CEE 4674 HW 5 Solution

Problem 1.

a) A hotel company proposes to build a 135-foot tall building to be located 7,220 feet from the approach end of a precision runway. The hotel would be located 1,130 feet to the right of the extended centerline of the runway. Determine if the proposed hotel is an obstruction to navigation.

- Building height (135ft) < Horizontal surface height (150ft), Okay
- Building location from runway center line (1130ft) < Right border of approach surface (1531 ft) from center line at 7220ft away from runway threshold, so the building is in approach surface.
  500+7,220*0.15=1584
- Building height (135ft) < Approach surface height (140.4ft)
  (7220-200)/50=140.4 ft.
- Therefore, the hotel is not an obstruction to navigation.

b) Determine if a new 216 foot antenna to be constructed 11,900 feet from the runway threshold of a non-precision runway. The antenna would be constructed along the extended runway centerline. Determine if the proposed antenna is an obstruction to navigation. State the critical Part 77 imaginary surface or other rules that apply at the location of the proposed antenna.

- The antenna is 11,900 ft. away from runway threshold. It means the antenna is in conical surface.
- The height of conical surface at 11,900 ft. away from runway threshold is 235ft.
  (11,900-10,000-200)/20=85 ft.
  150+85=235 ft.
- The approach surface ends 10,200 feet from the runway threshold. No calculation is necessary for approach surface.
- Therefore, the antenna is not an obstruction to navigation.

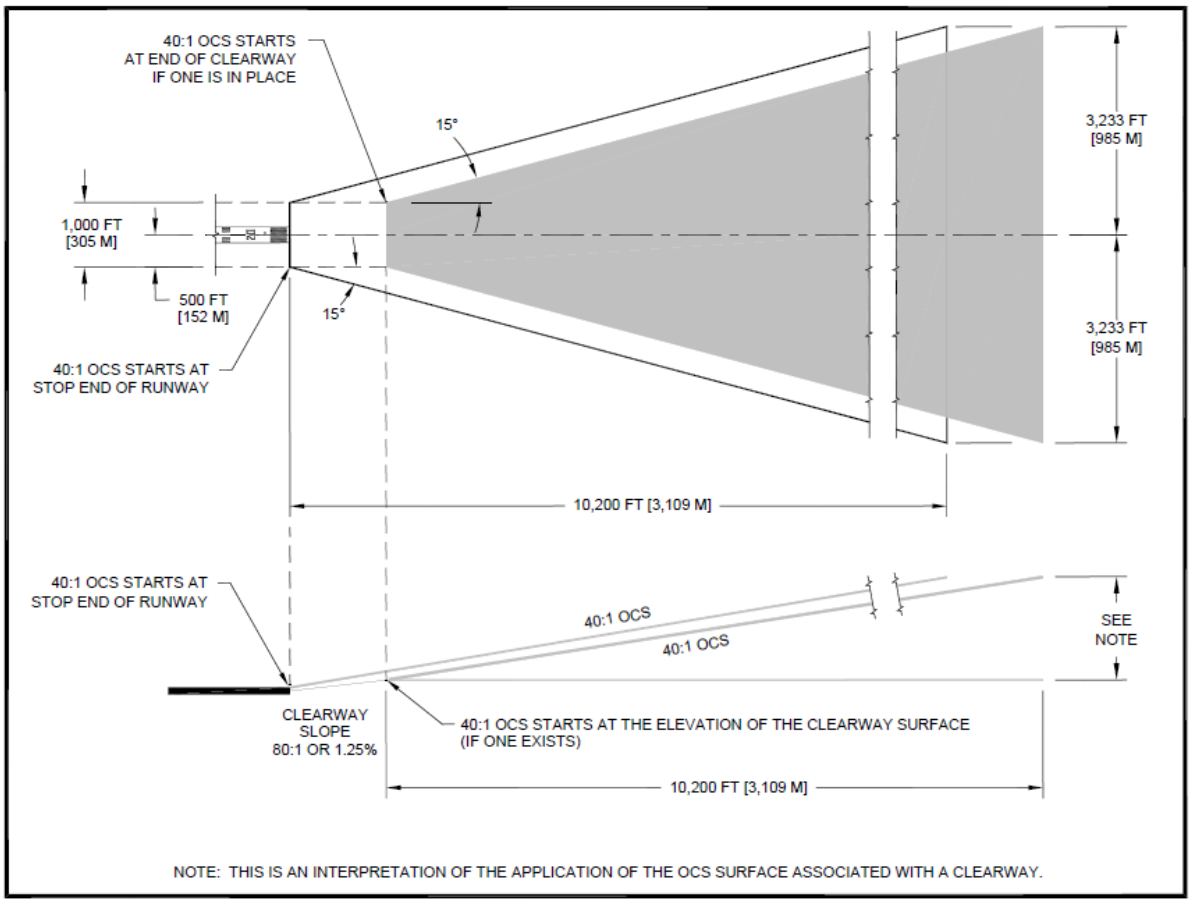
c) Check if a 35 foot tall tree located at a point 1,200 feet from the end of a precision runway and offset 750 feet from the extended runway centerline constitutes an obstacle to navigation according to FAR Part 77 rules.

