TECHNICAL GUIDE

DESIGN: ENGINEERING WEATHER DATA

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CHAPTER 1 INTRODUCTION

1-1 PURPOSE AND SCOPE.

This technical guide provides an overview of and instructions for access to engineering weather data (EWD) required by UFC 3-410-01 for use for design of facilities. The technical guide also describes how the data is organized and potential uses for the data.

1-2 GLOSSARY.

APPENDIX B contains acronyms, abbreviations, and terms.

1-3 REFERENCES.

APPENDIX C contains a list of references used in this document.

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CHAPTER 2 ACCESSING EWD

2-1 OUTDOOR DESIGN CONDITIONS

Outdoor design conditions required for heating and cooling load calculations in accordance with UFC 3-410-01 are provided in EWD obtained from the 14th Weather Squadron (14 WS) website: https://climate.af.mil/. Follow these steps:

- Use the center drop down menu to select EWD
- Use the right drop down menu to select the site country or state
- Click the Submit button
- On the next screen, select the location
- On the next screen, the EWD is available along with other products available for that site
- The outdoor design conditions are listed on the first page of the EWD under Design Criteria Data.

2-2 RETRIEVING DATA.

A common access card is required to access the 14th WS website. Non-common access card users may request EWD from 14 WS if they are working on a DoD contract by following these instructions:

1. Attach a completed Support Assistance Request (SAR) to an email requesting support to 14WS_SAR@us.af.mil. This email inbox is monitored Monday through Friday from 0730 to 1630, Eastern Standard Time, except for holidays.
2. A sample SAR form is in Appendix A.
3. Include a complete description of the information being requested including site location and coordinates, a suspense date, a statement about how the data applies to the mission, a military organization point of contact name and phone number, and contract number.
4. The 14 WS will verify that the contractor is working on a valid DoD contract before providing information. After verification, 14 WS will email a portable document format file of the data requested.
5. For climate data that is not for use for DoD projects, contact the National Centers for Environmental Information to purchase the necessary weather data.

2-3 UNLISTED SITES.

If a site is not included on the 14 WS website, submit a request on the 14 WS “Request Support” page: https://climate.af.mil/sar/. Provide a complete description of the information being requested including the site location and coordinates, a suspense date, a military organization point of contact name and phone number, project contract number (if available), and a statement about how the data applies to the mission.

CHAPTER 3 DATA DESCRIPTIONS.

3-1 INTRODUCTION.

This chapter summarizes each page in the EWD site data set.

3-2 DATA SET PAGE 1: DESIGN CRITERIA DATA.

Figure 3-1 is a sample of Data Set Page 1 which summarizes the site's climate.

3-2.1 Location Information.

This section of Data Set Page 1 contains a summary table that includes site name, location, elevation (above mean sea level), period of record (POR), and average atmospheric pressure not corrected to sea level (higher elevations result in lower pressures). The POR is the time frame over which the data used to compute the statistics in this document were compiled.

3-2.2 Design Values.

3-2.2.1 Explanation of Design Values.

Design values are provided for dry bulb temperature, wet bulb temperature, and humidity ratio at specific percentile frequencies of occurrence. The design values of 0.4%, 1%, 2%, 99.6%, 99%, and 97.5% are based on the entire year. In other words, the design values are annual values, not seasonal values. The design values are peak load conditions used for sizing mechanical equipment. The applicable design criteria determines the frequency of occurrence design must be based upon.

3-2.2.2 Median of Extreme Highs or Lows.

The extreme high or low is determined for each calendar year of the POR along with the coincident values for dry bulb temperature, wet bulb temperature, humidity ratio, vapor pressure, wind speed, and prevailing wind direction. Median values are determined from the distribution of extreme highs or lows.

3-2.2.3 Mean Daily Range.

The mean daily range (difference between daily maximum and daily minimum temperatures) is the average of all daily dry bulb temperature ranges for the POR.

3-2.2.3.1 Other Design Values.

Listed is the dry bulb temperature, wet bulb temperature, and humidity ratio corresponding to a given annual cumulative frequency of occurrence and its respective mean coincident values for dry bulb temperature, wet bulb temperature, humidity ratio, vapor pressure, wind speed, and prevailing wind direction. The design value listed represents the value that was exceeded for the respective percent of time over the entire POR. For example, the 1.0% occurrence dry bulb design value temperature 93 °F (34 °C) has been exceeded only 1 percent of the time during the entire POR. All the observations occurring within one degree of the design value are grouped, and the Mean Coincident (Average) Values for Dry Bulb Temperature, Wet Bulb Temperature, Humidity Ratio, Vapor Pressure, and Wind Speed are calculated. The prevailing wind direction (the "mode" of the wind direction distribution) is also calculated.

3-2.3 Air Conditioning/Humid Area Criteria.

These are the number of hours, on average, that dry bulb temperatures of 93 °F (34 °C) and 80 °F (27 °C) and wet bulb temperatures of 73 °F (23 °C) and 67 °F (19 °C) are equaled or exceeded during the year.

3-2.4 Other Site Data.

This information is provided for general reference only and should not be used as the basis for design. There are some locations for which this data is not available. In these cases, that portion of the table will be left blank.

3-2.4.1 Weather Region.

Eleven weather regions have been developed by the Department of Energy. They are defined by the range of cooling degree-days and heating degree-days based on 65 °F (18 °C). ASHRAE/IESNA Standard 90.1 uses annual heating degree-days based on 65 °F (HDD65) (18 °C [HDD18]) and cooling degree-days based on 50 °F (CDD50) (10 °C [CDD10]) to select the appropriate Building Envelope Requirements table for energy conservation design. Refer to paragraph 2-10 for further explanation of this data.

3-2.4.2 Ventilation Cooling Load Index.

The Ventilation Cooling Load Index (VCLI) is a two-part index that defines the total annual cooling load for ventilation air by calculating sensible heat load separately from the latent heat load (moisture). The results are expressed in ton-hours per cubic feet per minute per year of latent and sensible load. Values for sensible heat load are calculated by comparing the outdoor temperature to indoor conditions (75 °F [24 °C] and 60% relative humidity [RH]), and calculating how much energy is required to bring the outdoor air to the indoor temperature. The latent load is calculated similarly. Separate calculations are made for each hour of the year and then summed to form the annual VCLI.

3-2.4.3 Average Annual Freeze-Thaw Cycles.

This value is the average number of times per year that the air temperature first drops below freezing and then rises above freezing, regardless of the duration of either the freezing or thawing. The number of cycles is summed per year and averaged over the entire POR. Days with high temperatures or low temperatures at 32 °F (0 °C) are not counted for a freeze- thaw cycle. A cycle is counted only when the temperature drops below freezing (31 °F [-0.5 °C] or colder) or goes above freezing (33 °F [0.5 °C] or warmer).

3-2.4.4 Other Values.

The following values are derived from sources other than the 14 WS. Review the publications listed below and contact the organizations for current values, including background information and complete guidelines for use of these data elements.

3-2.4.4.1 Groundwater.

National Ground Water Association

http://www.ngwa.org/

[C] 3-2.4.4.1 Groundwater

Average groundwater temperature parallels long-term average air temperature, because soil at a depth of 50 feet (15 meters) does not undergo significant temperature change over the course of a year. Soil temperature at 50 feet (15 meters) stays slightly warmer than average annual air temperature by approximately 2.5 °F (1.4 °C).

3-2.4.4.2 Rain Rate.

International Plumbing Code, from the International Code Council
http://www.iccsafe.org/

3-2.4.4.3 Frost Depth.

Refer to local codes or project geotechnical engineer. Modberg or FROST Modeler are available for estimating frost depth, both of which are within PCASE
https://transportation.erdc.dren.mil/pcase/

3-2.4.4.4 Basic Wind Speed.

ASCE/SEI 7, Minimum Design Loads and Associated Criteria for Buildings and Other Structures from the American Society of Civil Engineers at http://www.asce.org/

3-2.4.4.5 Ground Snow Loads.

ASCE Hazard Tool from the American Society of Civil Engineers at
https://ascehazardtool.org

3-3 DATA SET PAGE 2: AVERAGE ANNUAL CLIMATE.

Figure 3-2 is an example of Data Set Page 2, a graph summarizing the site’s average annual climate. The graph shows the site’s monthly mean temperature, dew point, and precipitation. The bar graph representing precipitation uses the scale on the right side of the chart (inches or centimeters). Lines of temperature and dew point use the scale on the left side of the chart (°F or °C). These charts have fixed maximum and minimum values on their axes for easy comparison between different sites. The precipitation chart is capped at a maximum of 15 inches (45 centimeters) per month. A few sites may exceed this value, but to keep the graph readable, a fixed maximum value was used. For a number of sites, no accurate precipitation data was available. In those cases, no bars appear on the chart.

The graph displays the average behavior of weather over a single year which can be used to compare rainfall patterns at one station with another and determine the relative importance of water resistance for the exterior envelope. The temperature and moisture patters can be compared to understand the relative importance of sensible and latent heat loads at the location. The monthly averages aid in identifying months are likely to be hot or cold, humid or dry, or have high precipitation to support mission planning as well as planning for construction and building operation. The graph should not be used to determine equipment capacities or building envelope thermal characteristics because the values displayed are averages rather than design or extreme values.

3-4 DATA SET PAGE 3: 30-YEAR PSYCHROMETRIC SUMMARY.

Figure 3-3 is an example of Data Set Page 3, a graph summarizing the site's psychrometric data.

3-4.1 Joint-Frequency Table.

The graph displays the joint cumulative percent frequency of temperature and humidity ratio. Hourly observations are grouped into bins of 5 °F degrees and 10 gr/lb (3 °C and 1.5 g/kg), centered on each value of temperature or humidity ratio. For example, the 70 °F (21 °C) temperature bin collects all observations between 67.5 °F and 72.5 °F (19.5 °C and 22.4 °C). The bin is depicted as a gridline on the chart; the vertical lines represent the temperature bins and the horizontal lines represent the humidity ratio bins. The intersection of temperature and humidity ratio lines represent a further subdivision of the observations into groups meeting both temperature and humidity ratio criteria. For example, the intersection of the 70 °F (21 °C) bin line and the 40 gr/lb (6 g/kg) bin line represent the observations when temperature was between 67.5 °F and 72.4 °F (19.5 °C and 22.4 °C) and the humidity ratio was between 35 gr/lb and 44 gr/lb (5.25 g/kg and 6.74 g/kg). Thus, a joint-frequency table is created for all temperature and humidity ratio bin combinations.

