Shade
	Use Evaporative Cooling
	Use High Thermal Mass with Night ventilation

Title 24 Requirements

Package	*C*	*D*
Ceiling Insulation	R49	R38
Wood Frame Walls	R29	R21
Glazing U-Value	0.38	0.55
Maximum Total Area	16%	20%

Climate

Zone 15 is the low desert and is characterized by extremely hot and dry summers and moderately cold winters.

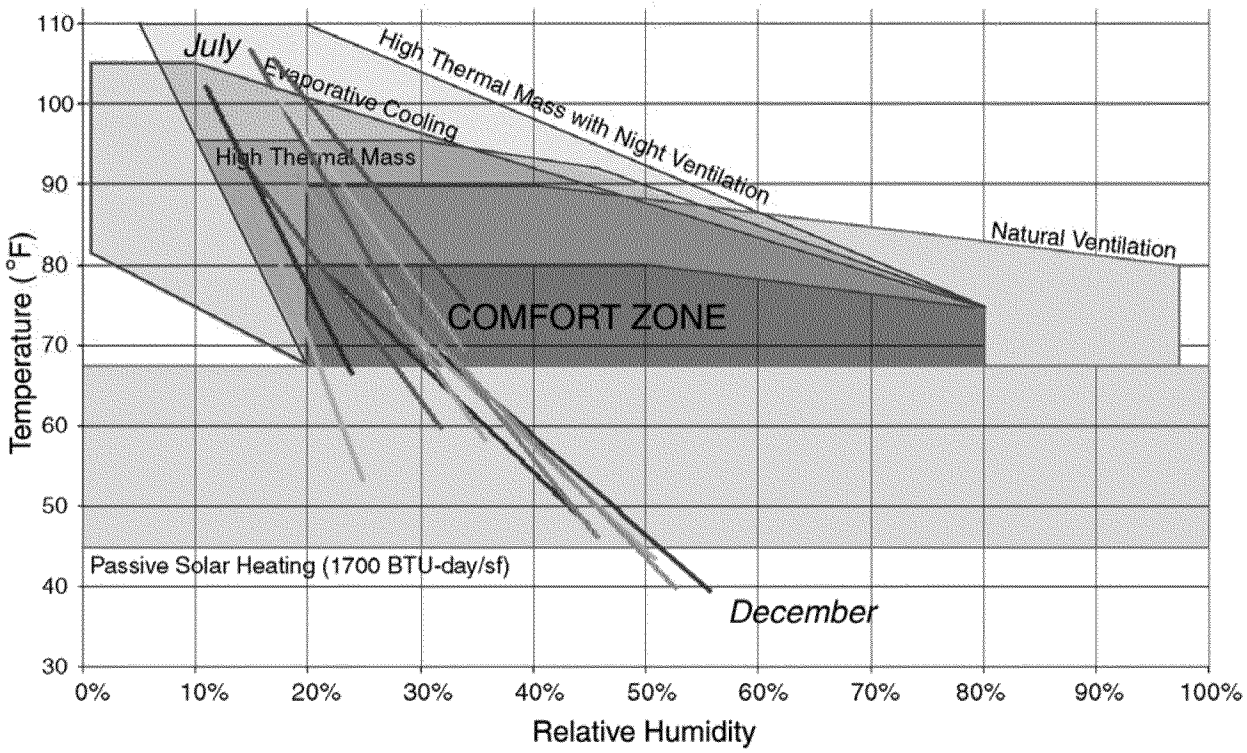
The average temperature in Climate Zone 15 is much higher than any other zone in California, especially in the summer. The humidity is below the comfort range much of the year, which results in a large diurnal temperature range and very cool nights.

The skies are clear most of the year with an annual sunshine of about 85%. Summer storms bring most of the annual precipitation. August is the wettest month, with 1 inch of rain The winters are short and mild, and can bring short frosts. While some heating is required during the winter, cooling is the overwhelming concern for designing within Zone 15.

	Brawley	*Blythe*	*El Centro*	*Needles*
HDD	1106	1295	1080	1227
CDD	6565	3977	3952	4545