- Tree height (35ft) < Horizontal surface height (150ft), Okay
- Tree location from runway center line (750ft) >642.9 Right border of approach surface (642.9ft) from center line at 750ft away from runway threshold, so the tree is outside the approach surface.
  (1,200-200)*0.15+500=650 ft. (edge of approach surface at 1200 feet)

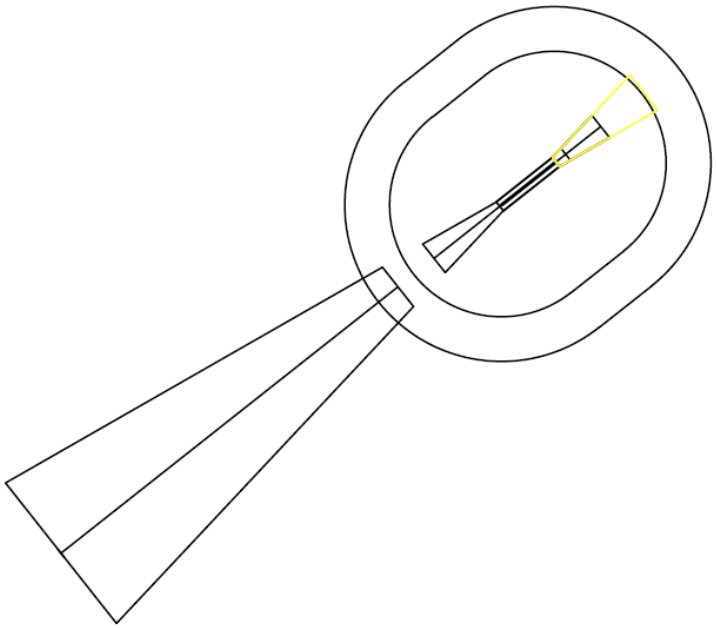
- The height of approach surface at 1200ft away from runway threshold is 20ft. (50:1). However, we need to check the height of the transitional surface at that location. At 7:1 the height of transitional surface is (750-650)/7 = 14.28 feet. The critical height is 20+14.28 = 34.28 feet.
- The 35-foot tree is an obstruction to navigation by 0.72 feet.

d) Find if the 35foot tall tree described in part (c) penetrates the departure surface for instrument runways according to FAA AC 150/5300-13a (Figure 3-4). Comment on how the new siting requirements stated in the FAA AC 150/5300-13a compare to the old FAR Part 77.

- The right edge of departure surface at 1200ft away from runway threshold is 821.5 ft. from center line. So, the tree is in the departure surface.
  Right edge of departure surface =500+ $\tan(15°)*1200 = 821.5$ ft
- The height of the departure surface at 1200 ft. away from runway threshold is 30 ft which is shorter than tree height (35ft)
- The tree exceeds departure surface standard.



Problem 2.




Shenandoah Valley Regional Airport
Shenandoah Valley Regional Airport
Google Earth
Image Landsat / Copernicus
6 mi
N

Problem 3.