The psychrometric graph is intended as a visual tool only. Its purpose is to allow a quick visual comparison between climates at different locations. Extrapolation of data directly from the graph is not advised due to the approximate plotting routine used to generate the graph from the binned data. This is evident where values of humidity appear past their saturation point. This discrepancy between the actual data and the graph is the result of the plotting routine used to generate the graph and not from errors in the original hourly data used to create the binned summary.

3-4.2 Contours.

The contours on this chart represent the areas containing 99%, 97.5%, 95%, 80%, and 50% of all observations (cumulative percent frequency or percentiles). The contours are centered on the most frequently occurring bins (50% contour), spreading outward until almost all observations (99%) are grouped. Contours are defined by calculating a percent frequency for each bin (relative to the others), and then accumulating these percent frequencies (from most frequent to least frequent) until the 50% value is passed, and thus the first set of bins is grouped. The accumulating continues until the 80% value is passed, and the second group of bins is grouped. This process continues until the 95%, 97.5%, and 99% values are passed.

3-4.3 Least Frequent (Most Extreme) Bins.

Consequently, the least frequent (most extreme) bins, which when accumulated amount to less than 1 percent of the total observations, are outside of the 99% contour. Any bins outside the 99% contour thus have either not occurred or have occurred so infrequently that they should not be taken into consideration for sizing equipment.

3-4.4 Most Common Conditions

The graph displays the long-term history of temperature and moisture at each station which can represent a total of 262,800 hourly observations over a 30-year POR. The graph can be used to ascertain the most common temperature and moisture conditions that will be encountered over the operating life of the mechanical equipment. The behavior of proposed mechanical systems at these conditions can be assessed to ensure that selected equipment and controls are capable of modulation and control at all points of operation rather than simply at the peak design or extreme conditions.

3-5 DATA SET PAGE 4: PSYCHROMETRIC DISPLAY OF DESIGN VALUES.

Figure 3-4 is an example of Data Set Page 4, a psychrometric display of the site's design values.

3-5.1 Saturation Curve.

Similar to Data Set Page 3, this chart depicts the saturation curve (when RH = 100%) along with peak design values. The design values are calculated as in the table on Data Set Page 1 (Figure 3-1), but this chart shows their relationships graphically, depicting their position relative to each other and relative to the saturation curve.

3-5.2 Observations.

Above and to the left of the saturation curve, RH would be greater than 100% . The area below and to the right of the curve, including the points on the curve itself, represent the area where RH is less than or equal to 100%, and thus where all observations occur.

Note that since the humidity ratio is a function of pressure, and pressure varies with elevation, different sites will have different saturation curves.

3-5.3 Scatter Plot.

The dry bulb temperature is the horizontal coordinate on this scatter plot, and the humidity ratio is the vertical coordinate. Peak design values are depicted by the red square (1.0% Temperature [dry bulb]), the green circle (1.0% Humidity Ratio), and the blue diamond (99% Temperature [dry bulb]).

3-5.4 Table.

The table below the chart shows the exact values of 99% dry bulb temperature, 1.0% humidity ratio, and 1.0% dry bulb temperature, along with calculated values of enthalpy, mean coincident wet bulb temperature, and humidity ratio (as applicable)..

3-6 DATA SET PAGES 5 THROUGH 9: TEMPERATURE BIN DATA.

Figures 3-5 through 3-9 are examples of Data Set Pages 5 through 9, respectively. These tables show the number of hours that temperatures occur in 5 °F (3 °C) bins of specific 8-hour daily periods during a given month. The 8-hour periods are based upon a 24-hour clock and displayed in Local Standard Time (LST). For each month, the number of observations for each temperature bin during each of the specific 8-hour periods of the day appear in a column under the specific Hour Group (LST). The total number of observations (hours) in each temperature bin is displayed in the “Total Obs” column for the month. The mean coincident wet bulb temperature is the mean value of all those wet bulb temperatures that occur coincidentally with the dry bulb temperatures in the particular 5° temperature bin. At the upper, or warmer, end of the mean coincident wet bulb distribution, the values occasionally reverse their trend because the highest wet bulb temperatures do not necessarily occur with the highest dry bulb temperatures. There are 13 such tables, one for each month and one representing the overall annual summary. These binned summaries can be useful for informal estimates of energy consumption by cooling and heating equipment or gaining a general understanding of temperature and moisture patterns at different times of the day, month, or year. Do not use the binned summaries to calculate design moisture loads.

These particular binned summaries are based on the dry bulb temperature. After each observation has been placed into a dry bulb bin, the average humidity ratio is calculated for all observations in each bin. Consequently, dry bulb bins underestimate the magnitude of dehumidification and humidification loads because the averaging calculation “flattens” the peaks and valleys of humidity ratios. The amount of the underestimation varies according to the intended humidity control level.

3-7 DATA SET PAGE 10: ANNUAL TEMPERATURE SUMMARY.

Figure 3-10 is an example of Data Set Page 10. This chart shows a week-by-week summary of dry bulb temperatures for the given site. The observations are grouped into 7-day periods (approximate calendar weeks). For example, observations from January

1 through 7 from all years are grouped, observations from January 8 through 14 from all years are grouped, and so on, overlapping the end of one month and beginning of the next month where necessary. The following statistics are shown for each of the 7-day periods:

- 1% Dry Bulb Temp is the dry bulb temperature that is exceeded 1% of the time during that calendar week.
- MCWB (1% Dry Bulb) is the mean of wet bulb temperatures coincident with 1% dry bulb temperatures during the same week.
- Mean Max Temp is the daily maximum dry bulb temperature, averaged by week over the POR.
- Mean Min Temp is the daily minimum dry bulb temperature, averaged by week over the POR.
- 99% Min Dry Bulb Temp is the daily dry bulb temperature that is at or above this value 99% of the time, or below this value 1% of the time.

The weekly 1% and 99% temperatures are useful for understanding the probable temperature extremes that can occur during a given week of the year and the change of seasons at a given location for mission or construction project planning. Do not base equipment selection on the temperature extremes presented. The mean maximum and minimum temperatures shown for each week seldom occur in the same year. The mean values are useful for understanding the typical range of temperatures in a given week but do not represent the actual day-to-night temperature swing in a given week.

[C] 3-7 DATA SET PAGE 10: ANNUAL TEMPERATURE SUMMARY

The information in the chart is calculated on a weekly basis; information on a climate summary (Data Set Page 1) is calculated on an annual basis.

The mean maximum and minimum temperatures shown for each week seldom occur in the same year. Keep in mind that these are mean values that are useful for understanding the typical range of temperatures in a given week. The difference does not represent the actual day-night temperature swing in a given week.

3-8 DATA SET PAGE 11: ANNUAL HUMIDITY SUMMARY.

Figure 3-11 is an example of Data Set Page 11. Similar to the annual temperature summary (see Sample Data Set Page 10, Figure 3-10), this chart depicts mean maximum and minimum values of humidity ratio, plus the 1% maximum humidity ratio, along with its mean coincident dry bulb temperature, summarized by calendar week. The chart uses two vertical axes: on the left are the humidity ratio values and on the right is a temperature scale for the mean coincident dry bulb temperature. The high and low humidity ratios shown for each week seldom occur in the same year. Keep in mind that these are mean values that are useful for understanding the typical range of humidity ratio in a given week. The difference does not represent the actual day-night humidity ratio swing in a given week.

The weekly humidity ratios are useful for understanding the probable humidity extremes during a given week of the year and the change of seasons at a given location. The display is also useful for planning humidity-controlled storage projects and understanding factors contributing to atmospheric corrosion. Humidity affects the deterioration rate of building materials and weathering of military equipment and structures exposed to the elements. Do not base equipment selection on the humidity extremes presented. The mean maximum and minimum humidity values shown for each week seldom occur in the same year. The mean values are useful for understanding the typical range of humidity ratio in a given week but do not represent the actual day-to-night humidity ratio swing in a given week.

3-9 DATA SET PAGE 12: ANNUAL DRY BULB TEMPERATURE AND HUMIDITY SUMMARY TABLES.

Figure 3-12 is an example of Data Set Page 12. Data Set Page 12 consists of tables containing the values used to plot the charts on Data Set Page 10 and Data Set Page 11. The left half of the table uses Data Set Page 10 and the right half uses Data Set Page 11.

3-10 DATA SET PAGE 13: BUILDING ENVELOPE LOADS.

Figure 3-13 is an example of Data Set Page 13. Data Set Page 13 consists of charts summarizing a site's mean heating and cooling degree-days.

3-10.1 Calculation of Cooling Degree-Days (Base 65).

Cooling degree-days based on 65 °F (CDD65) (18 °C [CDD18]) are derived by multiplying the number of hours that the outdoor temperature is above the base temperature of 65 °F (18 °C) times the number of degrees of that temperature difference. For example, if 1 hour was observed at a temperature of 78 °F (25 °C), that observation adds 13 (7) degree-hours to the annual total. The sum of the degree-hours is divided by 24 to yield degree-days.

3-10.2 Calculation of Heating Degree-Days.

Heating degree-days are calculated similarly, against the base temperature of 65 °F (18 °C), so a 1-hour outside temperature observation of 62 °F (17 °C) adds 3 (1) degree-hours to the annual total. Heating degree-days are summed separately from the cooling degree-days. Heating and cooling degree-hours do not cancel each other out, since both heating and cooling conditions may occur over the course of a given day.

3-10.3 Cooling Degree-Days (Base 50).

The cooling degree-days based upon a base temperature of 50 °F (10 °C) is included. This data is intended to allow determination of a site's climate zone using ASHRAE Standard 169 when the climate zone is not explicitly listed in the standard. The climate zone selection is used to determine the applicability of various requirements within ASHRAE Standard 90.1 (Refer to UFC 1-200-02, for applicable publication date).

3-11 DATA SET PAGE 14: VENTILATION AND INFILTRATION LOADS.

Figure 3-14 is an example of Data Set Page 14. Data Set Page 14 consists of a graph and table that display the independent loads imposed by heating, cooling, humidifying, and dehumidifying outside air as it is brought into a building. The calculation assumes that air inside the building is maintained at conditions between 68 °F (20 °C)/30% RH and 75 °F (24 °C)/60% RH. For the purposes of these calculations, when the outside air is within that range of temperature and moisture, any incoming air is assumed not to impose any load. The information presented aids in understanding the nature and magnitude of ventilation and infiltration loads on an annual basis and how the loads vary from month to month throughout the year.