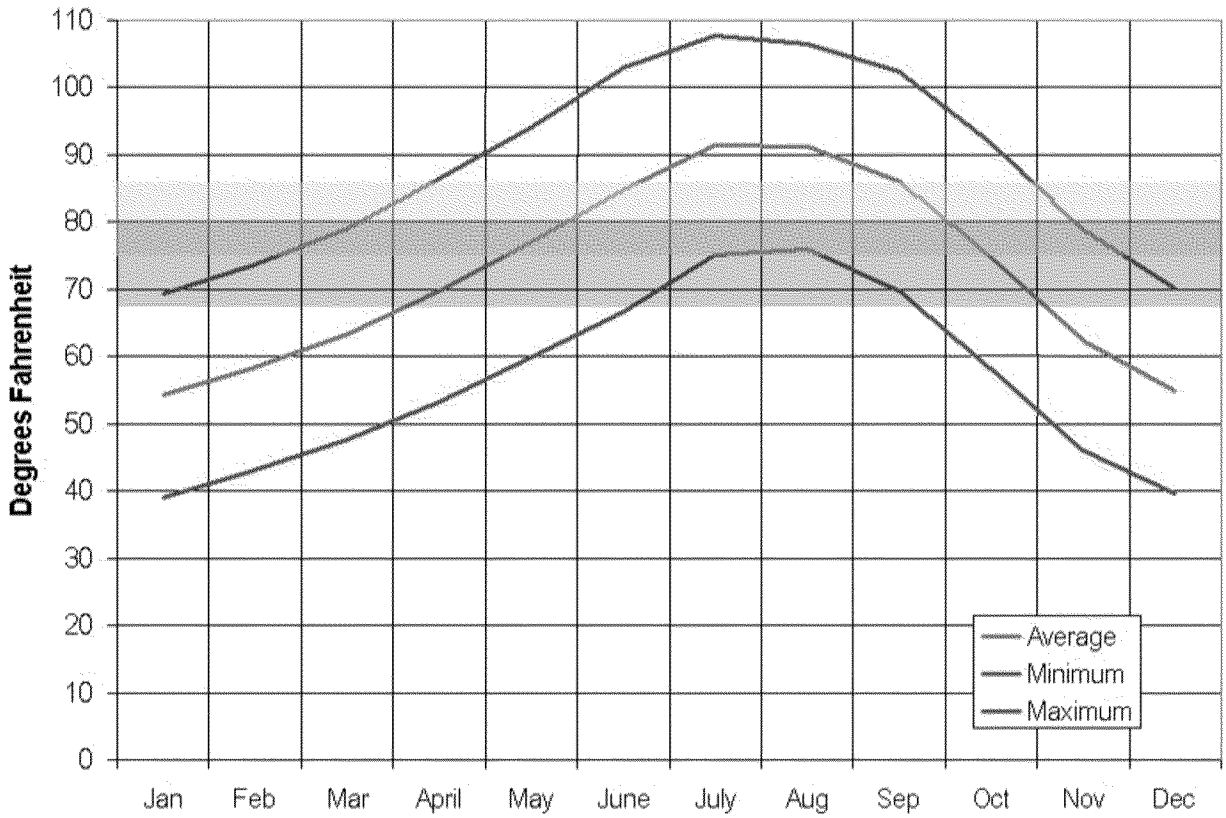
HDD = Heating Degree Days (base 65F)
CDD = Cooling Degree Days

