Assignment 7: Airport Geometric Design Standards

Date Due: March 23, 2018
Instructor: Trani

Problem 1

An airport is designing a new pier terminal to accommodate five Airbus A350-1000 passenger planes simultaneously per side (see Figure 1 - only 3 per side shown). The airport authority needs to know the dimensions (A through G and also radii R1 and R2) of the apron area shown in Figure 1. In your solution consider the maneuvering envelopes of the Airbus A350-1000 using the appropriate technical data. **Design and draw to scale** (**no hand sketches will be accepted**) your solution. Provide 30 feet of clearance between the nose of the aircraft and the terminal building. Clearly state all the dimensions in your drawing. Note that a two-lane service road is provided behind the parking positions of A350-1000 as shown in Figure 1. If desired, DWG files for the Airbus A350-1000 can be found at: http://www.airbus.com/aircraft/support-services/airport-operations-and-technical-data/autocad-3-view-aircraft-drawings.html.

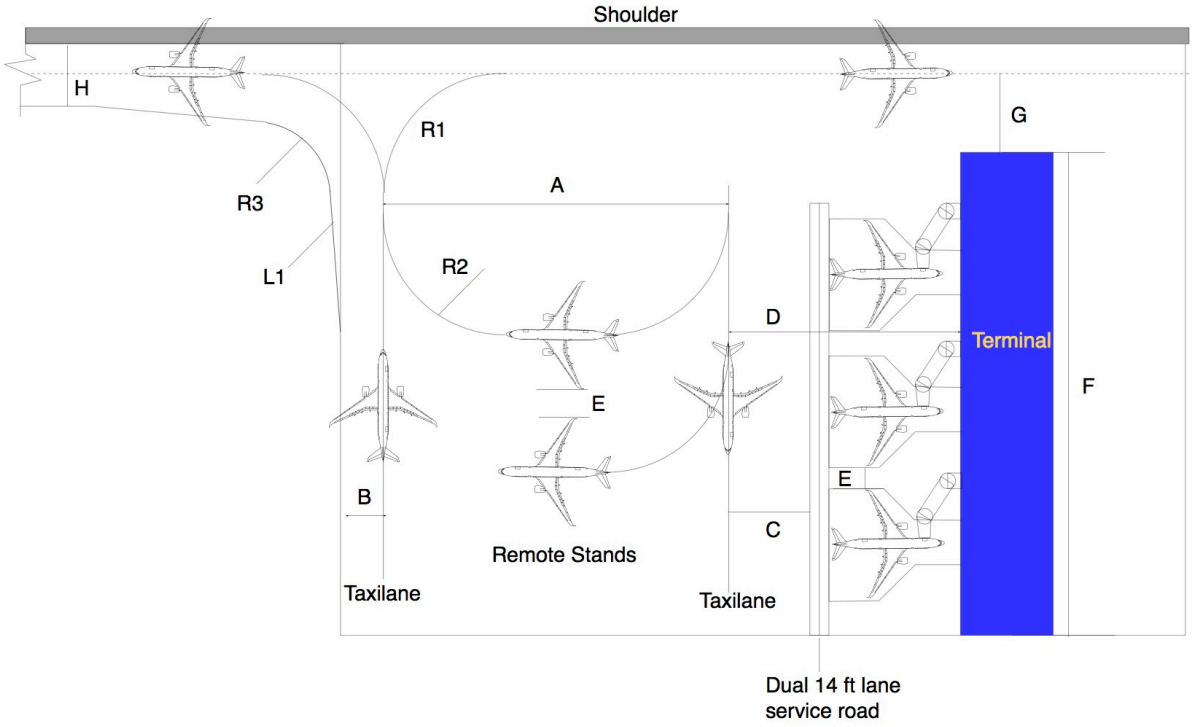

Figure 1. Proposed Airport Terminal Configuration.

Problem 2

The purpose of this analysis is to locate three high-speed exits for a runway at an airport with a fleet mix shown in Table 1. The critical aircraft is a Boeing 787-8 shown in Figure 2. The runway designed to be 3,000 meters long. Use the Three-Point Method Matlab computer program provided in class (http://128.173.204.63/courses/cee4674/cee4674_pub/ThreePointMethod_stochastic.m). In your design consider the typical operational exit speeds recommended in class. In your design, selects the runway locations to accommodate 85% of the landings simulated. The data shown in Table 1 has been collected by Virginia Tech Air Transportation Lab at several airports in the country.

Figure 2. Japan Airlines Boeing 787-8 in Tow at Tokyo Narita International Airport (A. Trani).

Table 1. Estimated Aircraft Landing Roll Characteristics for Runway Exit Design.

