Assignment 6: Geometric Design Standards

Date Due: March 24, 2017

Instructor: Trani

Problem #1

A new airport in Nevada is expected to serve business jets and regional jets using a single 7,500 foot runway. The airport is expected to have an ILS Category 1 precision approach system available to both runway ends. After consultation with airlines and corporate flight departments, the largest and most critical aircraft to operate from the facility is the Embraer190 regional airliner (see Figure 1). The aircraft has an approach speed of 136 knots at maximum allowable landing weight.

Figure 1. Embraer 190 Regional Aircraft Departs LGA Airport (A. Trani) .

a) Determine the dimensions of the complete runway taxiway layout shown in Figure 2 (for the new airport). Clearly indicate the FAA standards used.

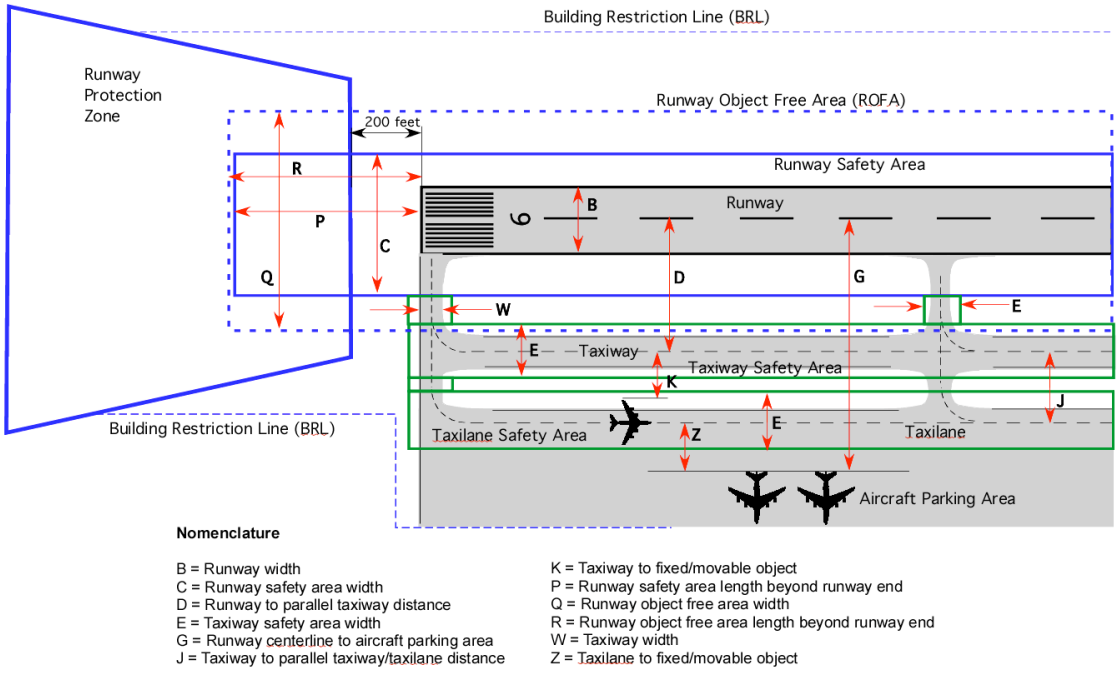

Figure 2. Simplified Airport Layout for Problem 1.

b) Find the size of the runway and taxiway shoulders needed at this airport.

c) Assuming the top of Figure 2 is the North side of the airport, find the closest distance from the runway that a developer could build a 10-story hotel (say 110 feet tall). Explain the controlling surfaces and dimensions considered in your analysis. You need to investigate both Part 77 and OFZ surfaces to answer this question.

Problem #2

a) Find the minimum distance between two parallel taxiways "Bravo" and "Echo" shown in Figure 3. Assume the critical aircraft is the Airbus A380-800. In your design use the latest FAA criteria for taxiway-taxiway intersections considering the aircraft ADG and TDG groups.

Note 1 in Table 4-2 of the FAA advisory circular provides the key to this problem. Need 350 feet between parallel taxiways to provide a 180 degree turn for ADG VI. Use the dimensions in Table 4-8 coupled with the design for a cross-over taxiway.