Bioclimatic Chart

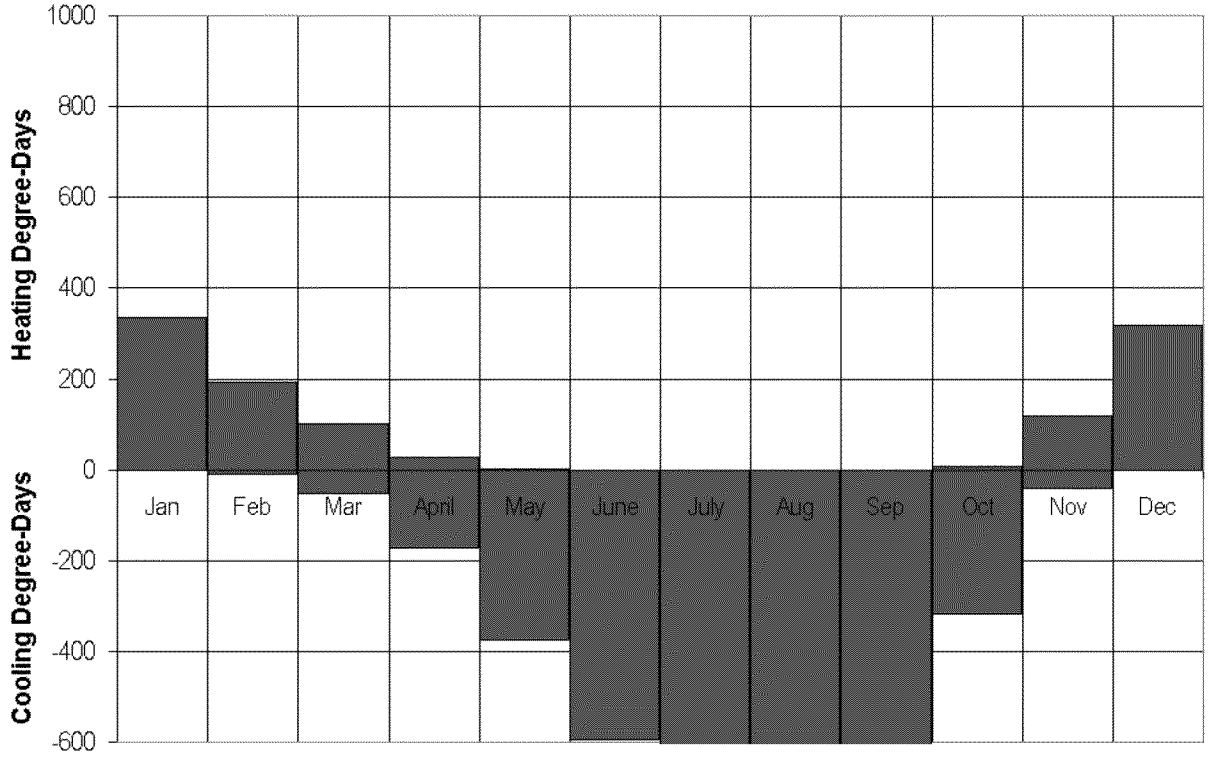


Temperature

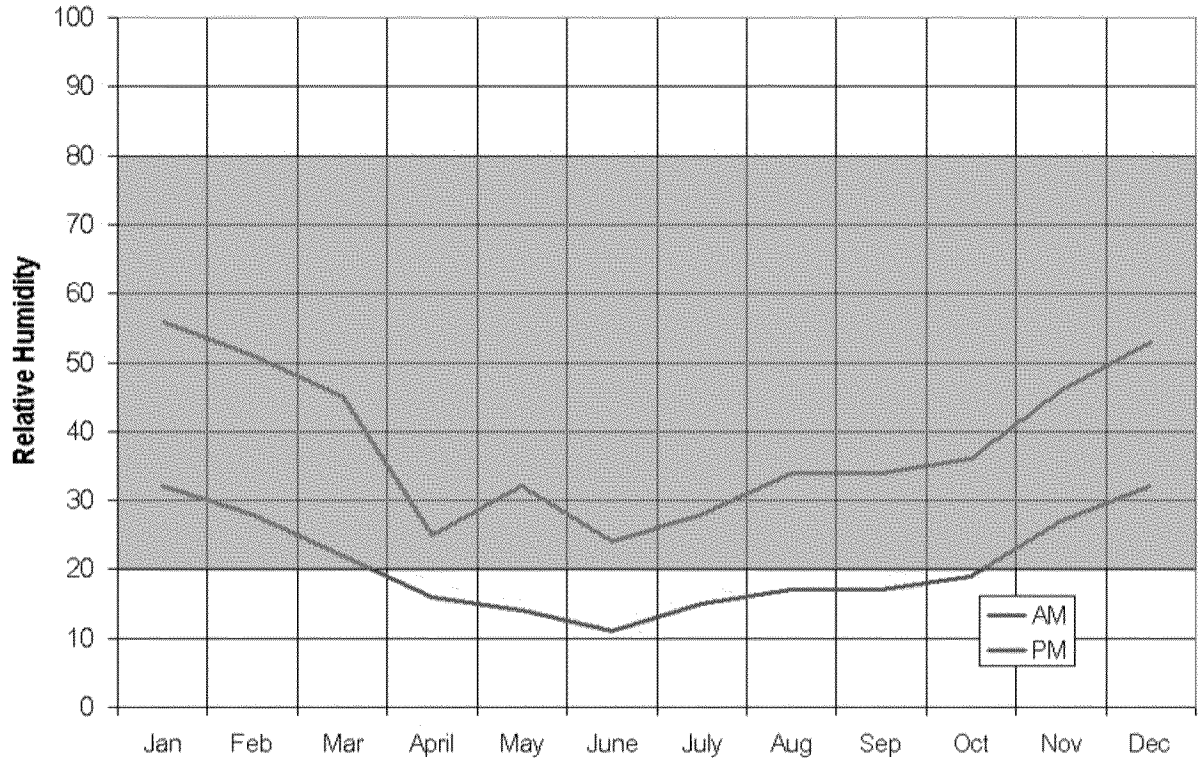
(Typical Comfort Zone: 68-80°F)



Degree Day
(Base 65°)

