Assignment 5: Wind Rose and Master Plan

Date Due: Monday after Spring Break Instructor: Trani

Problem 1

A new airport location has been proposed and the airport design team would like to know the optimal runway orientation at the site. The airport is expected to receive commercial traffic with Boeing 737-800 as the critical aircraft (see figure below). For this analysis use the FAA Java application for wind rose available at: https://airports-gis.faa.gov/airportsgis/publicToolbox/windroseForm.jsp. Wind data collected at the airport proposed site is shown in Table 1.

Figure 1. Air Jamaica Boeing 737-800 Pushing Back at Kingston International Airport (A. A. Trani).

a) For the proposed airport, find the **design crosswind component** according to FAA criteria.

b) Find the optimal runway orientation for the runway (or runways) for the airport using the wind data provided in Table 1. Plot the runway orientation vs. the coverage achieved for every runway orientation every 10 degrees and indicate the optimal runway orientation in your plot. Show the final wind rose for the optimal solution indicating the coverage obtained using both runway thresholds.

c) Find the percent of the time **each runway end** can be used (independently) if an 8-knot tailwind is allowed in the calculations. What runway end will likely be used the most? Explain.

d) What would be crosswind design criteria if the airport was in Pusan, South Korea? Explain.

Table 1. Wind Data for New Airport. Speeds are Shown in knots (i.e., nautical miles per hour) in the Table Header.

Azimuth (degrees)	0-3	4-6	7-10	11-16	17-21	22-27	28-33	33-40	41 and over
10	286	178	124	87	36	30	12	5	3
20	345	286	213	198	110	36	16	0	2
30	320	230	84	10	0	0	0	0	0
40	287	230	145	45	13	0	0	0	0
50	376	201	119	75	33	12	0	0	0
60	385	286	142	76	27	15	8	0	0
70	437	277	143	30	0	0	0	0	0
80	390	185	182	42	0	0	0	0	0
90	323	210	176	96	6	0	0	0	0
100	460	400	129	13	0	0	0	0	0
110	503	220	169	91	34	14	0	0	0
120	488	540	327	165	40	20	5	0	0
130	457	400	230	78	11	0	0	0	0
140	632	520	240	59	31	24	17	9	5
150	540	230	120	55	44	16	14	4	2
160	635	620	540	210	120	80	33	10	6
170	634	490	320	190	45	43	14	11	2
180	506	420	176	135	36	30	12	5	3
190	460	400	129	13	0	0	0	0	0
200	515	243	213	26	13	13	13	13	7
210	432	319	213	78	24	1	0	0	0
220	667	347	236	93	62	43	32	9	3
230	286	310	254	103	31	1	0	0	0
240	178	168	135	106	35	0	0	0	0
250	190	238	178	98	21	12	0	5	0
260	461	512	146	80	29	16	12	4	4
270	236	221	141	94	29	0	0	0	0
280	436	231	150	107	54	31	21	7	6
290	198	227	185	77	8	0	0	0	0
300	548	301	167	54	24	16	12	5	3
310	258	127	107	50	8	0	0	0	0
320	98	215	211	119	37	10	8	0	0
330	269	153	119	46	30	13	5	4	2
340	289	195	99	22	0	0	0	0	0
350	243	128	128	38	0	0	0	0	0
360	311	197	105	28	9	3	1	0	0

Problem 2

Solve the problem stated in Problem 2 but now design the runway orientation for General Aviation aircraft. The typical aircraft is a Cessna 182 (Skylane) as whose in the figure below.

Figure 2. Typical General Aviation Aircraft (Cessna 182). Picture: A. Trani.

Problem 3

Familiarize yourself with the Roanoke-Blacksburg Regional Airport (ROA) using Google Earth and answer the following questions.

a) Check compliance of the **runway safety area beyond the runway for landing** aircraft on runway 06-24.The largest aircraft operating at ROA are cargo Boeing 757-200 and Airbus A300-600.

b) Comment on the use of an EMAS system to improve the safety of operations on runway 06-24.

That will be a welcome addition for safety. However, needs work on both ends to provide an EMAS solution that will satisfy the FAA criteria for 70 knots. Both ends are very limited in the space available to build an EMAS.

c) Estimate the size of the EMAS compatible with Boeing 757-200 aircraft.

For 70 knots, the EMAS for a Boeing 757-200 should be around 450 feet long.

Problem 4

Charlotte-Douglas International Airport released a final version of its latest airport master plan in 2016 (http://www.cltairport.com/AboutCLT/Documents/Development%20Master%20Plan/CLT%20ACEP%2002232016%20-%20FINAL.pdf). The following questions address sections of the master plan.

a) Read Chapter 1 and explain how Converging Runway Operations at CLT have affected the capacity of the airport.

b) Read Sections 4.3.1 and 4.3.2 of the master plan and verify the runway length suggested using the Airbus A330-300 (with PW4168A engines) as critical aircraft. Assume CLT's mean-max temperature is 87 degrees Fahrenheit. Use maximum takeoff weight in your calculations. Is the proposed runway length justified? Comment.

Use MTOW from CLT for an Airbus A330-300 with PW engines to get a required runway length of 11,000 feet at 510,000 lbs of takeoff weight. The runway increases to near 12,000 feet at the weight for brake energy limitation (518,000 lb).

c) Examine Exhibit 6-29 and read Section 6.5.2 in the master plan document and comment on whether or not the new proposed runway to the East can be used for independent operations with the existing runway 18L/36R. What runway separation rule is proposed in the master plan?

d) If CLT builds the fourth parallel runway shown in Exhibit 6-29, state the possible runway naming convention adopted using the rules discussed in class.