3-11.1 Calculations

These values are calculated with the methodology used to calculate the annual VCLI on Data Set Page 1, except that values on this page are computed by month and the result is displayed as Btu/cfm (kWh/l/s) rather than as ton-hours per CFM per year (kilowatt-hours per liter per second per year). The heating and humidifying loads are shown as negative values. Cooling and dehumidifying loads are displayed as positive values.

These calculations are based on the load created when 1 cubic foot (1 liter) of outside air is brought into the building each minute (second). The results of the calculation include the moisture load or deficit, and the sensible heat load or deficit created by that cubic foot of air during each month of the year. Note that most months have both a load and a deficit for temperature and moisture. The monthly deficit and load do not “cancel” from the perspective of the mechanical system, because temperature and moisture loads will often occur at different times of the day.

3-11.2 Alternate Conditions

The values displayed assume that the inside air is maintained between 68 °F (20 °C) and 30% RH and 75 °F (24 °C) and 60% RH. If the inside conditions are held in a different range of temperature or moisture, the loads will be different. For example, in calculating loads for humidity-controlled but unheated storage, the loads vary according to the change in both temperature and humidity, since the inside temperature varies but the inside humidity is held constant. For estimating loads in that or similar applications, the engineer may obtain better results by using the average maximum weekly humidity data shown on Data Set Pages 11 and 12 (Figures 3-11 and 3-12).

3-12 DATA SET PAGES 15 AND 16: SOLAR RADIATION DATA.

Figures 3-15 and 3-16 are samples of Data Set Page 15 and 16, respectively. The data can be used for calculating solar radiation cooling loads and for estimating the value of solar illumination for daylighting calculations. Refer to NREL’s Solar Radiation Data Manual for Buildings (1995) for description of data use.

3-12.1 Data Source.

This data is reproduced courtesy of the National Renewable Energy Laboratory (NREL). The data were first published in the NREL's Solar Radiation Data Manual for Buildings (1995). The user should refer to that publication for a complete description of how to use this data. The manual can be accessed online at http://www.osti.gov/bridge by searching for "NREL/TP--463-7904."

3-12.2 Site Location.

The site used in each station record is the nearest NREL-published site available within a 1.5° latitude radius from the requested location. Consequently, some sites may be several miles away, and in some cases, the NREL location may be in a neighboring state. Use caution when the nearest site available is not in the same city as the requested location, since significant differences in cloud climatology can exist over short distances. When this document was prepared, the only sites available from NREL were Puerto Rico, Guam, and the 50 states. For locations where solar radiation data is not available, Data Set Pages 15 and 16 are blank. For these locations, users may wish to contact NREL directly to obtain advice concerning data not published in the NREL solar radiation data manual.

The data source for the NREL reports comes from the National Solar Radiation Database rather than the data set used to calculate peak design values and other monthly temperature and moisture data in this document. The two data sets will differ for many reasons, including different POR, measurement locations, sampling methodology and frequency, and differences in calculation methodology. Consequently, the user should expect differences in degree-days, minimum and maximum temperatures, and humidity values between this data and that calculated by the 14 WS. For design criteria, use the temperature and moisture values presented on the Design Criteria Data section of Data Set Page 1 (see Figure 3-1) of this document. These were calculated more recently and used a longer POR. Also, they are taken from records at DoD locations rather than from civilian locations near, but not always identical to, the military data collection points.

3-13 DATA SET PAGES 17 AND 18: WIND SUMMARY.

Figures 3-17 and 3-18 are samples of Data Set Page 17 and Data Set Page 18, respectively.

3-13.1 Chart Depiction.

These charts depict the frequency of different wind direction and wind speed combinations. The observations are binned into 36 compass directions and 5 speed categories (1 to 5 knots [1 to 3 m/s], 6 to 14 knots [3 to 8 m/s], 15 to 24 knots [8 to 12 m/s], 25 to 34 knots [12 to 18 m/s], and greater than 34 knots [18 m/s]). The frequency of direction and the tick marks indicate that values lie along each "spoke" of the wind chart. The wind speed bins for each direction are color coded by the legend at the bottom of the chart.

3-13.2 Percent Frequency.

To determine the percent frequency of a particular wind direction, look for the tick mark bounding the outer edge of a colored (wind speed) area. In the case of the first wind speed bin (1 to 5 knots [1 to 3 m/s]), the percent frequency is simply the value of the tick mark on the outer edge of the 1 to 5 knot (1 to 3 m/s) region. For the higher speed bins (6 to 14 knots [3 to 8 m/s] or greater), subtract the earlier spoke values from the value shown to get the frequency for the speed bin in question.

3-13.3 Total Percent Frequency.

The values for percent frequency have been summed by direction, so to determine the total percent frequency for all speeds from a particular direction, look up the tick mark (or interpolated value) bounding the outermost colored area along that spoke. That tick mark represents the total percent frequency of wind from that direction.

3-13.4 Calm Conditions.

Since the calm condition has no direction, the percent occurrence of calm conditions is displayed at the center of the chart or in small print below the chart titles.

3-13.5 Wind Summary Chart Example.

The wind summary charts are prepared by 3-month seasons, over all hours (example: December, January, February for northern hemisphere winter or southern hemisphere summer; March, April, May for northern hemisphere spring or southern hemisphere fall). See the December through February sample wind summary chart in Figure 3-17 for an example of determining percent frequencies.

3-13.5.1 December through February.

From the December through February sample wind summary chart, the percent frequency of wind between 1 to 5 knots (1 to 3 m/s) and from the north is about 1%. The percent frequency of wind between 6 to 14 knots (6 to 8 m/s) and from the south is about 3% (~4.25% minus ~1.25%). The percent frequency of all wind speeds from the south (S) is about 5%. The percent frequency of all wind directions from the west through north (270° - 360°) is about 35% (2% + 2.75% + 3.875% + 4.5% + 4.5% + 4.25% + 3.875% + 3.25% + 3% + 3%, respectively – all values approximated). It is easy to determine that wind speeds greater than 34 knots (18 m/s) almost never occur (or are such a small frequency from any direction) because the colored area (yellow) is not shown or is indistinguishable because it is extremely small.

3-13.5.2 Calm Wind.

The percent of time the wind is calm is indicated in the center of the chart—in this case, 8.1%. (The calm percentage may also be shown in small print below the chart title.) When the outermost value from each of the 36 directions are summed and added to the percent calm, the result is 100% (allowing for rounding). Occurrences of variable wind direction are omitted from the sample before computing percent frequency by direction. The wind currents around any building are strongly affected by the geometry of the building and the topography of the site as well as those of any surrounding buildings. The wind data used for these wind summaries are typical of flat and open airfields where there are no obstructions near the observation point.

Figure 3-1 Data Set Page 1

SCOTT AFB MIDAMERICA, IL	
Latitude = 38.55 N	Station ID = ICAO_KBLV
Longitude = 89.84 W	Elevation = 459 Feet
Period of Record = 1988 To 2017	Average Pressure = 29.55 inches Hg

Design Criteria Data

	Mean Coincident (Average) Values				
Dry Bulb Temperature (T)	Design Value (°F)	Wet Bulb Temperature (°F)	Humidity Ratio (gr/lb)	Wind Speed (mph)	Prevailing Direction (NSEW)
Median of Extreme Highs	100	77	105	7.8	VRB
0.4% Occurrence	95	78	118	7.9	S
1.0% Occurrence	93	77	117	8	S
2.0% Occurrence	90	76	113	8.1	S
Mean Daily Range	20	-	-	-	NW
97.5% Occurrence	18	17	10	8.4	NW
99.0% Occurrence	12	11	7	8	NW
99.6% Occurrence	7	6	5	8.3	NNW
Median of Extreme Lows	1	0	4	7.4	NNW

Wet Bulb Temperature (T_{wb})	Design Value (°F)	Dry Bulb Temperature (°F)	Humidity Ratio (gr/lb)	Wind Speed (mph)	Prevailing Direction (NSEW)
Median of Extreme Highs	83	92	154	7.1	S
0.4% Occurrence	81	90	145	7	S
1.0% Occurrence	79	88	135	6.9	S
2.0% Occurrence	78	87	131	6.9	S

Humidity Ratio (HR)	Design Value (gr/lb)	Dry Bulb Temperature (°F)	Vapor Pressure (in. Hg)	Wind Speed (mph)	Prevailing Direction (NSEW)
Median of Extreme Highs	162	87	1.05	6	S
0.4% Occurrence	151	86	0.99	6.5	S
1.0% Occurrence	143	85	0.94	6.1	S
2.0% Occurrence	134	84	0.88	6.3	VRB

Air Conditioning/ Humid Area Criteria	Threshold	T ≥ 93°F	T ≥ 80°F	Twb ≥ 73°F	Twb ≥ 67°F
	# of Hours	98	1045	925	2083

Other Site Data

Weather Region	Rain Rate 100 Year Recurrence (in./hr)	Basic Wind Speed 3 sec gust @ 33 ft 50 Year Recurrence (mph)	Ventilation Cooling Load Index (Ton-hr/cfm/yr) Base 75°F-RH 60% Latent + Sensible
7	3.3	90	3.8 + 1.1
Ground Water Temperature (°F) 50 Foot Depth*	Frost Depth 50 Year Recurrence (in)	Ground Snow Load 50 Year Recurrence (lb/ft²)	Average Annual Freeze-Thaw Cycles (#)
58.6	38	20	55

*Note: Temperatures at greater depths can be estimated by adding 1.5°F per 100 feet additional depth.