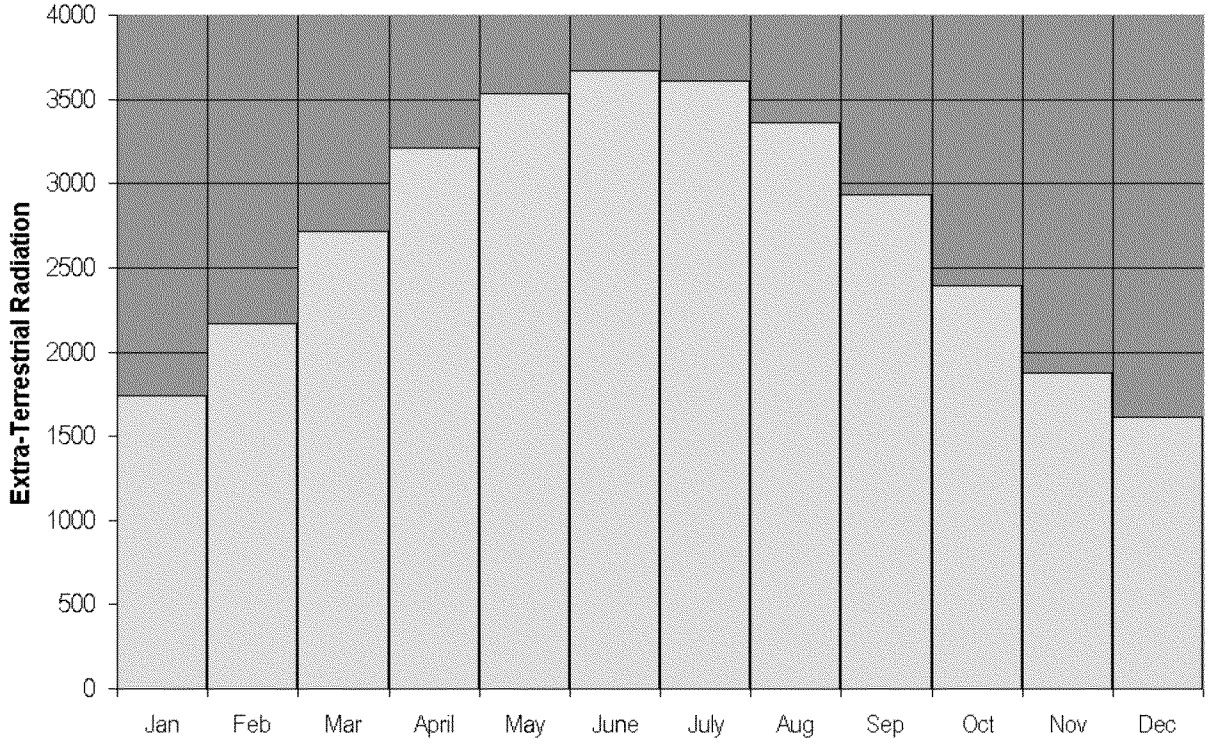


Relative Humidity
(Typical Comfort Zone: 20-80%)

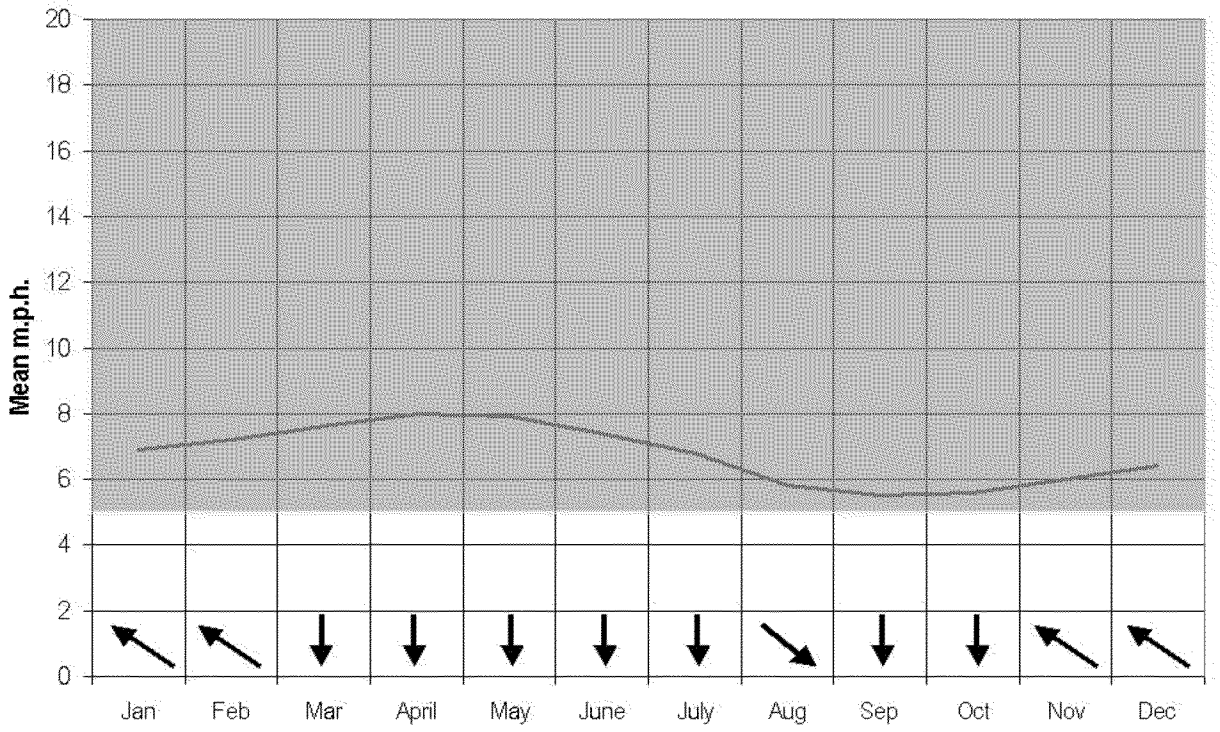


Extra-Terrestrial Radiation

Daily Mean ETR: 2735



Wind Speed



Prevailing Wind Direction

Summer: N
Winter: SE

Natural Ventilation is most effective when wind speed is 5 mph or greater.