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

According to the statement, the critical aircraft is Bombardier Q400 and Embraer 170 and both aircrafts have C-III of RDC. According to the following table, the design crosswind component for RDC C-III is 16 knots.

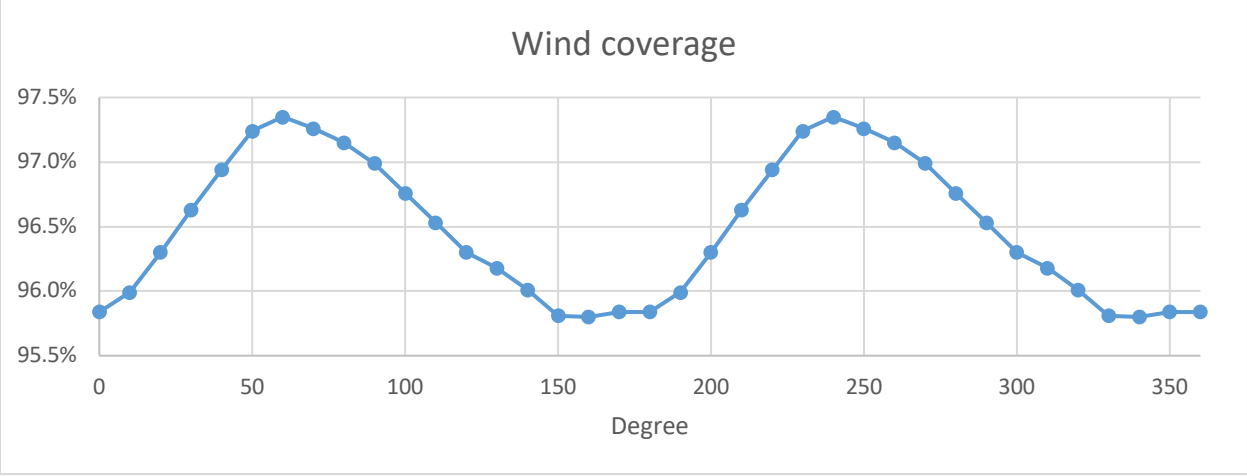
Table 3-1. Allowable crosswind component per Runway Design Code (RDC)

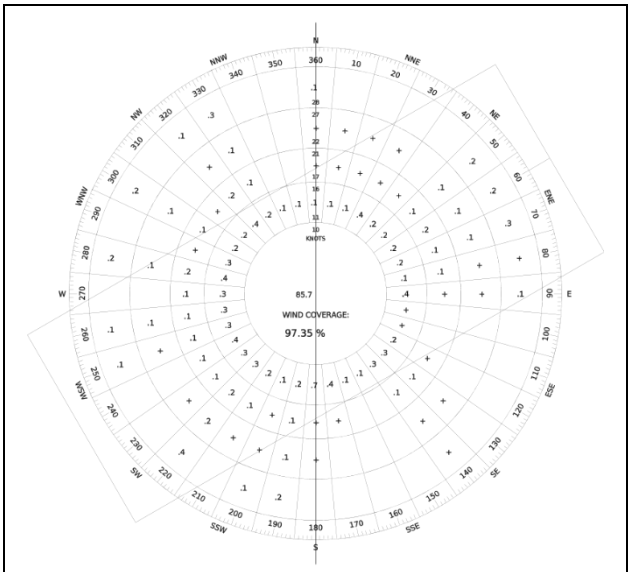
RDC	Allowable Crosswind Component
A-I and B-I *	10.5 knots
A-II and B-II	13 knots
A-III, B-III, C-I through D-III D-I through D-III	16 knots
A-IV and B-IV, C-IV through C-VI, D-IV through D-VI	20 knots
E-I through E-VI	20 knots

* Includes A-I and B-I small aircraft.

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 your proposed wind rose for the optimal solution indicating the coverage obtained using both runway thresholds.

According to the wind rose analysis, 60/240 orientation has the highest wind coverage (97.35%).





Wind Rose for Optimal Orientation (60-240 degrees)

c) If the airport is designed in India, what changes in the Wind Rose analysis would you consider. Explain.

