

Assignment 5: Master Plans and Wind Rose Analysis

Solution

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Problem 1

Briefly answer the following questions with two or three short sentences.

- a) The master plan for LAX explained in class included two alternatives each one with one additional runway. Explain why such alternatives were discarded.

The two alternatives with an additional runway offer little capacity improvements because the runways would have been to close to existing runways.

- b) The master plan process must involve the community. Explain why as an engineer you need to involve the community. How would you involve the community. Provide one concrete example.

Many times communities are oppose to airport expansion programs. Noise, pollution and ground traffic are some of the reasons why communities do not like airport expansions.

- c) Flora and fauna are considerations in the master plan. Explain the rationale for including such factors.

Endangered species and birds are two important reasons to be included in master plans. Birds present a challenge and risk to aircraft operations.

- d) Explain the reasons for the low flight demand at the Felipe Angeles Mexico airport.

The airport is located far away from the population centers of Mexico City. Besides, the airport lacks a fast and reliable ground access transportation. Airports need good ground connections for accessibility.

- e) Why environmental considerations are important in master plans? Give an example.

It is important to develop airports in a sustainable fashion. Noise, emissions and wetlands are some of the items studied in environmental impact statement plans.

Problem 2

Collect summarized wind information for Virginia Tech Airport (BCB) using the Iowa State Mesonet Database available at <https://mesonet.agron.iastate.edu/agweather/>. Perform a custom wind rose as explained in class. Use data from 1994 until the most recent datasets. Import the wind data collected into an Excel spreadsheet (or program of your choice) and answer the following questions.

- a) Show the graphical depiction of a custom wind rose with wind speed bins in knots at 3,5,10,16,21 and 27 knots.

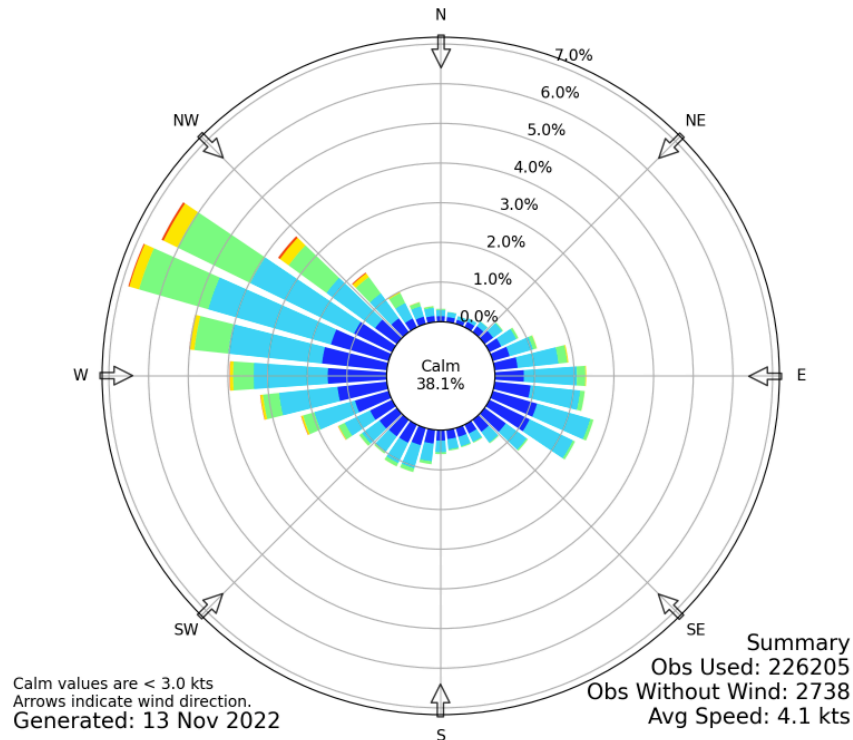


Figure 1. BCB Wind Rose with Custom Speed Intervals.

- b) How often do calm winds prevail at BCB airport?

If calm winds are considered below 3 knots, 38.1% of the time winds are calm at BCB.

- c) What is the most prevalent wind direction observed at BCB during the period of analysis?

6.8% of the time, the wind is reported from 285-295 degrees. This is the most prevalent wind direction.