California Climate Zone 16

Reference City: Bishop
Latitude: 37.22 N
Longitude: 118.22 W
Elevation: 4108 ft

Basic Climate Conditions

	(F)
Summer Temperature Range	34
Record High Temperature (1972)	109
Record Low Temperature (1974)	-7

Design Day Data

Winter	99%	11		
	97.5%	15		
Summer				
	1%:	102	MCWB	61
	2.5%:	100	MCWB	61

Climatic Design Priorities

Winter: Insulate
Reduce Infiltration
Passive Solar
Summer: Shade
Use Evaporative Cooling
Use High Thermal Mass with Night ventilation

Title 24 Requirements

Package	*C*	*D*
Ceiling Insulation	R49	R38
Wood Frame Walls	R29	R21
Glazing U-Value	0.42	0.55
Maximum Total Area	14%	20%

Climate

Climate Zone 16 is a high, mountainous and semiarid region above 5,000 feet in elevation. It covers a large area from the Oregon Border to San Bernadino county.

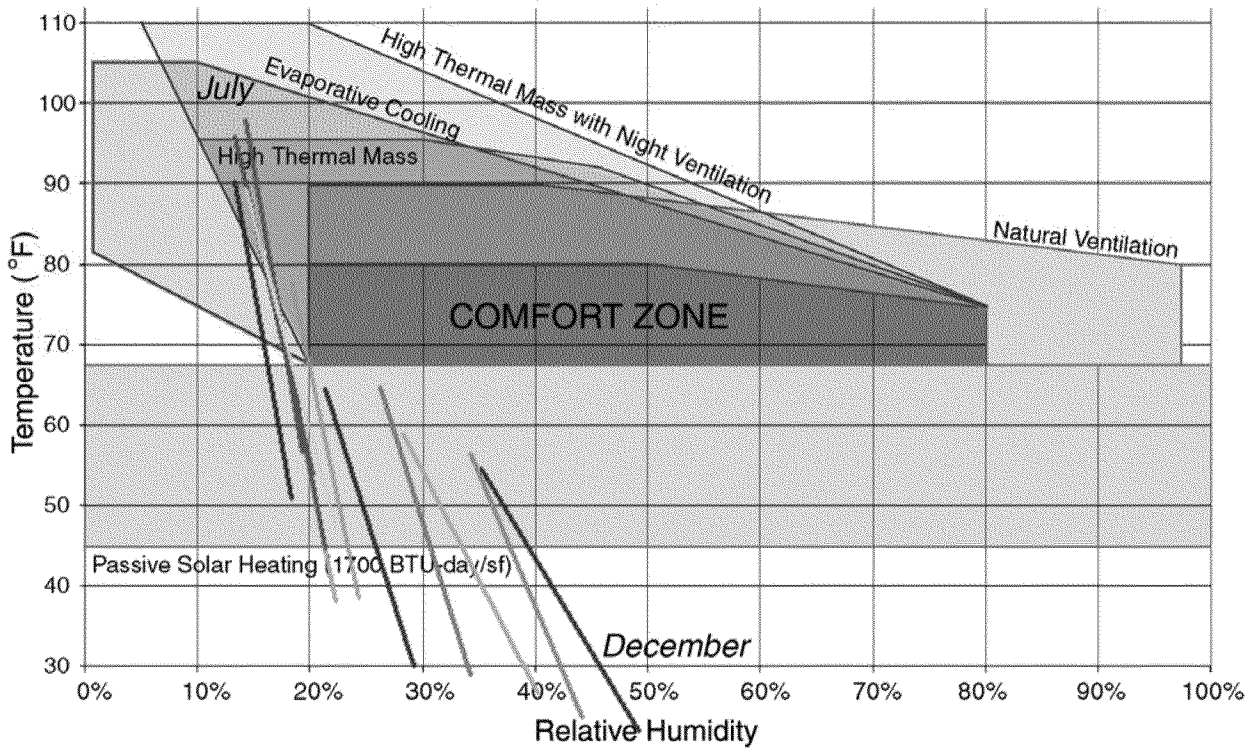
The climate is mostly cold, but seasonal changes are well defined and summer temperatures can be mild. Temperature varies tremendously with the slope orientation and elevation, but cool temperatures and snow cover predominate for more than half of the year. Fortunately, summer temperatures are modest, although the nights are cool. The annual precipitation can between 30-60 inches a year in this large geographic region, 90% of which falls in the winter.

	Bishop	*Sierra City*	*Mount Shasta*	*Hetch Hetchy*
HDD	4313	5183	5991	4740
CDD	1037	492	235	619