Figure 3-2 Data Set Page 2

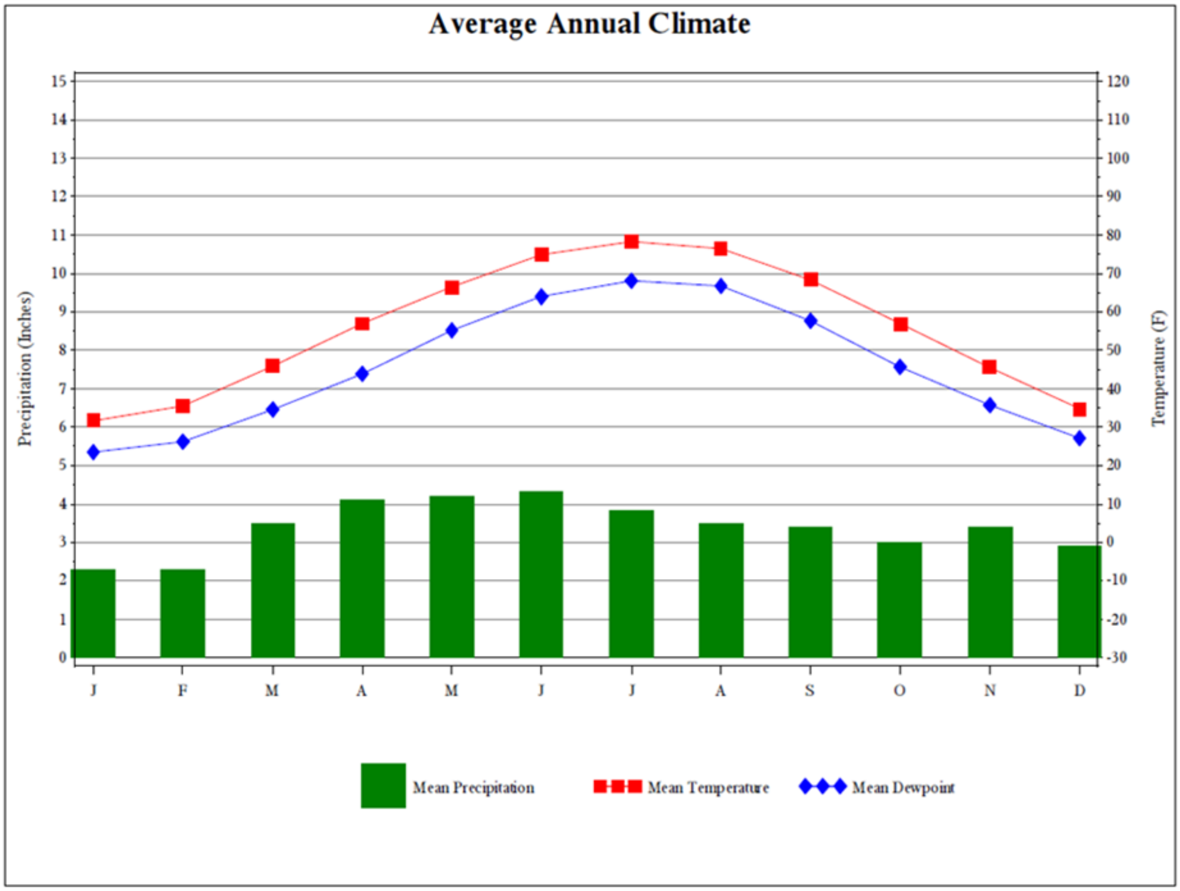


Figure 3-3 Data Set Page 3

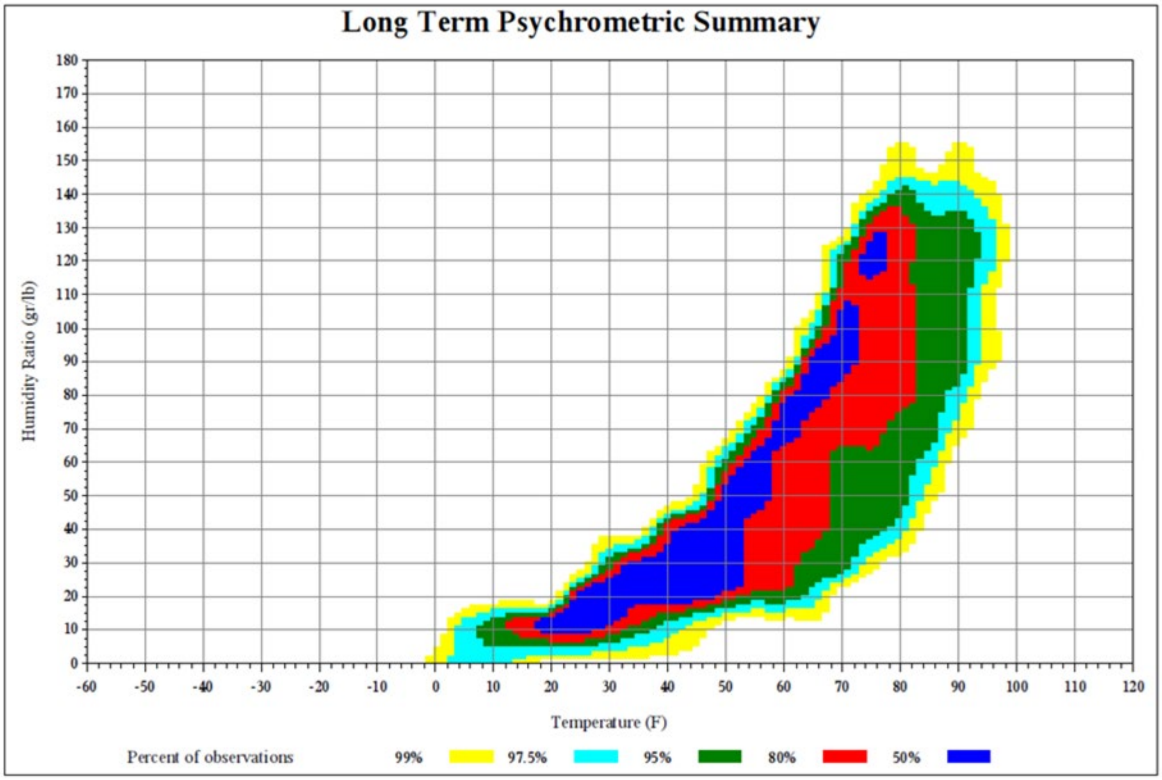
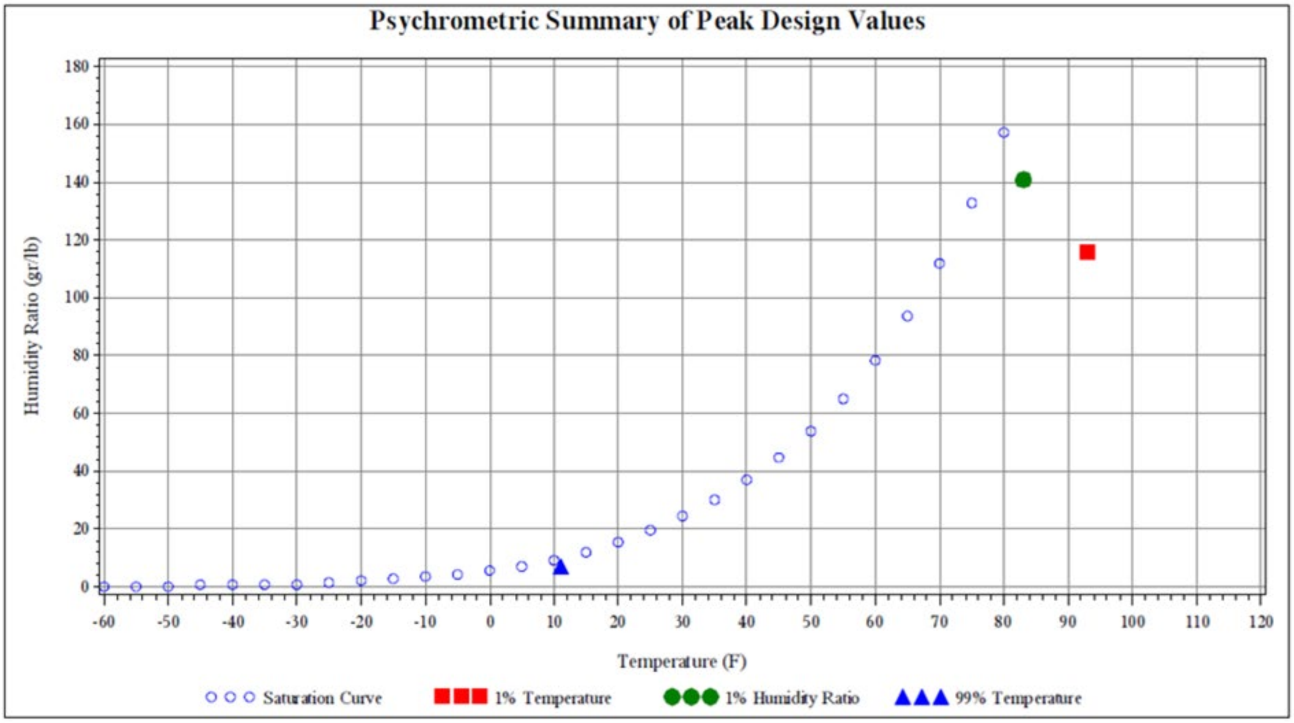


Figure 3-4 Data Set Page 4



	(°F) / (gr/lb)	MCDB (°F)	MCWB (°F)	MCDP (°F)	MCHR (gr/lb)	Enthalpy (btu/lb)
1.0% Dry Bulb	93.0		77		116.0	40.6
99.0% Dry Bulb	11.0				7.0	3.6
1.0% Humidity Ratio	141.0	83.0	78.5	76.7		42.1

Figure 3-5 Data Set Page 5

Dry-Bulb Temperature Hours For An Average Year

Temperature Range (°F)	January					February					March				
	01 To 08 LST	09 To 16 LST	17 to 00 LST	Total Obs	MCWB (°F)	01 To 08 LST	09 To 16 LST	17 to 00 LST	Total Obs	MCWB (°F)	01 To 08 LST	09 To 16 LST	17 to 00 LST	Total Obs	MCWB (°F)
105/109															
100/104															
95/ 99															
90/ 94															
85/ 89												0	0	0	63.6
80/ 84							0		0	57.3		3	0	3	64.5
75/ 79							0	0	0	60.4		9	2	11	63
70/ 74		1		1	58.8		1	0	1	59.3	1	15	7	23	60.4
65/ 69	0	3	0	3	58.8	0	4	1	5	55.9	3	14	13	30	57.3
60/ 64	2	6	3	11	55.5	2	10	5	17	54.1	11	22	18	51	54.4
55/ 59	4	10	6	20	51.8	4	14	9	27	50.2	16	31	24	71	50.2
50/ 54	7	13	10	30	47	7	21	13	41	45.6	19	36	33	88	45.8
45/ 49	7	22	13	42	41.7	14	28	22	64	41.9	36	39	43	118	42
40/ 44	15	28	23	66	38.2	19	28	27	74	38	34	29	33	96	38.1
35/ 39	37	43	43	123	34.1	35	40	42	117	34	47	26	35	108	34.2
30/ 34	49	45	51	145	29.8	48	33	46	127	29.6	40	16	23	79	29.5
25/ 29	42	31	38	111	24.7	43	20	28	91	24.9	25	6	12	43	24.9
20/ 24	27	16	20	63	20.2	20	11	12	43	20.1	10	2	3	15	20.5
15/ 19	24	15	19	58	15.8	15	7	9	31	15.7	5	1	1	7	16.4
10/ 14	17	9	11	37	10.8	9	4	6	19	10.7	1	0	1	2	11.1
5/ 9	11	4	5	20	6.1	6	2	2	10	6	1	0	0	1	6.2
0/ 4	5	1	2	8	1.1	2	0	1	3	0.8	0			0	3
-5/ -1	1	0	1	2	-3	0	0	0	0	-3.3					
-10/ -6	0	0	0	0	-7.4	1	0	0	1	-7.4					
-15/-11	0	0		0	-13.3	0			0	-12					
-20/-16	0			0	-15.5										

Caution: This summary reflects the typical distribtion of temperature in a typical year. It does not reflect the typical mositure distribution. Because wet bulb temperatures are averaged, this summary understates the annual moisture load. For accurate moisture load data, see the long-term humidity summary and the ventilation and infiltration load pages in this manual.