Aircraft	Landing Technical Characteristics
Boeing 787-8	Mean approach speed = 148 knots Approach speed std deviation = 3.1 knots Free roll time = 4.5 seconds Mean touchdown distance = 520 m Std. Dev. Touchdown distance = 60 m Mean braking rate = -1.70 m/s-s Std. Dev. braking rate = 0.25 m/s-s Transition segment deceleration = 0.35 m/s-s
Airbus A320	Mean approach speed = 136 knots Approach speed std deviation = 2.4 knots Free roll time = 4.5 seconds Mean touchdown distance = 510 m Std. Dev. Touchdown distance = 53 m Mean braking rate = -1.8 m/s-s Std. Dev. braking rate = 0.25 m/s-s Transition segment deceleration = 0.4 m/s-s

Aircraft	Landing Technical Characteristics
Bombardier Q400	Mean approach speed = 115 knots Approach speed std deviation = 2.3 knots Free roll time = 4.0 seconds Mean touchdown distance = 450 m Std. Dev. Touchdown distance = 50 m Mean braking rate = -1.70 m/s-s Std. Dev. braking rate = 0.25 m/s-s Transition segment deceleration = 0.4 m/s-s

a) Plot the Three Cumulative Exit Distance curves (one for each aircraft) and clearly state the selected runway exit locations (i.e., the distance from the runway threshold to the point of curvature of each runway exit).
b) Provide (do not draw) all relevant dimensions of the high-speed runway exit based on the critical aircraft (only one for all three exits). State the Taxiway Design Group used.
c) Estimate the percent of Boeing 787-8 aircraft that could take the second high-speed exit (i.e., one designed for A320s).
d) Compare the runway exit locations Points of Curvature of your design with the locations of three high-speed exit locations at Chicago O'Hare runway 10C - designated P3, P5 and P6 (see diagram in Figure 3). Comment.
e) Design a 90-degree runway exit to "catch" all aircraft that are not able to take anyone of the three high-speed. Select the exit location so that the 90-degree runway exit does not overlap with the last high-speed exit.
f) What is the recommended distance between the new runway centerline and the parallel taxiway at the airport? Explain.

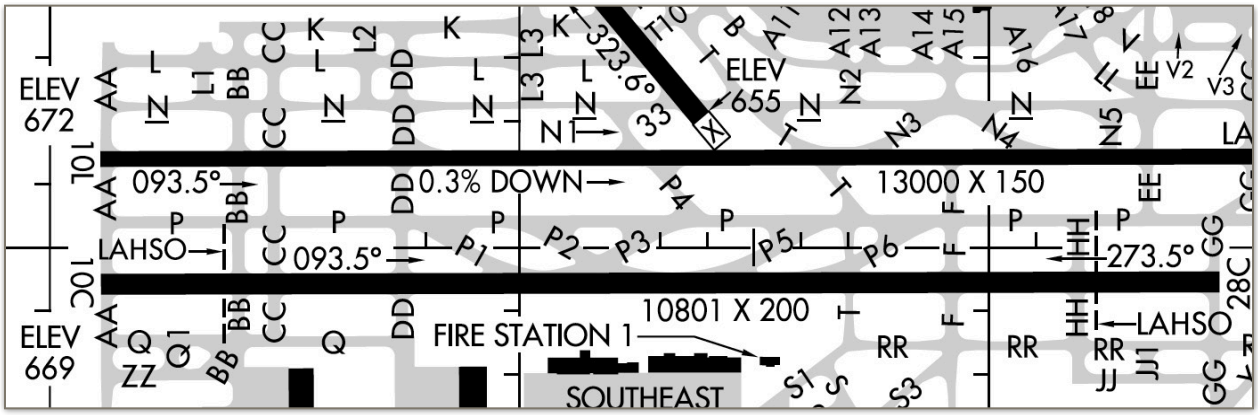

Figure 3. Runways 10C and 10L at Chicago O'Hare International Airport.

Problem 3

Before solving this problem, read carefully paragraph 407 in the FAA Advisory Circular 150/5300-13A.

a) Specify (**do not draw**) the dimensions of a crossover taxiway shown in Figure 4 using the FAA taxiway design methods contained in Chapter 4 of the Advisory Circular 5300-13A. The critical aircraft is the Boeing 747-8i. Specify all dimensions shown in Figure 4 considering the critical aircraft operating at the airport.

b) Briefly contrast the dimensional standards used in this design and those used in Problem 2.