HDD = Heating Degree Days (base 65F)
CDD = Cooling Degree Days

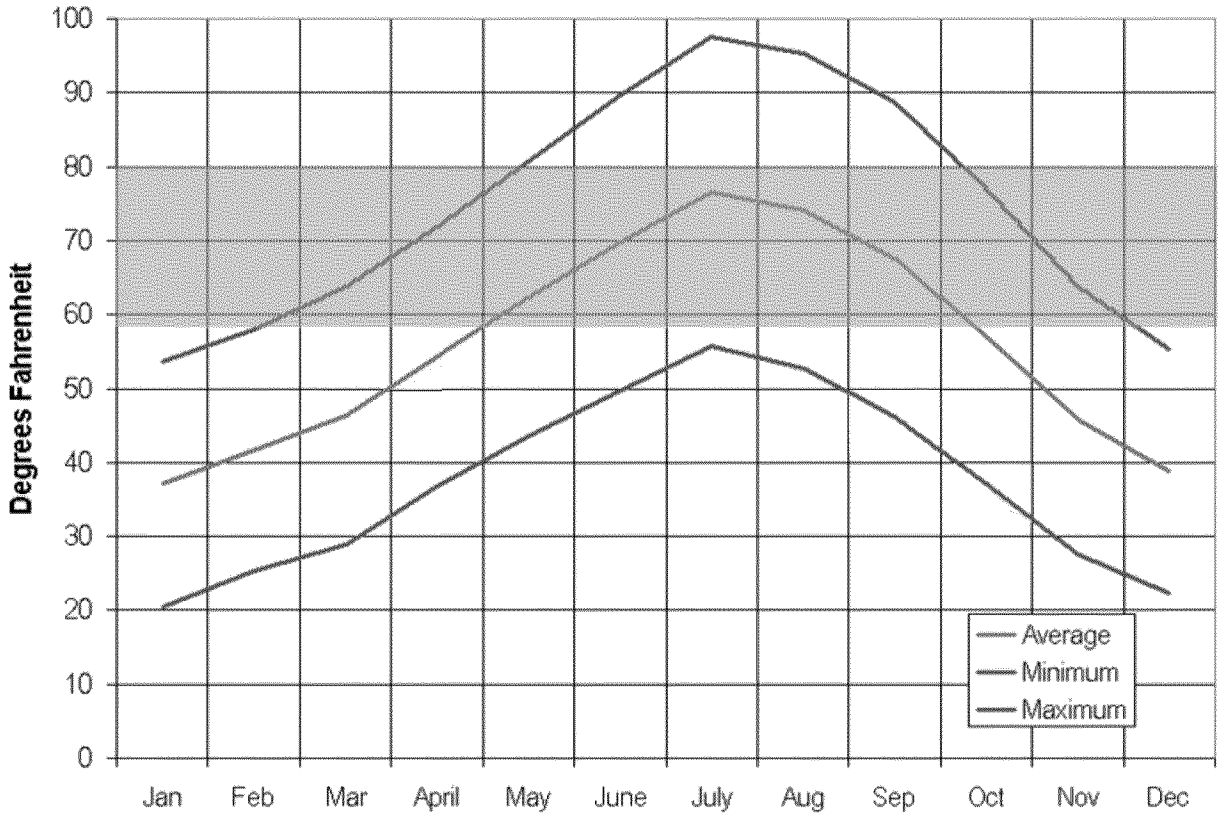
Since this zone experiences the most extreme range of temperatures, the energy consumption, especially for heating, is the highest in the state.