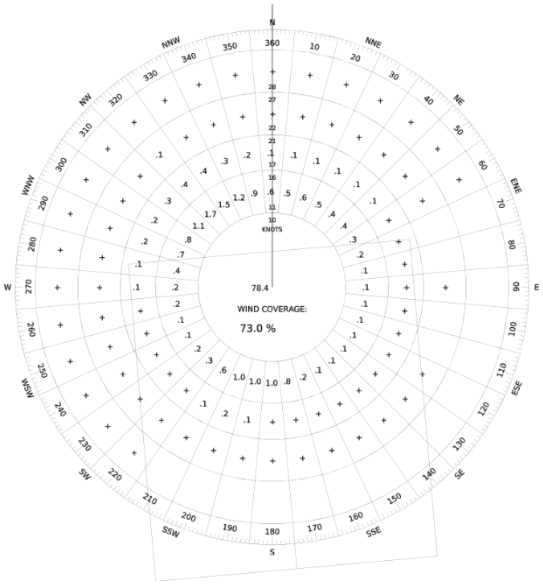
In India, the airports were designed by ICAO standard. So, the wind rose analysis would be conducted by ICAO standard. ICAO's process of wind rose analysis is very similar to FAA criteria. You need to check for:

a) The design crosswind value. According to the ICAO crosswind design criteria, the crosswind value is determined by runway length. Therefore, if we conduct wind rose analysis for the airport in India, we should consider runway length (per ICAO standard).

Problem 4.

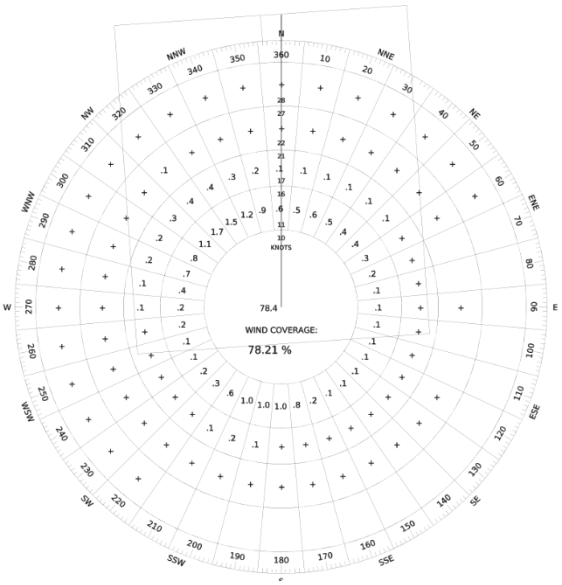
a) Find the percent of the time, all-weather landing operations at DCA airport occur on runway 19 if a 5-knot tailwind component is allowed in the landing operations.

- RDC of Boeing 757-200 is C-IV so the allowable crosswind component is 20 knots.
- According to the Airnav.com, the orientation of runway 19 is 175 true
- The wind coverage is 73%. South-flow operations can be conducted 73% of the time.



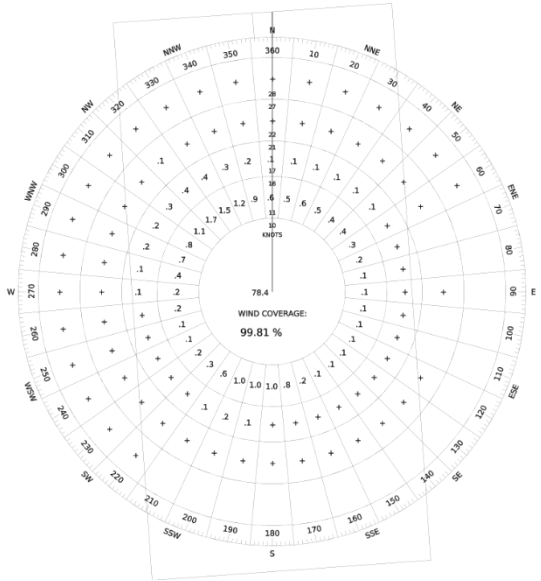
b) Find the percent of the time, all-weather landing operations at DCA airport occur on runway 1 if a 5 knot tailwind component is allowed in the landing operations.