- d) Find the percent of time, wind speeds range from 10-21 knots at the airport (all directions).

11.25% of the time, the wind is reported with speeds 10-21 knots.

- e) Find the percent of time the wind blows from directions from 240 to 320 degrees.

33.71% of time the wind is reported between 240-320 degrees.

- f) What is the design crosswind component for a Bombardier Challenger 350 aircraft (see Figure 1).

16 knots because it belongs to group C-II.

Problem 3

Answer the following questions.

- a) A 1,900 meter runway is to be constructed at a new airport in Pakistan. Find the design crosswind component for the airport.

ICAO runway code for runways greater than 1,500 meters require 20 knot critical wind component.

- b) A new airport in Oregon is designed to serve the following aircraft: Boeing 787-9, Boeing 737-8Max, Airbus A320, Embraer 190, and large corporate jets represented by the Gulfstream 550. Find the design crosswind component for the airport.

Critical aircraft is the Boeing 787-9. ADG V AAC D. 20 knot crosswind component.

- c) One day an Airbus A319 lands on runway 06 at Roanoke-Blacksburg Regional Airport. The pilot listens to the Automated Surface Observing System (ASOS) which reports the wind from 100 degrees and 24 knots. Find the crosswind and headwind/tailwind component for the flight.

ASOS report is magnetic heading. Runway magnetic heading is 58 degrees. Wind is 48 degrees off the runway heading.

Crosswind = $24 \sin(48) = 17.8$ knots.

- d) Find the design crosswind component for a Pilatus PC-12 NG (see Figure 2). State the ADG and AAC groups for the aircraft.

ADG II and AAC A. 13 knots crosswind component.

Problem 4

Use the BCB airport data collected for Problem 2 to answer the following questions. The Bombardier Challenger 350 is the design aircraft at BCB.

- a) Use Autocad and the wind rose DWG/DXF templates provided in class, to plot the traditional wind rose used in airport design. The traditional wind rose should have the percentage of wind reported values in each cell of the wind rose.