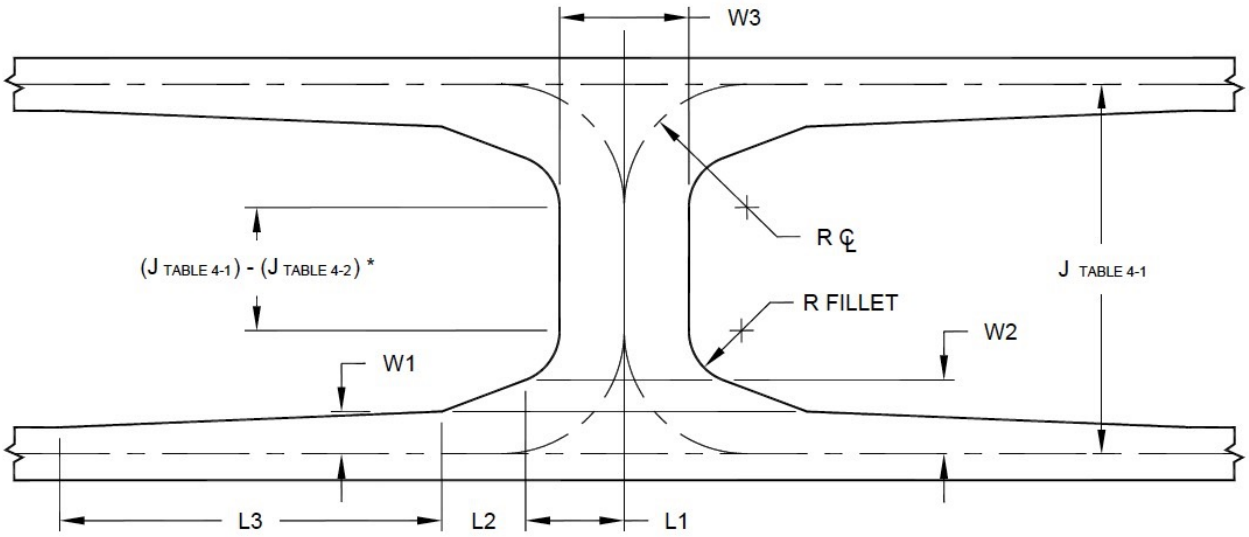

Figure 4. General Layout of a Crossover Taxiway (source: FAA AC 150/5300-13A Figure 4-16).

Problem 4

Use Google Earth to answer the following questions.

a) Estimate the critical FAA ADG group operating at ORD Airport and parking between terminals G and H (see Figure 5). Note that a dual taxi lane is provided between terminals G and H.

b) Estimate the critical FAA ADG group operating at ORD Airport on taxiways “Alpha” and “Bravo” (see Figure 5). Alpha and Bravo are perimeter taxiways around the terminals at the airport.

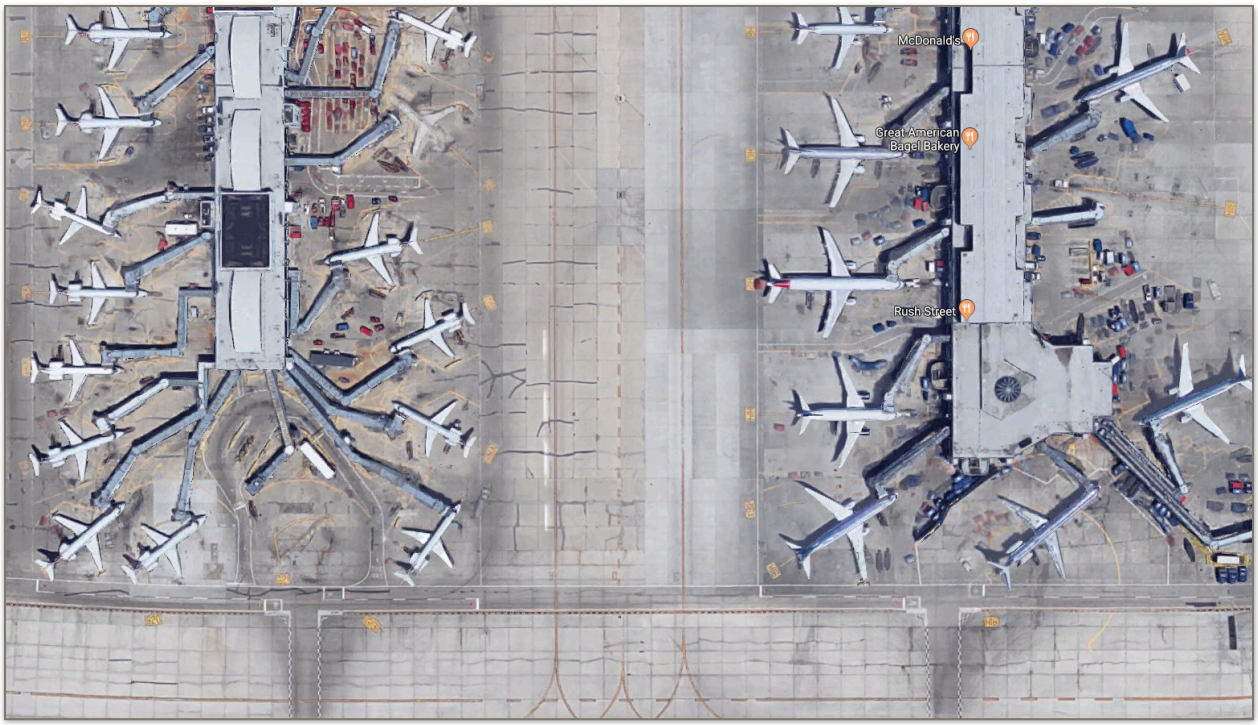

Figure 5. Terminals G (left) and H (right) at ORD Airport.

Figure 6. Perimeter Taxiways at ORD Airport. These taxiways are Designated "Alpha" (inner taxiway) and "Bravo" (outer).