- RDC of Boeing 757-200 is C-IV so the allowable crosswind component is 20 knots.
- According to the Airnav.com, the orientation of runway 1 is 356 true
- The wind coverage is 78.21%. This airport has slightly higher chance to be operated in North-flow operations.



c) Find the percent of coverage at the airport (all weather conditions) if runways 1-19 combined are used. Does the airport meet the FAA wind design criteria?

- RDC of Boeing 757-200 is C-IV so the allowable crosswind component is 20 knots.
- In case of bi-directional runway, the tailwind component is 60 knot.
- The wind coverage is 99.81%. The airport easily meets the FAA wind design criteria (>95%).



d) Find the percent of the time, IFR landing operations at DCA airport occur on runway 19 if 5 knot tailwind component is allowed in the landing operations. Is the answer very different compared to the result obtained in part (a)? Explain.

- RDC of Boeing 757-200 is C-IV so the allowable crosswind component is 20 knots.
- Use 5 knots of tailwind component

- The wind coverage is 69.56%.

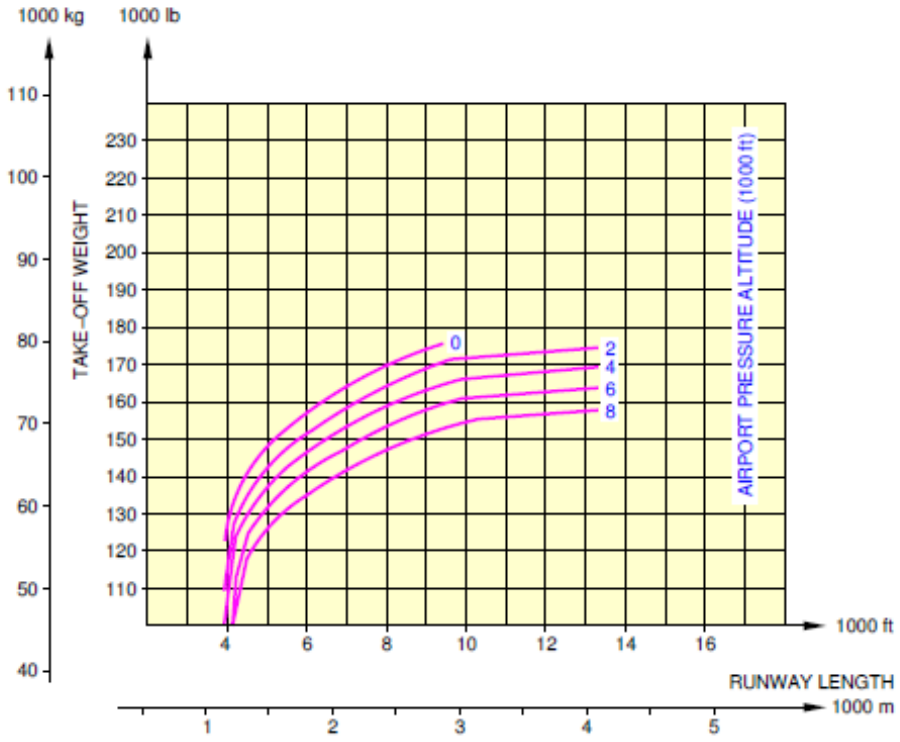
e) Under VFR weather conditions, find the percent of the time the wind is reported from 340 degrees and between 11-16 knots.

Find the percent value in the wind rose diagram for the cell intersecting 340 degrees and 11-16 knots.

