Assignment 5: Master Plans and Wind Rose Analysis

Solution Instructor: Trani

Problem 1

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

a) A master plan traditionally includes aviation demand forecasts. Explain the typical time horizon of master plan forecasts.

20 years or more depending on the time horizon that the client requires.

b) Explain why involving the community around an airport is a good idea in developing a master plan.

Maybe the community will protest for the airport construction and expansion. The airport has an effect on the surroundings, such as noise and land use and land development.

c) Master plans should involve financial considerations. Explain why.

Airport construction is not only a civil engineering problem, but also a financial problem. We should balance the cost and revenue. A medium or large size airport is an expensive investment. It requires several billion dollars for land acquisition, construction, operation, and maintenance.

d) How often should we revise or update airport master plans? Briefly explain.

5 years. May be 10 years for small airports.

e) Why environmental considerations are important in master plans? Give a couple of examples.

The master plan sometimes should be scotched if an EIS has been completed.

For a runway extension at LAX airport, a dangerous species of butterfly that is unique for that area.

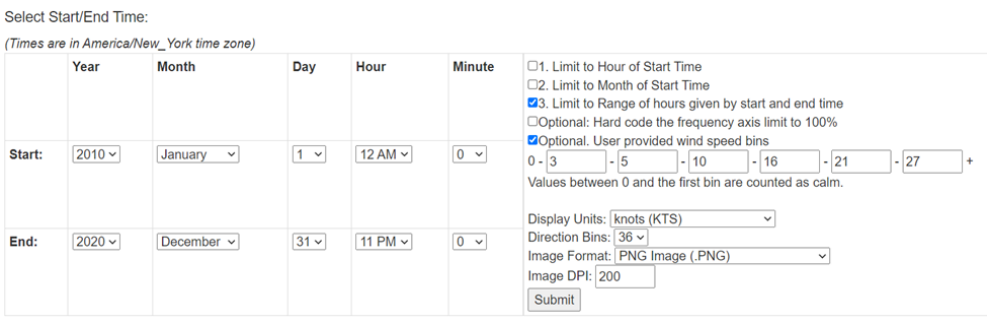
Noise concerns at Schipol airport in the Netherlands allows runway operations in one direction for takeoffs.

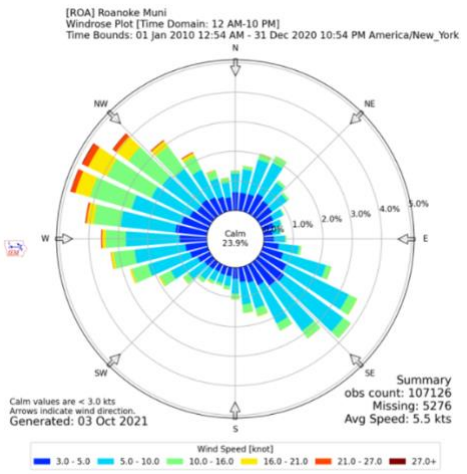
A second runway was constructed in Punta Cana to mitigate noise impacts on neighboring communities.

Problem 2

Collect summarized wind information for Roanoke Municipal Airport (ROA) using the Iowa State Mesonet Database available at https://mesonet.agron.iastate.edu/agweather/. Note that today the airport is named Roanoke-Blacksburg Regional Airport. Perform a custom wind rose as explained in class. 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.





b) How often do calm winds prevail at ROA airport?

23.92 percent of time is calm winds for recent years. (2010-2020)

c) Find the percent of time, wind speeds range from 5-16 knots at the airport (all directions).

50.773%

d) Find the percent of time, wind speeds range from 10-16 knots and wind direction range from 265 to 314 degrees (with both conditions met simultaneously).

6.613%

e) What is the crosswind component for a Cessna 340 aircraft (see Figure 1) landing on runway 13 in Blacksburg when the automated weather observation system reports winds from 090 degrees (true) at 20 knots.

20*sin (117-90) =9.1 kts

f) A 3,500 meter runway is to be constructed at a new airport in Pusan, Korea. Find the design crosswind component for the airport.

20 knots based on ICAO Crosswind Design Criteria (runways Code 4)

g) A Boeing 737-8Max is the largest aircraft operated at a regional airport in the US. Find the design crosswind component for the airport.

RDC for Boeing 737-8 Max is D-III.

The design crosswind component for the airport is 16 knots.

h) Figure 2 shows a 20-year old diagram for DCA airport. Explain the change of runway labels 18-36 and 3-21 (in 2000) to 01-19 and 04-22 (today). Use the current runway heading information available in Airnav to explain.

This is because the magnetic variation (or declination) of the airport can change over time. The runway labels depend on the magnetic azimuth.

Today, runway 19 has a magnetic heading of 186. Dive by 10 and the nearest integer is 19.