Table 4-2. Design standards based on Taxiway Design Group (TDG)

ITEM	DIM (See Figure 4-7)	TDG 1	TDG 2	TDG 3	TDG 4	TDG 5	TDG 6	TDG 7
Taxiway Width	W	25 ft (7.5 m)	35 ft (10.5 m)	50 ft (15 m)	50 ft (15 m)	75 ft (23 m)	75 ft (23 m)	82 ft (25 m)
Taxiway Edge Safety Margin	M	5 ft (1.5 m)	7.5 ft (2 m)	10 ft (3 m)	10 ft (3 m)	15 ft (5 m)	15 ft (5 m)	15 ft (5 m)
Taxiway Shoulder Width		10 ft (3 m)	10 ft (3 m)	20 ft (6 m)	20 ft (6 m)	25 ft (7.5m)	35 ft (10.5 m)	40 ft (12 m)
Taxiway/Taxilane Centerline to Parallel Taxiway/Taxilane Centerline [1]	J	70 ft (21 m)	70 ft (21 m)	160 ft (49 m)	160 ft (49 m)	240 ft (73 m)	350 ft (107 m)	350 ft (107 m)
TAXIWAY FILLET DIMENSIONS		See Table 4-3, Table 4-4, Table 4-5, Table 4-6, Table 4-7 and Table 4-8						

Note: 1. Use this dimension or the dimension specified in Table 4-1, whichever is larger, when 180 degree turns between parallel taxiways are required.

Table 4-8. Standard intersection details for TDG 7

TDG 7								
Dimension (See Figure 4-13, Figure 4-14, Figure 4-15, and Figure 4-16)								
Δ (degrees)	30	45	60	90	120	135	150	180 [3]
W-0 (ft)	41	41	41	41	41	41	41	41
W-1 (ft)	50	50	55	56	60	57	55	60
W-2 (ft)	65	75	85	85	95	102	107	105
W-3 (ft)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	184
L-1 (ft)	360	355	390	440	450	489	410	450
L-2 (ft)	110	155	135	125	110	145	165	120
L-3 (ft)	17	31	49	129	246	363	594	141
R-Fillet (ft)	0	0	0	60	60	60	60	75
R-CL (ft)	150	150	150	130	155	165	170	175
R-Outer (ft)	400	300	270	205	210	215	215	N/A

Note: Values in the table are rounded to the nearest foot. 1 foot = 0.305 meters.

b) Design a 180 degree connector between two parallel taxiways as shown in Figure 3.

c) Draw your solution using the CAD program of your choice. Label the main dimensions of the geometric design.

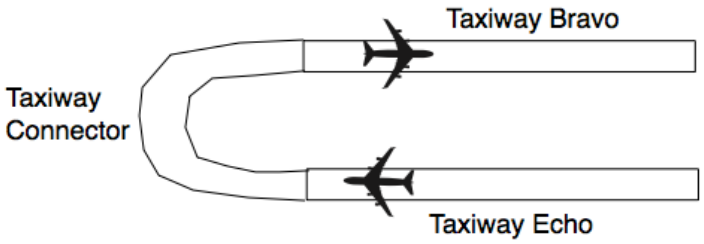

Figure 3. Taxiway Connector for Problem 2.

Problem # 3

A 2,900 meter long runway at an airport has three longitudinal grades (from left to right): at 0.65%, -0.88% and 0.7% with the points of intersection located at metric stations 1180 and 1820 from the left threshold. Assume the left threshold is located at station 0.

a) Test the suitability of this runway to be used at airport with Boeing 767-300 operations. Comment on your answers.

b) Design the second transition curve for this runway using a symmetric parabola. Specify the elevations (every 20 meters) as a function of the station (in meters). Refer to the formulas in the handout Geometric Design to create a symmetrical parabola. Use Excel or Matlab to simplify your work. You are allowed to use the Matlab script provided in class.

Problem # 4

A new airport is expected to serve regional airline operations using aircraft such as the Bombardier CRJ-900 aircraft (see Figure 4). The longest runway length needed has been set to be 2,300 meters. The airport is located at an elevation of 560 feet above mean sea level conditions. The airport will have a precision runway and serve approaches with visibility minima down to 1/2 mile. Determine the following dimensions for your design:

a) The length and width of the approach and departure surfaces for the airport
b) The elevation of the horizontal surface above mean sea level conditions
c) The radius of the horizontal surface for the runway.
d) The length and slope of the conical surface.

e) The slope of the Obstacle Clearance Surface (OCS).
f) A utilities company proposes to build a 110 foot tall water tank to be located 5,800 feet from the approach end of the precision runway. Determine if the proposed water tank is an obstruction to navigation. Does the tank violates the OCS surface?
g) Determine if a new 95 foot tall building to be constructed 1000 feet **perpendicular** from the runway centerline of the precision runway. State the critical imaginary surface used in the analysis.
h) Check if an 83 foot tall antenna located at a point 4,300 feet from the end of a non-precision runway and aligned with the runway centerline constitutes an obstacle to navigation. Does the antenna violates the OCS surface?

Figure 4. Bombardier CRJ-900 Aircraft Taxiing at CLT Airport (A. Trani).