Bioclimatic Chart

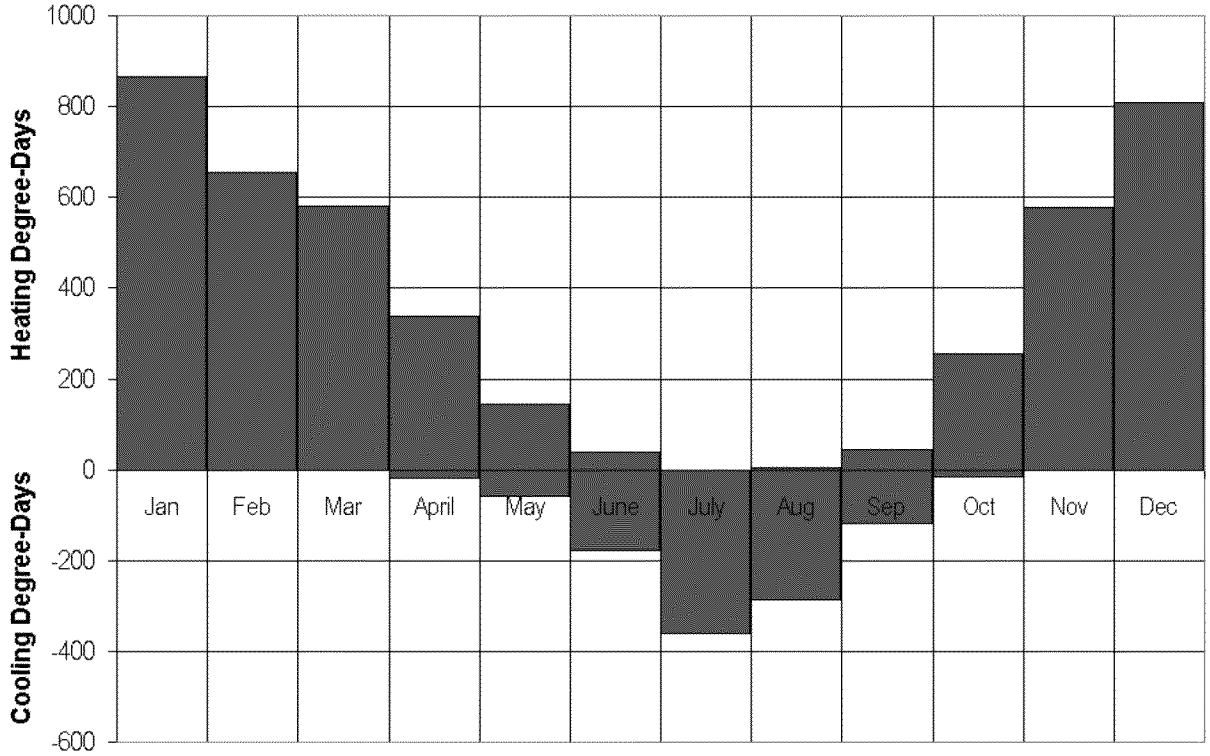


Temperature

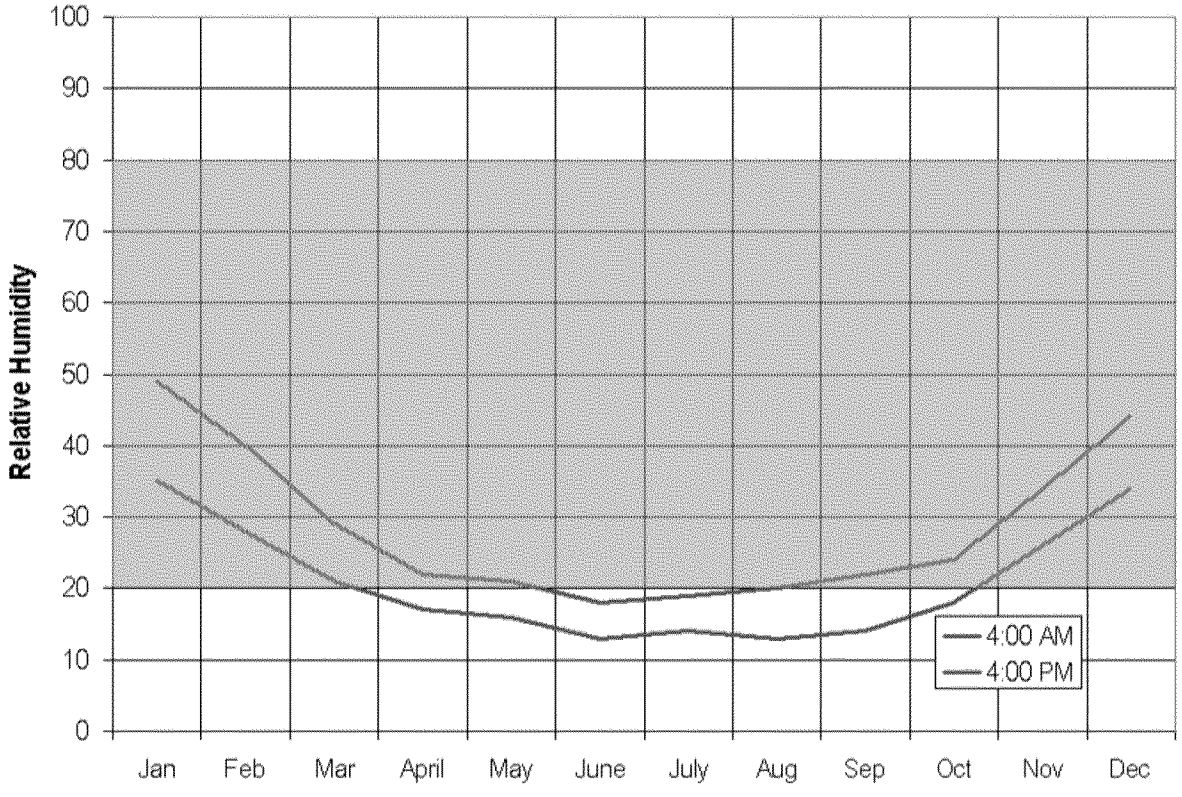
(Typical Comfort Zone: 68-80°F)