Figure 3-6 Data Set Page 6

Dry-Bulb Temperature Hours For An Average Year

	April					May					June				
Temperature Range (°F)	01 To 08 LST	09 To 16 LST	17 to 00 LST	Total Obs	MCWB (°F)	01 To 08 LST	09 To 16 LST	17 to 00 LST	Total Obs	MCWB (°F)	01 To 08 LST	09 To 16 LST	17 to 00 LST	Total Obs	MCWB (°F)
105/109												0	0	0	71.3
100/104												1	0	1	75.1
95/ 99							0		0	73		5	1	6	75.5
90/ 94		1	0	1	70.4		6	1	7	72.9	0	34	9	43	75.1
85/ 89		4	1	5	68.6		19	5	24	71.6	1	47	19	67	73.3
80/ 84		14	4	18	66.1	1	39	15	55	69.3	8	61	38	107	71.3
75/ 79	0	25	11	36	63.7	7	49	33	89	66.6	34	48	57	139	69.6
70/ 74	6	32	23	61	60.7	26	47	46	119	64.4	72	26	58	156	67.6
65/ 69	12	31	25	68	58.2	44	33	45	122	61.6	56	11	33	100	63.9
60/ 64	28	40	39	107	55.3	57	33	44	134	57.7	43	5	18	66	59.7
55/ 59	39	36	41	116	51.2	45	15	33	93	53	20	2	5	27	55.2
50/ 54	44	27	40	111	47.1	39	6	18	63	49	6	0	1	7	50.4
45/ 49	44	18	28	90	42.7	20	1	7	28	44.5	1			1	46.5
40/ 44	28	9	16	53	38.3	7	0	1	8	40.3					
35/ 39	23	3	10	36	34.5	2		0	2	36.8					
30/ 34	12	1	3	16	29.9										
25/ 29	3	0	0	3	24.7										
20/ 24	0			0	21										
15/ 19															
10/ 14															
5/ 9															
0/ 4															
-5/ -1															
-10/ -6															
-15/-11															
-20/-16															

Caution: This summary reflects the typical distribtion of temperature in a typical year. It does not reflect the typical mositure distribution. Because wet bulb temperatures are averaged, this summary understates the annual moisture load. For accurate moisture load data, see the long-term humidity summary and the ventilation and infiltration load pages in this manual.

Figure 3-7 Data Set Page 7

Dry-Bulb Temperature Hours For An Average Year

	July					August					September				
Temperature Range (°F)	01 To 08 LST	09 To 16 LST	17 to 00 LST	Total Obs	MCWB (°F)	01 To 08 LST	09 To 16 LST	17 to 00 LST	Total Obs	MCWB (°F)	01 To 08 LST	09 To 16 LST	17 to 00 LST	Total Obs	MCWB (°F)
105/109															
100/104		2	0	2	76.6		1	0	1	77.1		0		0	77.8
95/ 99		18	3	21	78.5		14	2	16	78.2		3	0	3	74.6
90/ 94	0	51	16	67	77.3		41	10	51	77		16	2	18	73.8
85/ 89	2	59	26	87	75.1	1	56	19	76	74.5	0	26	5	31	71.4
80/ 84	18	63	56	137	73.2	8	67	45	120	72.6	1	46	15	62	69.2
75/ 79	65	36	68	169	71.8	45	45	68	158	71.3	10	52	35	97	67.6
70/ 74	85	15	52	152	68.9	87	18	62	167	68.8	36	45	50	131	65.5
65/ 69	43	3	19	65	64.7	52	4	27	83	64.5	38	24	41	103	62.5
60/ 64	27	1	8	36	60.7	38	1	12	51	60.5	53	18	42	113	58.7
55/ 59	7		1	8	56.6	14		3	17	55.8	46	8	30	84	54.2
50/ 54	0			0	53	3		0	3	51.1	34	2	14	50	50
45/ 49						0			0	45.1	14	1	4	19	45.4
40/ 44											5		1	6	40.5
35/ 39											2		0	2	36.9
30/ 34											0			0	31
25/ 29															
20/ 24															
15/ 19															
10/ 14															
5/ 9															
0/ 4															
-5/ -1															
-10/ -6															
-15/-11															
-20/-16															

Caution: This summary reflects the typical distribtion of temperature in a typical year. It does not reflect the typical mositure distribution. Because wet bulb temperatures are averaged, this summary understates the annual moisture load. For accurate moisture load data, see the long-term humidity summary and the ventilation and infiltration load pages in this manual.

Figure 3-8 Data Set Page 8

Dry-Bulb Temperature Hours For An Average Year

	October					November					December				
Temperature Range (°F)	01 To 08 LST	09 To 16 LST	17 to 00 LST	Total Obs	MCWB (°F)	01 To 08 LST	09 To 16 LST	17 to 00 LST	Total Obs	MCWB (°F)	01 To 08 LST	09 To 16 LST	17 to 00 LST	Total Obs	MCWB (°F)
105/109															
100/104															
95/ 99															
90/ 94		1		1	71.9										
85/ 89		5	0	5	69.3										
80/ 84		16	1	17	66.1		1		1	63.5					
75/ 79	1	28	7	36	64.1		4	0	4	61.9					
70/ 74	5	36	19	60	61.7	0	12	2	14	60.8		1		1	62.2
65/ 69	13	34	24	71	59.4	2	14	7	23	58.8	0	2	0	2	59.9
60/ 64	28	45	39	112	56	11	25	18	54	55.9	2	7	4	13	57.2
55/ 59	36	37	46	119	51.8	17	33	24	74	51	5	13	7	25	52
50/ 54	47	29	45	121	47.8	23	34	32	89	47	8	20	12	40	47.2
45/ 49	49	15	35	99	43.5	33	42	41	116	42.6	15	32	22	69	42.8
40/ 44	33	3	18	54	39.2	36	31	35	102	38.5	22	33	31	86	38.5
35/ 39	26	1	11	38	35.3	43	25	38	106	34.2	38	50	49	137	34.4
30/ 34	11		2	13	31.1	40	13	28	81	29.7	53	38	49	140	30
25/ 29	1		0	1	26.8	21	4	10	35	25.1	43	25	34	102	25
20/ 24						8	1	4	13	20.5	23	10	18	51	20.4
15/ 19						4	0	2	6	16.4	18	10	12	40	16.1
10/ 14						1		0	1	11.1	10	5	7	22	11.1
5/ 9						0			0	7.2	5	1	3	9	6.4
0/ 4											2	1	1	4	1.5
-5/ -1											1	1	0	2	-3.5
-10/ -6											1	0	1	2	-7.8
-15/-11											0	0	0	0	-12.4
-20/-16															

Caution: This summary reflects the typical distribtion of temperature in a typical year. It does not reflect the typical mositure distribution. Because wet bulb temperatures are averaged, this summary understates the annual moisture load.
For accurate moisture load data, see the long-term humidity summary and the ventilation and infiltration load pages in this manual.

Figure 3-9 Data Set Page 9

Dry-Bulb Temperature Hours For An Average Year

	Annual				
Temperature Range (°F)	01 To 08 LST	09 To 16 LST	17 to 00 LST	Total Obs	MCWB (°F)
105/109		0	0	0	71.3
100/104		5	1	6	76.5
95/ 99		40	6	46	77.7
90/ 94	0	150	37	187	76.2
85/ 89	4	216	75	295	73.7
80/ 84	36	309	174	519	71.2
75/ 79	162	297	280	739	69.2
70/ 74	317	248	319	884	66.1
65/ 69	263	176	236	675	61.8
60/ 64	302	213	250	765	57.3
55/ 59	254	197	229	680	52.1
50/ 54	236	188	218	642	47.4
45/ 49	233	197	216	646	42.7
40/ 44	198	162	186	546	38.4
35/ 39	253	189	228	670	34.3
30/ 34	254	146	202	602	29.8
25/ 29	178	86	123	387	24.9
20/ 24	88	40	57	185	20.3
15/ 19	66	33	43	142	15.9
10/ 14	38	18	25	81	10.8
5/ 9	22	7	10	39	6.1
0/ 4	9	2	3	14	1.2
-5/ -1	2	1	1	4	-3.2
-10/ -6	2	0	1	3	-7.6
-15/-11	1	0	0	1	-12.6
-20/-16	0			0	-15.5

Caution: This summary reflects the typical distribtion of temperature in a typical year. It does not reflect the typical mositure distribution. Because wet bulb temperatures are averaged, this summary understates the annual moisture load. For accurate moisture load data, see the long-term humidity summary and the ventilation and infiltration load pages in this manual.