04-22 heading 037 magnetic and 217 magnetic

Figure 1. Cessna 340 at BCB Airport.

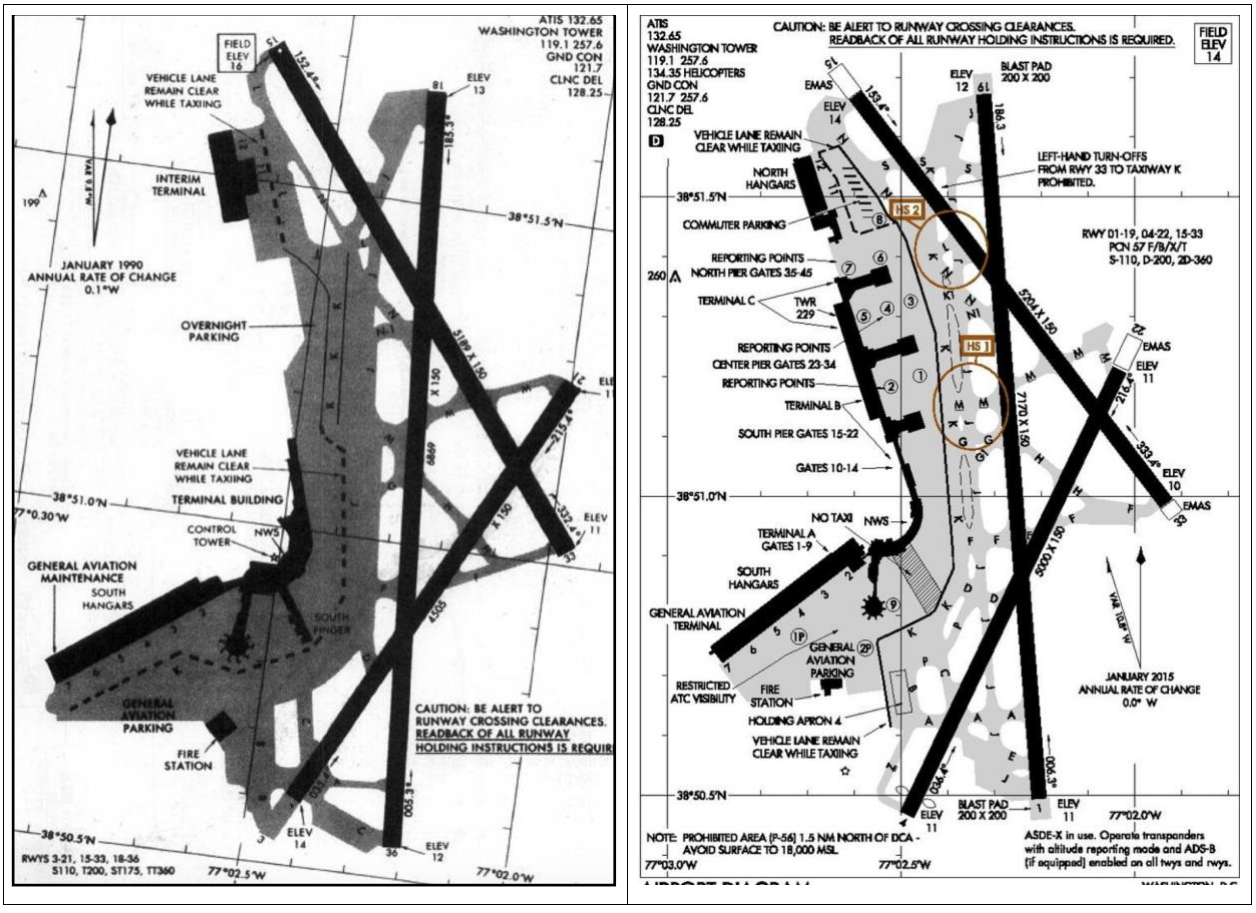


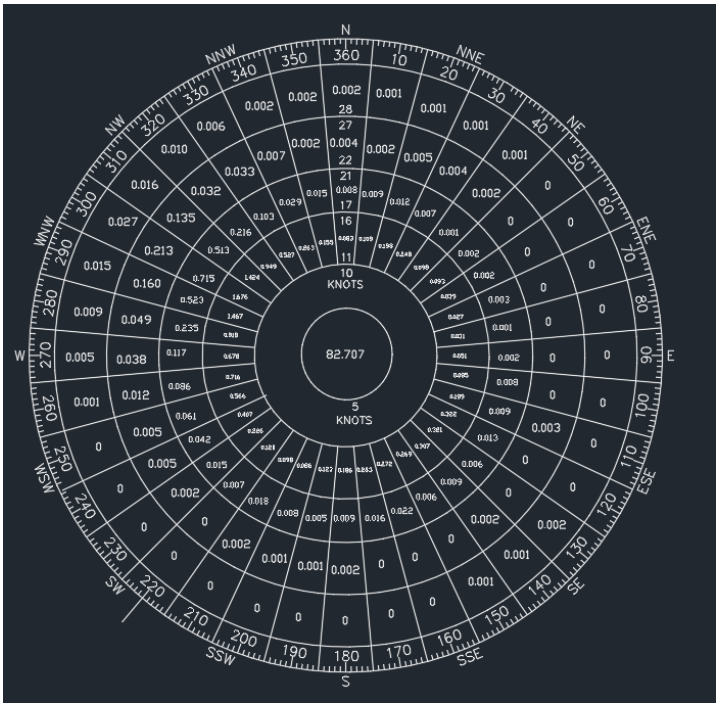
Figure 2. DCA Airport Diagrams. Left Diagram is Circa 2000. Right Diagram is Today's Airport.

Problem 3

Use the ROA airport data collected from the Mesonet Database in Problem 2 to answer the following questions.

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.

Direction	Calm(0~2.(	3.0~4.9	5.0~9.9	10.0~15.(	16.0~20.(	21.0~26.(	27.0+
355-004	23.92	0.617	0.633	0.083	0.008	0.004	0.002
005-014		0.606	0.795	0.109	0.009	0.002	0.001
015-024		0.615	1.212	0.198	0.012	0.005	0.001
025-034		0.732	1.17	0.248	0.007	0.004	0.001
035-044		0.629	0.758	0.098	0.001	0.002	0.001
045-054		0.588	0.616	0.093	0.002	0	0
055-064		0.468	0.373	0.039	0.002	0	0
065-074		0.393	0.261	0.027	0.003	0	0
075-084		0.308	0.25	0.031	0.001	0	0
085-094		0.344	0.37	0.051	0.002	0	0
095-104		0.517	0.682	0.085	0.008	0	0
105-114		0.72	1.512	0.189	0.009	0.003	0
115-124		0.961	2.351	0.322	0.013	0	0
125-134		1.083	2.474	0.321	0.006	0	0.002
135-144		0.992	1.892	0.307	0.009	0.002	0.001