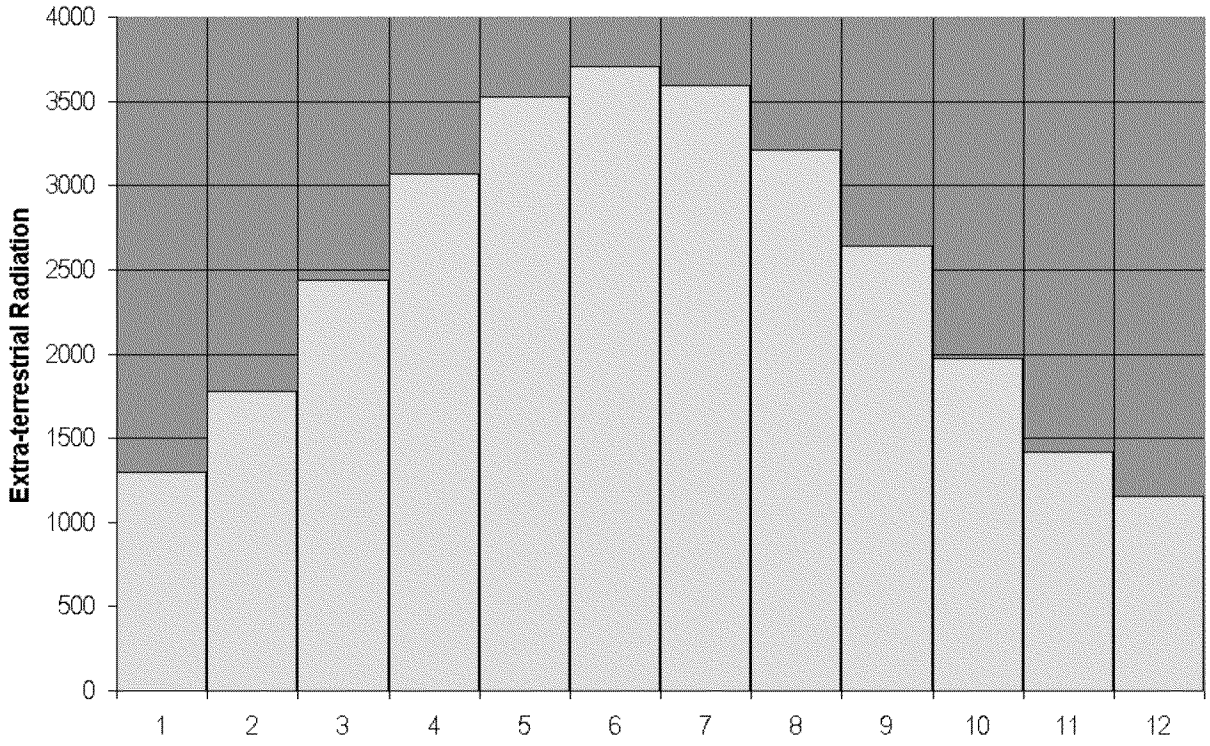
Degree Day
(Base 65°)



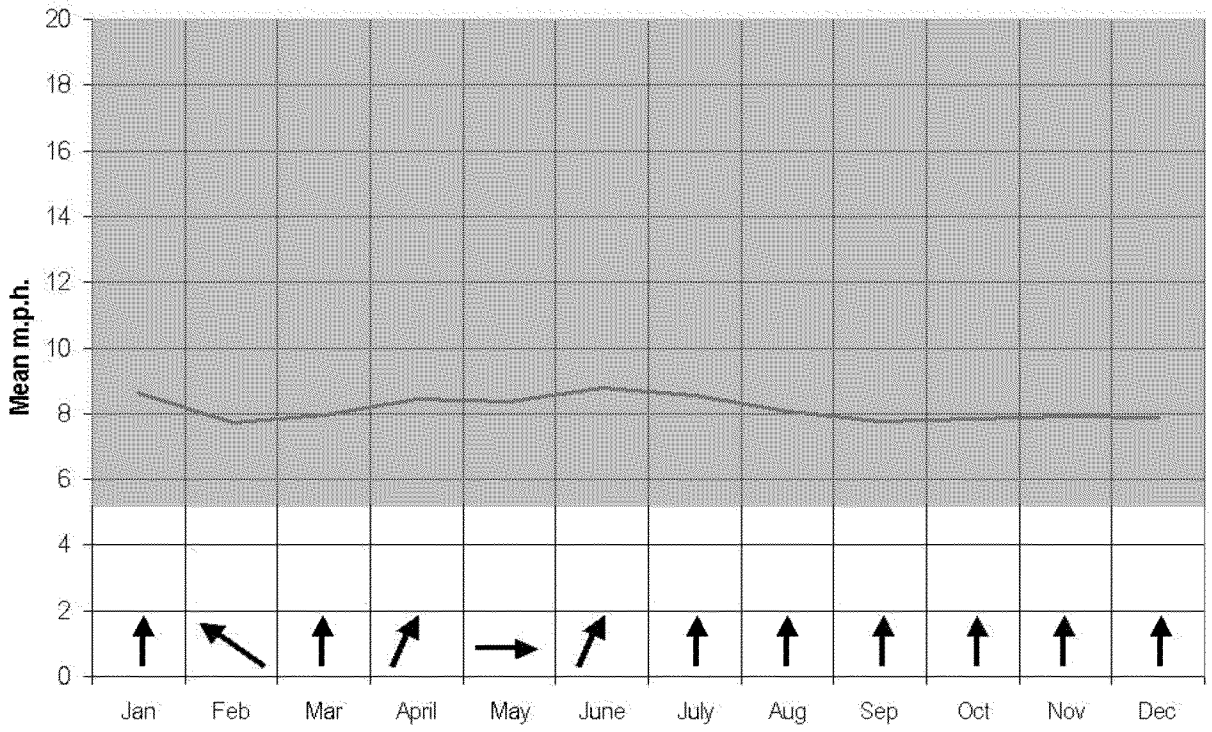
Relative Humidity
(Typical Comfort Zone: 20-80%)



Extra-Terrestrial Radiation Daily Mean ETR: 2484



Wind Speed



Prevailing Wind Direction
Summer: S
Winter: NW

Natural Ventilation is most effective when wind speed is 5 mph or greater.