Figure 3-10 Data Set Page 10

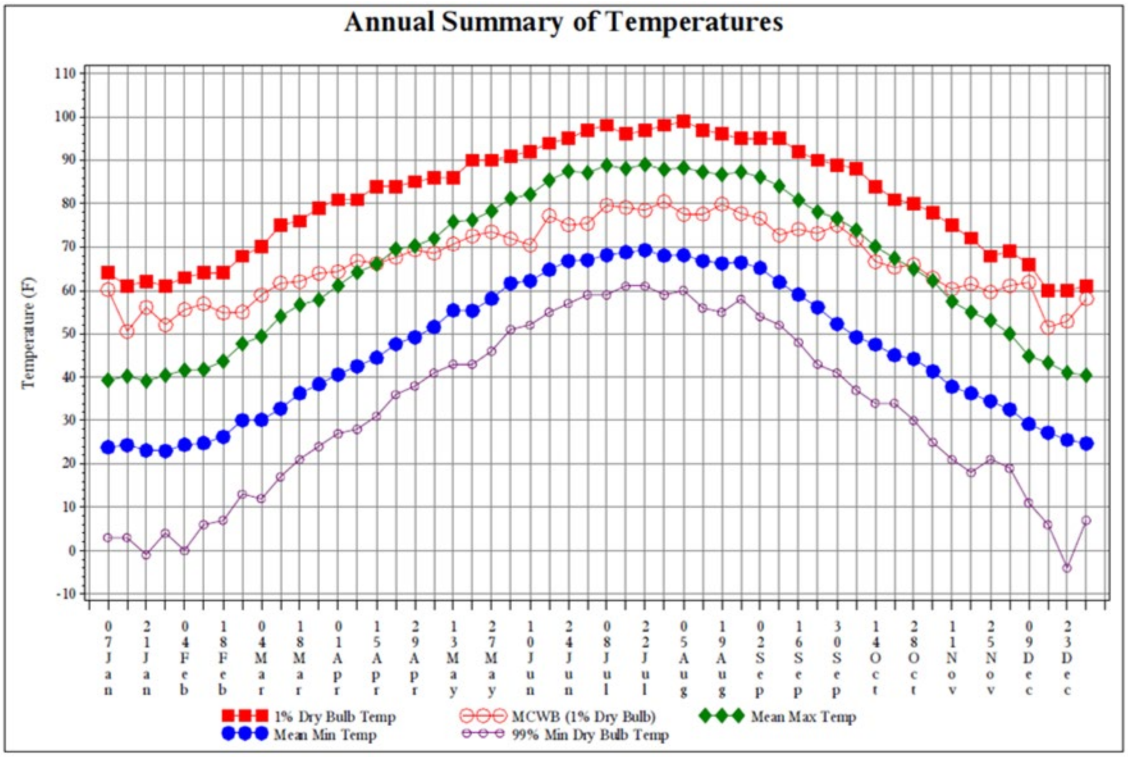


Figure 3-11 Data Set Page 11

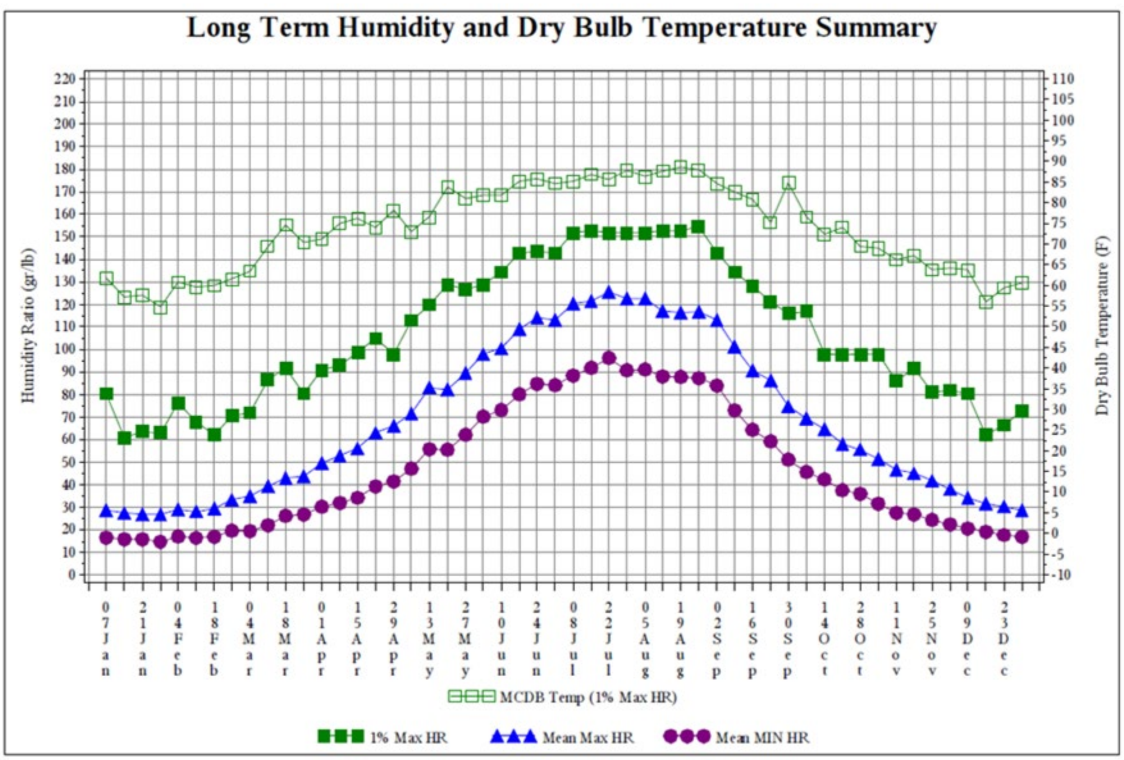
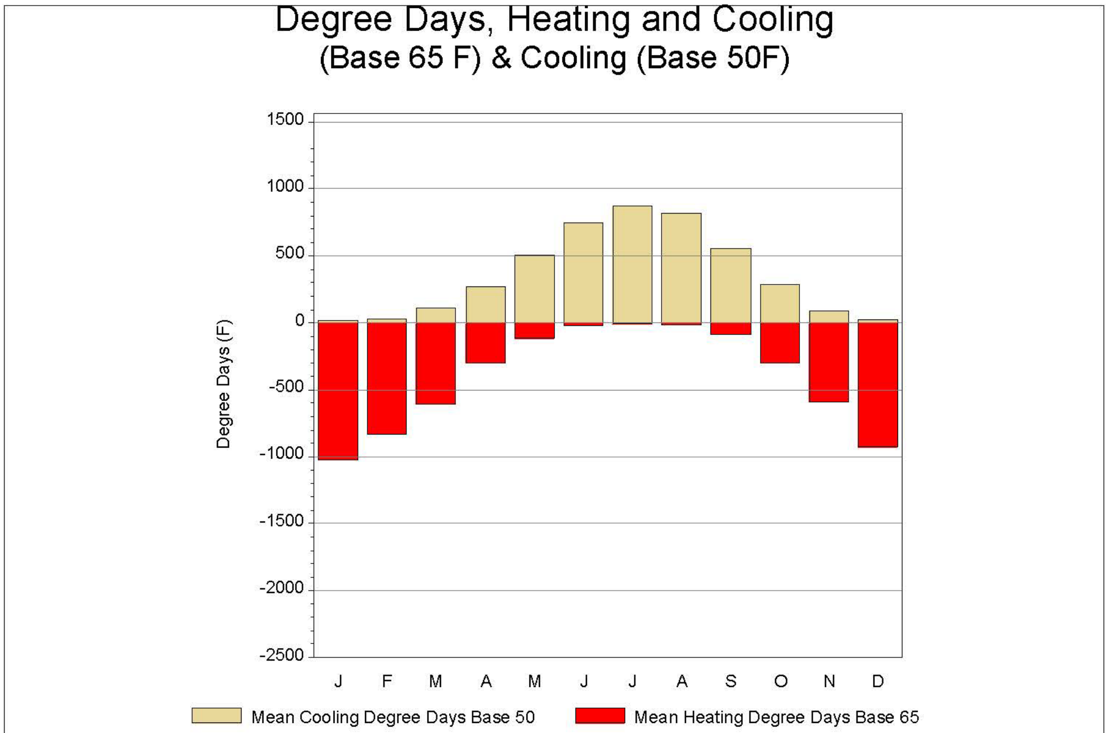