145-154		0.775	1.44	0.269	0.006	0	0.001
155-164		0.573	0.904	0.272	0.022	0	0
165-174		0.499	0.767	0.283	0.016	0	0
175-184		0.383	0.504	0.186	0.009	0.002	0
185-194		0.298	0.337	0.123	0.005	0.001	0
195-204		0.294	0.299	0.086	0.008	0.001	0
205-214		0.267	0.345	0.098	0.018	0.002	0
215-224		0.301	0.43	0.128	0.007	0	0
225-234		0.327	0.667	0.226	0.015	0.002	0
235-244		0.444	1.02	0.407	0.042	0.005	0
245-254		0.624	1.49	0.566	0.061	0.005	0
255-264		0.732	1.737	0.716	0.086	0.012	0.001
265-274		0.919	1.828	0.678	0.117	0.038	0.005
275-284		1.071	1.878	0.918	0.235	0.049	0.009
285-294		0.927	1.763	1.467	0.523	0.16	0.015
295-304		0.748	1.452	1.676	0.715	0.213	0.027
305-314		0.632	1.468	1.424	0.513	0.135	0.016
315-324		0.677	1.289	0.949	0.216	0.032	0.01
325-334		0.604	1.036	0.527	0.103	0.033	0.006
335-344		0.514	0.649	0.263	0.029	0.007	0.002
345-354		0.45	0.503	0.155	0.015	0.002	0.002

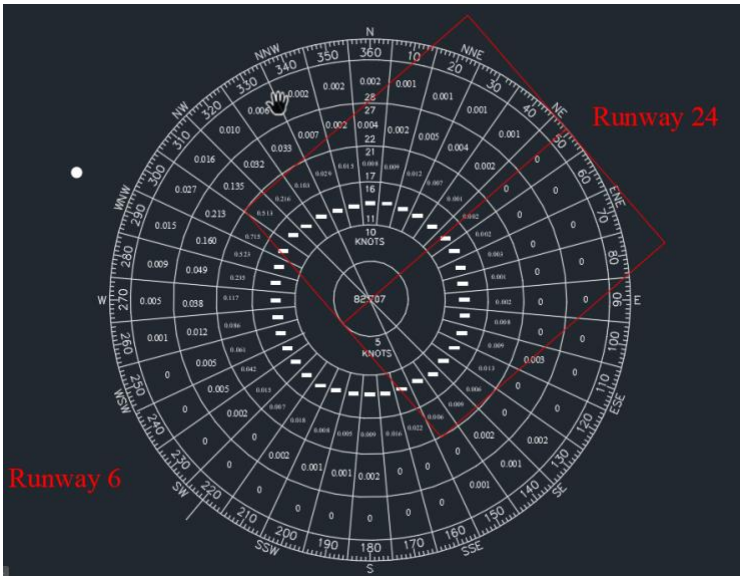


b) Find the percent of the time runway 06 can be used for departures (or arrivals) at the airport if a 5-knot tailwind allowance is used. The critical aircraft operating at ROA is the Airbus A300-600 cargo aircraft from UPS.