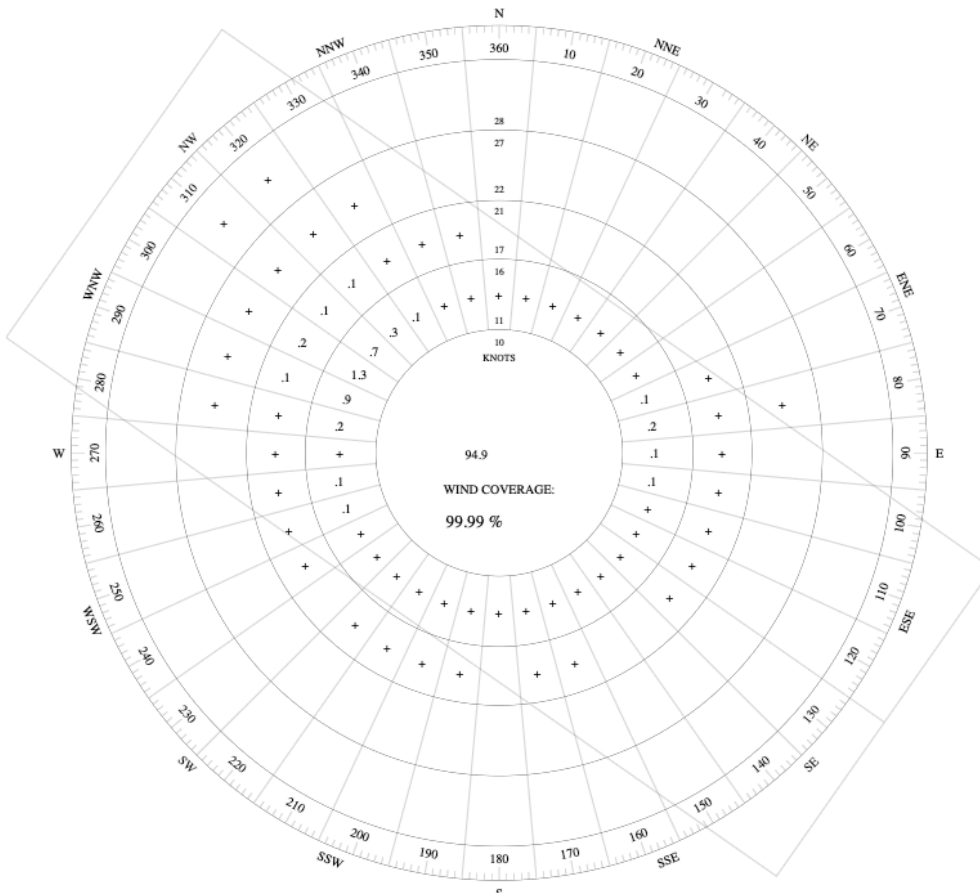


Figure. BCB Wind Rose with 16-knot Crosswind Component. Design Aircraft is C-II.

- b) Find the percent of the time runway 31 can be used for departures (or arrivals) at the airport if a zero tailwind allowance is used. Pilots of small planes do not like to takeoff with a tailwind conditions.

77.02% of the time pilots can use runway 31 (see figure below).

- c) Find the percent of the time runway 13 can be used for departures (or arrivals) at the airport if a zero tailwind allowance is used.

66.9% of the time (see figure below).

- d) Find the crosswind coverage at BCB. Does the airport meets the 95% coverage rule? Explain.

Yes it does. Using the runway from both directions provides a 99.9% coverage with 16-knot crosswind component.

- e) The airport used to have two runways three decades ago. The second runway was oriented 06/24. Explain why the airport could make a change from two runways to one?

The crosswind component for small aircraft operating decades ago was 10.5 knots. The new crosswind component of 16 knots provides more flexibility to orient a runway.

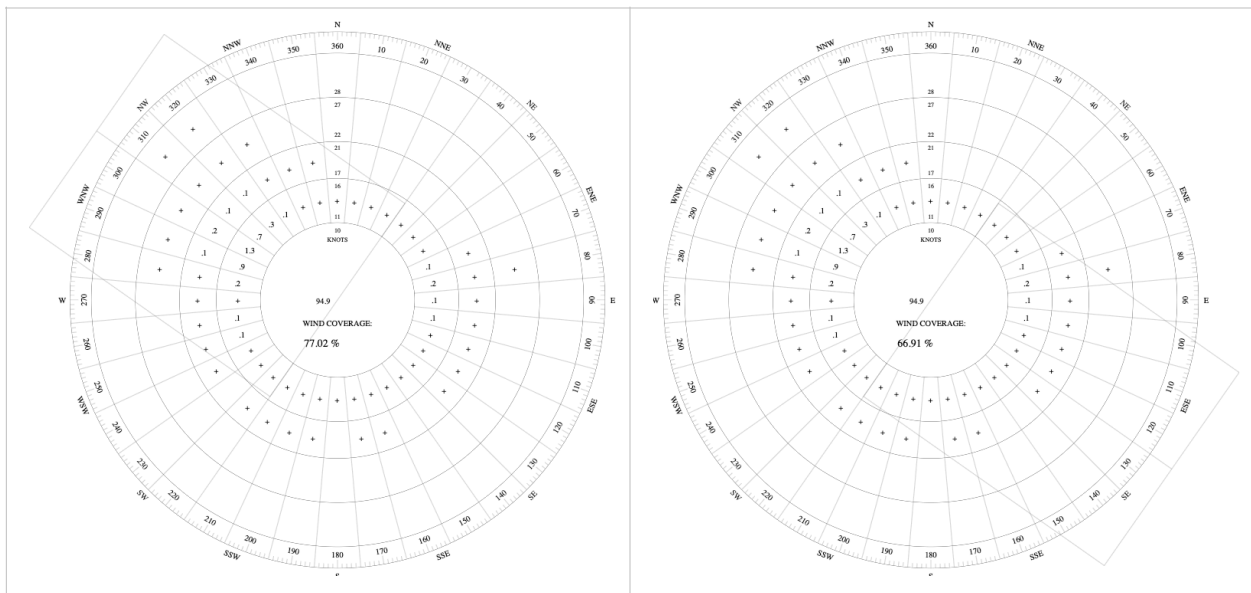


Figure. BCB Operations. Runway 31 Left. Runway 13 Right.