Figure 3-12 Data Set Page 12

Long Term Humidity and Dry Bulb Temperature Summary

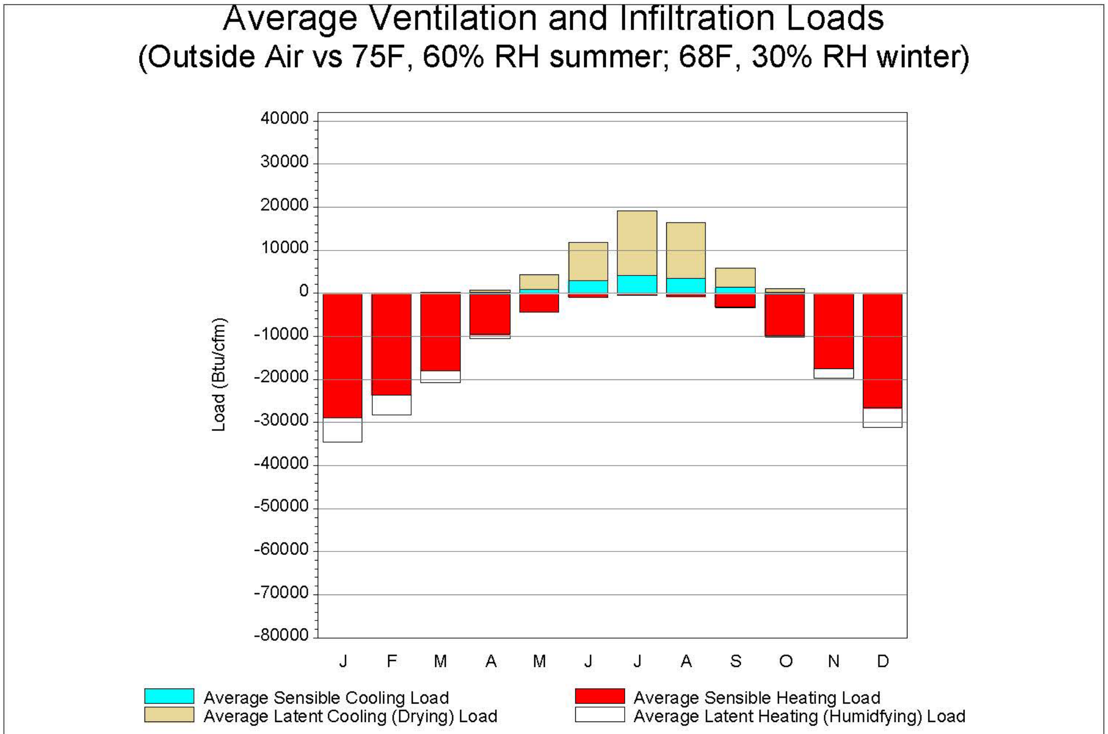
Week Ending	1.0% Temp (°F)	MCWB@ 1% Temp (°F)	Mean Max Temp (°F)	Mean Min Temp (°F)	99% Temp (°F)	1.0% HR (gr/lb)	MCDB@ 1% HR (°F)	Mean Max HR (gr/lb)	Mean Min HR (gr/lb)
7-Jan	64	60.2	39	23.5	1	80.5	61.8	29.1	16.7
14-Jan	63	54.4	40.3	23.9	3	63	57.5	28.4	15.9
21-Jan	61	53.5	39.5	23.5	0	65.1	58.3	27.6	16.5
28-Jan	61	52	41.7	24.3	5	63	54.8	28.4	15.9
4-Feb	63	55.4	42.3	24.9	2	63.7	56.8	29.1	17.1
11-Feb	64	56.6	42.7	25	7	72.1	59.6	29.4	16.8
18-Feb	64	53.9	43.8	26.3	7	63	59.2	29.7	17
25-Feb	70	60.5	48	29.7	10	75.6	63.8	34.3	19.8
4-Mar	70	58.9	49.1	29.4	11	76.3	60.6	35.1	19.2
11-Mar	75	61.7	54.1	32.8	16	86.8	69.2	40.4	22.7
18-Mar	77	64.1	56.8	36.3	21	91.7	74.8	44.1	26.7
25-Mar	79	63.9	58.2	38.3	25	80.5	69.7	44.8	27.5
1-Apr	79	63	60.9	40.3	26	91.7	71.8	49.9	30.6
8-Apr	81	67	64.2	42.6	29	98	74.7	54.1	32.7
15-Apr	84	66.2	66.6	44.7	31	98.7	75.9	57.1	34.6
22-Apr	84	67.8	69.6	47.6	36	105	73.8	64	39.8
29-Apr	84	67.5	69.8	49	39	98	77.6	66.3	42.1
6-May	86	69.2	71.3	51.1	40	112.7	74.9	71.1	47.2
13-May	86	71	75.5	55.2	43	120.4	77	83.9	56.1
20-May	88	70.3	75.8	55	43	126	80.5	81.8	55.4
27-May	90	73.5	78.1	58	46	126.7	80.7	90	62.6
4-Jun	91	71.8	80.8	61.2	51	128.8	81.9	97.3	70.2
10-Jun	92	71	82.3	61.8	52	133.7	82.1	99.9	72.8
17-Jun	93	74.7	85.8	65.4	56	143.5	85.3	111.8	82.9
24-Jun	96	74.8	87.6	67	57	143.5	85.5	115.3	85.1
1-Jul	97	75.6	87.1	66.8	58	142.8	84.5	113.4	84.6
8-Jul	98	79.6	88.5	67.9	59	151.9	85.2	121.4	89.1
15-Jul	96	79	88.1	68.7	61	160.3	86.6	122.3	92.5
22-Jul	97	78.5	89.1	69.5	61	161	87.5	128.4	98.6
29-Jul	97	79	87.6	68.2	59	157.5	87.7	123.7	92.8
5-Aug	97	78	88.2	68	60	151.9	86.3	123.1	92.2
12-Aug	97	77.6	87.2	66.8	56	157.5	86.5	118.4	89.6
19-Aug	96	79.9	86.6	66	55	152.6	88.7	117	88.9
26-Aug	95	78.1	87.2	66.2	57	154.7	88	117.6	88
2-Sep	95	76.6	86.5	65.5	55	142.8	84.5	115.3	86.7
9-Sep	95	73	84.1	61.8	52	135.8	81.6	102.9	74.6
16-Sep	92	74.5	80.7	58.9	48	128.1	80.8	92.4	65.4
23-Sep	91	73.3	78.6	56.1	43	120.4	75	88.4	60.8
30-Sep	89	73	76.5	52.3	41	111.3	77.4	75.5	51.7
7-Oct	88	71.8	74.8	50.4	37	114.1	76.6	72.5	48.4
14-Oct	84	66.9	70.7	47.6	34	103.6	74	65.9	43
21-Oct	82	64.7	67.9	45.3	34	100.8	72.8	58.4	38
28-Oct	80	65.4	65.1	44	30	98.7	71.9	56.7	36.4
4-Nov	78	63.5	62.2	41.2	25	98	69	53	32.7
11-Nov	75	61.8	57.8	37.5	21	91.7	71.2	47.3	28.2
18-Nov	73	60.2	55.4	36.4	19	88.2	66.6	45.3	26.9
25-Nov	68	59	53.3	34.2	21	81.2	63.9	41.3	24.5
2-Dec	70	61.9	50.9	32.6	19	80.5	65.8	38.2	22.8
9-Dec	66	61.2	45.1	29.1	11	80.5	63.8	34.4	20.8
16-Dec	63	56.6	44.2	27.7	6	75.6	59.3	33.2	19.8
23-Dec	61	57.3	41.7	26.1	-4	70.7	59.6	31.3	18.3
31-Dec	61	58.2	40.5	24.7	7	72.8	60.5	29.5	17.2

Figure 3-13 Data Set Page 13



Month	Mean Cooling Degree Days (°F) Base 50	Mean Cooling Degree Days (°F) Base 65	Mean Heating Degree Days (°F) Base 65
JAN	17.2	0.4	1019.8
FEB	28.7	1.7	829
MAR	112.3	16.1	608
APR	269.5	54.7	296.7
MAY	504.1	147.1	115.9
JUN	749.1	318.1	19
JUL	872.4	413	5.6
AUG	818.6	365.5	11.9
SEP	556.6	188.7	87.1
OCT	283.9	60.2	301.5
NOV	92.3	8.3	587.5
DEC	21.1	0.4	930.1
ANN	4325.8	1574.2	4812.1

Figure 3-14 Data Set Page 14



Month	Average Sensible Cooling Load (Btu/cfm)	Average Sensible Heating Load (Btu/cfm)	Average Latent Cooling Load (Btu/cfm)	Average Latent Heating Load (Btu/cfm)
JAN	0	-28836	7	-5690
FEB	1	-23661	10	-4528
MAR	42	-17990	106	-2710
APR	243	-9509	473	-814
MAY	927	-4252	3330	-67
JUN	2906	-912	9012	-1
JUL	4210	-351	14805	0
AUG	3466	-621	13011	0
SEP	1450	-3268	4475	-20
OCT	295	-9676	796	-565
NOV	14	-17452	108	-2285
DEC	0	-26512	15	-4625
ANN	13554	-143040	46148	-21305

Figure 3-15 Data Set Page 15

Average Annual Solar Radiation - Nearest Available Site
Source: National Renewable Energy Laboratory, Golden CO, 1995

Station Information		Shading Geometry in Dimensionless Units	
City, State, WBAN	ST.LOUIS, MO 13994	Window:	1.000
Lat, Lon, Elev	38.75N 90.38W 564ft	Overhang:	0.498
Press, Stn_Type	14.5psia Secondary	Vert Gap:	0.314

AVERAGE INCIDENT SOLAR RADIATION (Btu/sq.ft./day) Percentage Uncertainty = 9

		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
HORIZ.	Global	690	930	1230	1590	1860	2030	2020	1800	1460	1100	720	580	1340
	Std.Dev.	56	69	98	135	138	114	120	110	112	98	69	57	42
	Minimum	550	800	1060	1370	1550	1830	1750	1570	1190	870	590	490	1280
	Maximum	780	1070	1430	1930	2180	2350	2240	1960	1690	1250	870	710	1480
	Diffuse	340	460	590	710	810	840	810	730	600	430	350	300	580
Clear Day	Global	950	1300	1760	2230	2520	2630	2550	2290	1870	1400	1000	840	1780
NORTH	Global	210	280	360	440	550	630	600	490	380	290	220	190	390
	Diffuse	210	280	360	430	500	530	520	460	380	290	220	190	370
Clear Day	Global	190	250	330	430	580	680	630	470	360	270	200	170	380
EAST	Global	460	590	750	920	1060	1140	1130	1050	880	710	470	390	800
	Diffuse	260	340	440	530	600	640	620	570	470	360	270	230	440
Clear Day	Global	710	910	1150	1340	1440	1460	1430	1340	1170	940	730	640	1110
SOUTH	Global	1080	1110	1060	970	830	780	820	950	1110	1220	1020	940	990
	Diffuse	370	440	500	540	560	570	570	560	520	440	360	330	480
Clear Day	Global	1930	1970	1770	1380	1040	890	950	1210	1580	1840	1870	1860	1520
WEST	Global	470	600	740	920	1040	1110	1120	1030	880	700	480	390	790
	Diffuse	260	340	440	530	610	650	630	580	480	360	270	230	450
Clear Day	Global	710	910	1150	1340	1440	1460	1430	1340	1170	940	730	640	1110

Figure 3-16 Data Set Page 16

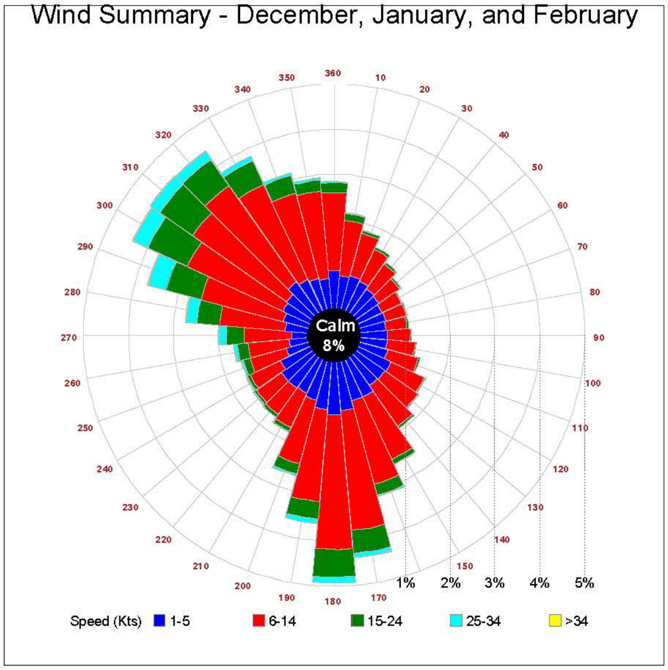
Average Annual Solar Radiation - Nearest Available Site
Source: National Renewable Energy Laboratory, Golden CO, 1995