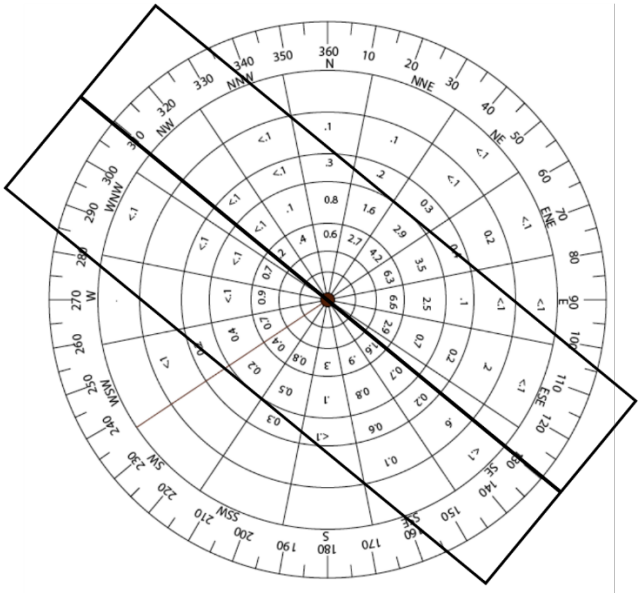
Problem 5.

a) Find the ICAO critical crosswind component needed to design the runway orientation of the airport if the runway serves aircraft such as the Airbus A319. Use ICAO Wind Rose standards.

- Assume 2000ft of elevation
- Maximum take-off weight (141 096lbs)
- Required runway length is 1510 m
- **Then the design crosswind value of ICAO standard is 20 knots**



b) Determine the optimal orientation of the runway if this was a new airport site with the wind data provided.

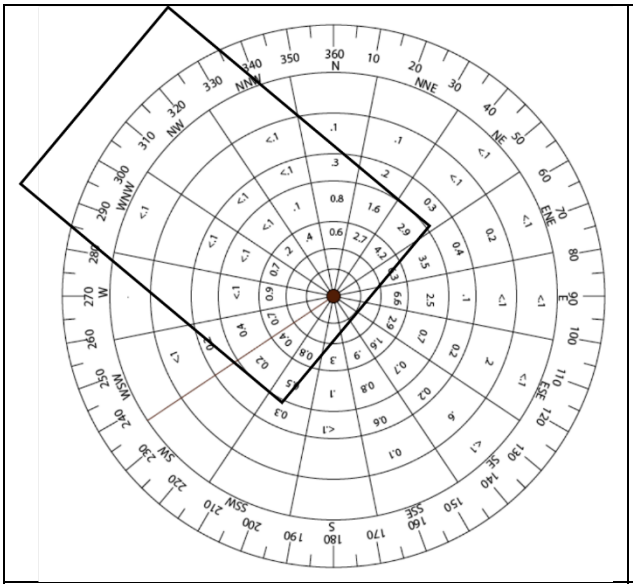
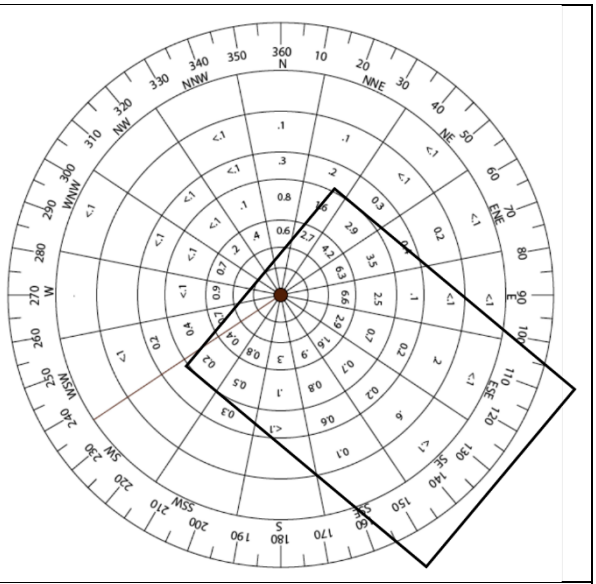


According to the analysis, 130/310 degrees of offset looks reasonable. In this case, the runway has 98.3% of wind coverage.

c) Find the percent of the time that each runway end can be used if the runway orientation you propose is built.

- Assume tailwind: 5knots

According to the analysis, Runway 13 is used 35% and runway 31 is used 65%.

	
Runway 13 (35% used)	Runway 31 (65% used)