Airbus A300-600 cargo AAC C ADG IV

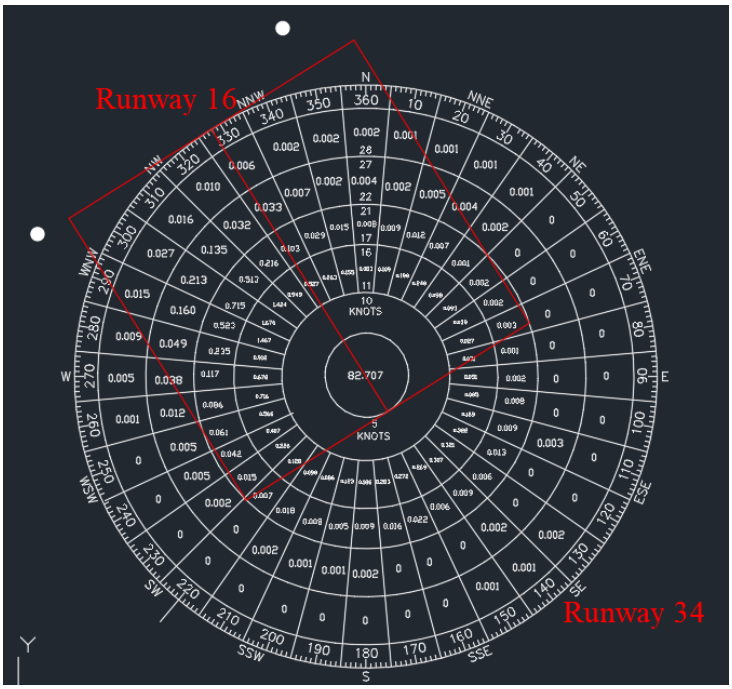
Allowable crosswind component for C-IV is 20knots.

90.8% of the time runway 06 can be used for departures (or arrivals) at the airport if a 5-knot tailwind allowance is used.



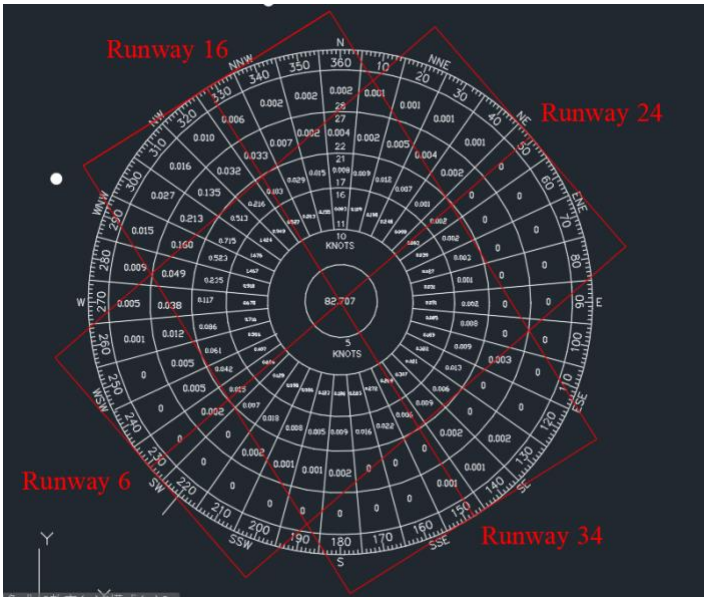
c) Find the percent of the time runway 34 can be used for departures (or arrivals) at the airport if a 5-knot tailwind allowance is used. Assume the same critical aircraft for that runway as well.

97.05% of the time runway 06 can be used for departures (or arrivals) at the airport if a 5-knot tailwind allowance is used.



d) Find the crosswind coverage of both runways at ROA from both directions (for every runway). Does the airport meet the 95% coverage rule? Explain.

The crosswind coverage of both runways at ROA from both directions (for every runway) is 99.22%. The airport meets the 95% coverage rule.



e) Most commercial flights use runway 06-24 at the airport. Provide a plausible reason for this.

a. Runway 06-24 is longer than runway 16-34. That offers safety benefits to commercial operations.

b. Most of time, the crosswind component operating from runway 6-24 is less than 16 knots. Note that the design crosswind component for the airport is 20 knots.