AVERAGE TRANSMITTED SOLAR RADIATION (Btu/sq.ft./day) FOR DOUBLE GLAZING Percentage Uncertainty = 9														
		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
HORIZ.	Unshaded	450	640	870	1150	1350	1480	1470	1300	1040	770	480	370	950
NORTH	Unshaded	150	190	250	300	370	410	390	330	260	200	150	130	260
	Shaded	130	170	220	270	330	370	350	300	240	180	140	110	230
EAST	Unshaded	320	410	530	660	750	810	810	750	620	500	320	270	560
	Shaded	290	370	470	570	650	700	700	650	550	450	290	240	490
SOUTH	Unshaded	810	810	740	630	510	470	490	600	750	870	760	700	680
	Shaded	790	750	590	420	350	360	360	390	550	770	730	680	560
WEST	Unshaded	320	420	520	650	740	790	800	740	620	490	330	270	560
	Shaded	290	370	460	570	640	680	690	640	550	440	300	240	490

AVERAGE INCIDENT ILLUMINANCE (klux-hr) FOR MOSTLY CLEAR AND MOSTLY CLOUDY CONDITIONS Percentage Uncertainty = 9											
				March					June		
		9am	11am	1pm	3pm	5pm	9am	11am	1pm	3pm	5pm
HORIZ.	M.Clear	40	73	82	64	26	48	84	101	96	67
	M.Cloudy	23	45	52	40	16	32	61	76	71	49
NORTH	M.Clear	10	14	15	13	8	19	16	17	17	15
	M.Cloudy	9	16	17	14	7	15	18	19	19	16
EAST	M.Clear	75	56	15	13	8	78	72	31	17	15
	M.Cloudy	25	30	17	14	7	40	49	27	19	16
SOUTH	M.Clear	40	73	82	64	26	12	31	45	41	19
	M.Cloudy	17	36	43	32	12	12	26	37	33	18
WEST	M.Clear	10	14	24	67	64	12	16	17	53	78
	M.Cloudy	9	16	21	33	22	12	18	19	41	50
M.Clear	(% hrs)	32	28	27	28	29	43	39	32	29	34

				Sept					Dec		
		9am	11am	1pm	3pm	5pm	9am	11am	1pm	3pm	5pm
HORIZ.	M.Clear	29	68	86	78	47	16	42	48	30	2
	M.Cloudy	17	42	58	53	31	9	25	28	17	2
NORTH	M.Clear	9	14	16	15	12	6	10	11	8	1
	M.Cloudy	7	15	18	17	12	4	10	11	7	1
EAST	M.Clear	65	70	28	15	12	42	39	11	8	1
	M.Cloudy	23	36	23	17	12	11	18	11	7	1
SOUTH	M.Clear	21	57	75	67	37	39	82	88	63	6
	M.Cloudy	11	31	45	41	21	10	29	32	20	2
WEST	M.Clear	9	14	16	54	74	6	10	22	50	9
	M.Cloudy	7	15	18	35	35	4	10	14	17	2
M.Clear	(% hrs)	47	47	41	41	43	31	30	30	30	32

Figure 3-17 Data Set Page 17



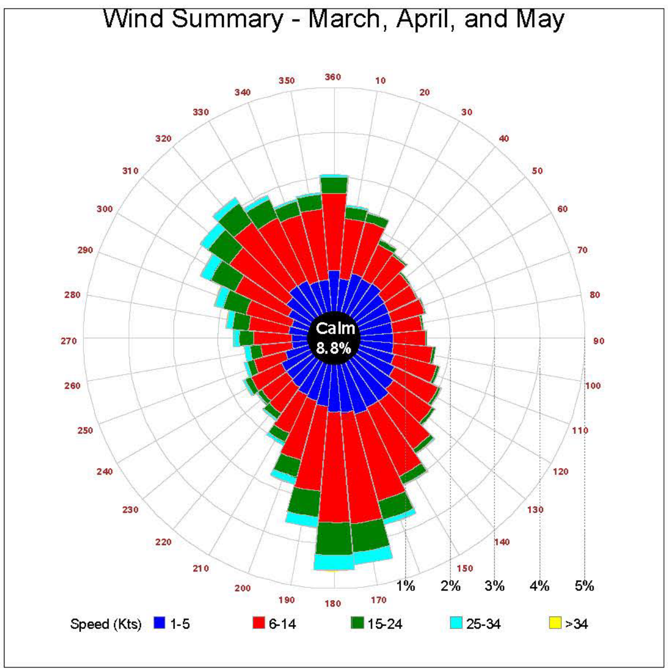
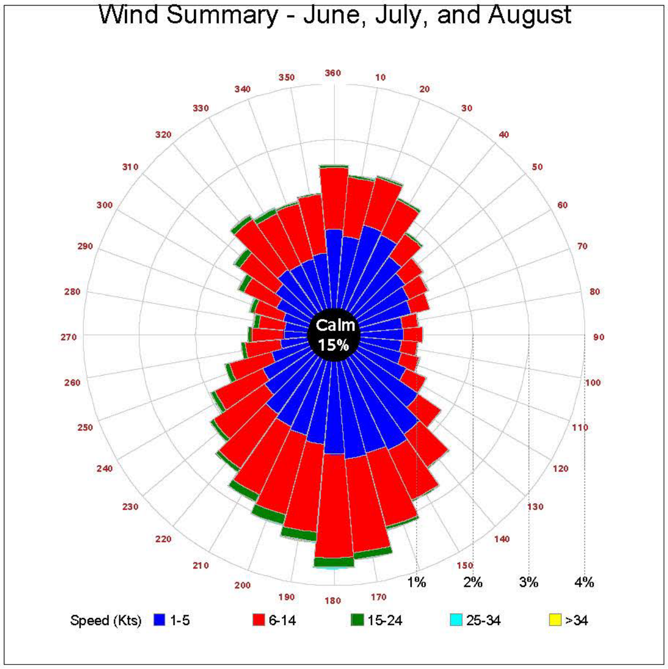
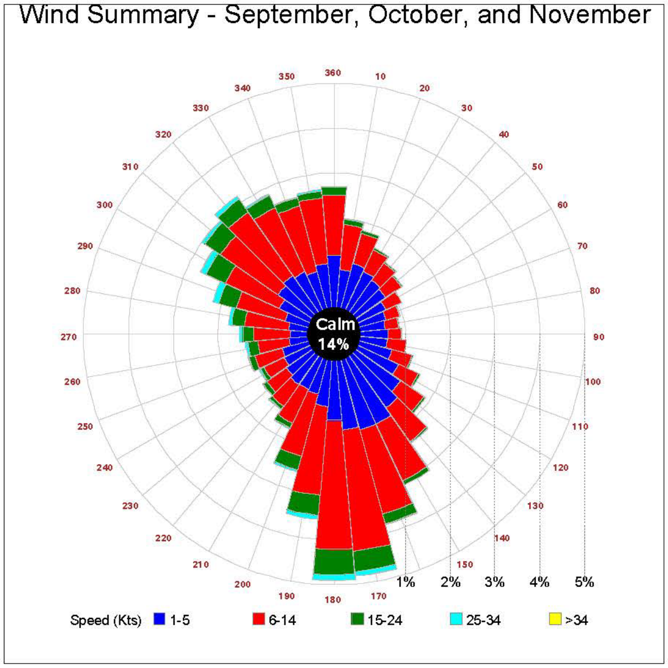


Figure 3-18 Data Set Page 18





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APPENDIX A SAMPLE SAR FORM

Figure A-1 SAR Form

14WS SUPPORT ANALYSIS REQUEST (SAR)

SUBJECT

CONTACT INFORMATION

RANK/TITLE | FULL NAME

TELEPHONE NUMBER | E-MAIL

ORGANIZATION | STATION

ORGANIZATION TYPE: | LOCATION

Are you Meteorological or Oceanographic Personnel? Yes ◉ No ○

Are you a part of the Air Force Weather community? Yes ◉ No ○

REQUEST

When do you need your data?

Describe what you need, include specific locations, if applicable and all pertinent details:

Who will receive the information? What it will be used for? Include any tangible benefits or expected impacts. If classified, contact via classified email.

IF DOD CONTRACTOR
MILITARY POINT OF CONTACT

RANK/TITLE | FULL NAME

CONTACT TELEPHONE | CONTRACT NUMBER

14 WS FORM 1, DEC 17 ***(EF-V3)*** PREVIOUS EDITIONS MAY BE USED. PAGE 1 OF 1 PAGES

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APPENDIX B GLOSSARY

B-1 ACRONYMS.

14 WS	14th Weather Squadron
AFCEC	Air Force Civil Engineer Center
BIA	Bilateral Infrastructure Agreement
Btu/cfm	British thermal unit per cubic foot per minute
°C	Degrees Celsius
CCR	Criteria Change Request
CDD10	Cooling Degree-Days based on 10 °C
CDD18	Cooling Degree-Days based on 18 °C
CDD50	Cooling Degree-Days based on 50 °F
CDD65	Cooling Degree-Days based on 65 °F
CFM	Cubic foot per minute
DoD	Department of Defense
EWD	Engineering Weather Data
°F	Degrees Fahrenheit
g/kg	Grains per kilogram
g/lb	Grains per pound
HDD18	Heating Degree-Days based on 18 °C
HDD65	Heating Degree-Days based on 65 °F
HQUSACE	Headquarters, U.S. Army Corps of Engineers
HNFA	Host Nation Funded Construction Agreements
kWh/l/s	Kilowatt-hours per liter per second
m/s	Meters per second
NAVFAC	Naval Facilities Engineering Systems Command

POR	Period of Record
RH	Relative Humidity
SAR	Support Assistance Request
SOFA	Status of Forces Agreements
UFC	Unified Facilities Criteria
U.S.	United States
VCLI	Ventilation Cooling Load Index

APPENDIX C REFERENCES

NATIONAL CENTERS FOR ENVIRONMENTAL INFORMATION

https://www.ncei.noaa.gov/

NATIONAL RENEWABLE ENERGY LABORATORY

Solar Radiation Data Manual for Buildings
https://www.osti.gov/search/semantic:nrel/tp--463-7904

U.S. DEPARTMENT OF ENERGY OFFICE OF SCIENTIFIC AND TECHNICAL INFORMATION

http://www.osti.gov/bridge

UNIFIED FACILITIES CRITERIA

https://www.wbdg.org/dod/ufc

UFC 1-200-01, *DoD Building Code*

UFC 1-200-02, *High Performance and Sustainable Building Requirements*

UFC 3-301-01, *Structural Engineering*

UFC 3-410-01, *Heating, Ventilating, and Air-Conditioning Systems*