Assignment 7: Airport Geometric Design Standards

Date Due: October 29, 2021
Instructor: Trani

Problem 1

a) A new airport is designed with two satellite terminal buildings as shown in Figure 1. The buildings are designed to accommodate aircraft up to the size of an Airbus A350-900. Find the dimensions A through R in Figure 1. Make sure that your design allows pilots entering the gate position to maneuver with steering angles no more than 50 degrees. Assume the service roads have 12-foot wide lanes.

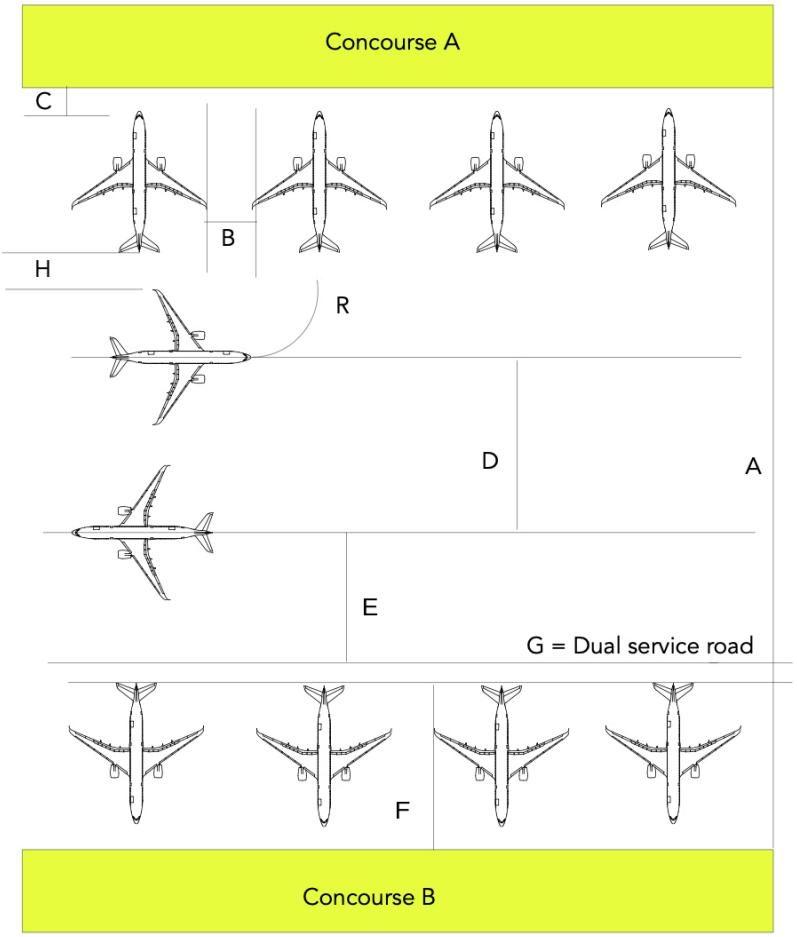

Figure 1. New Terminal Buildings for a Proposed Airport.

b) Estimate the steering angle and wingtip radius of the Airbus A350-900 for the radius R proposed in your solution. Consult the Airbus A350-900 airport design document.

c) Estimate the size (length) of the 100 feet/second engine exhaust contours for the Airbus A350-900 assuming that the pilot applies engine breakaway power (11% maximum thrust) while parking the aircraft nose-in towards the terminal building. The engine exhaust contours are included in the Airport Planning and Design aircraft documents (see Section 6). Will the 100 ft/s contours pose a problem for service vehicles moving on the opposite size of the dual taxi lane configuration?

Problem 2

The same international airport described in Problem 1 will have a 120 degree taxiway-taxiway connector (see Figure 2). Specify the dimensions of the complete 120-degree taxiway connector. Draw your solution in the CAD application of your choice.

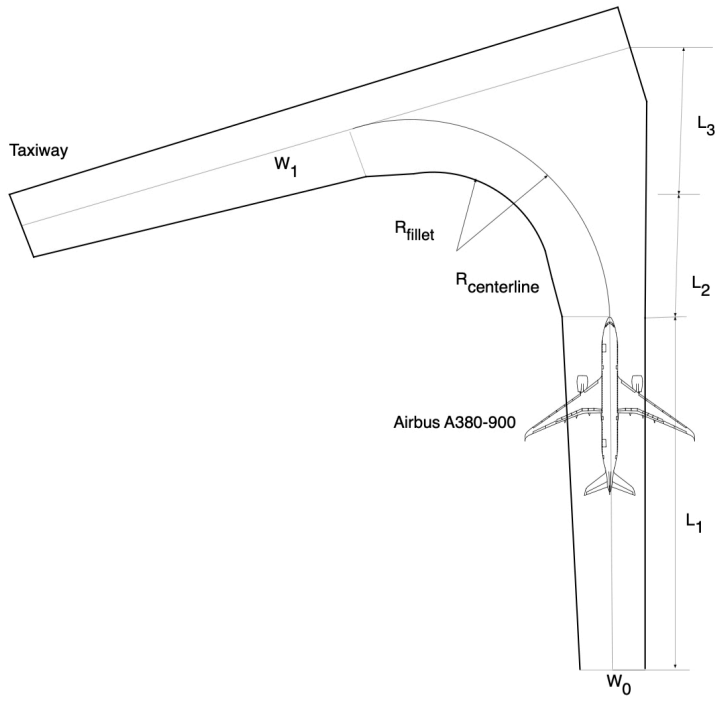

Figure 2. 120-degree Turn Taxiway-Taxiway Intersection.

Problem 3

Use the FAA/Virginia Tech Landing Events Database to answer the following questions.

a) Find the median (50%) arrival threshold ground speed for Boeing 737-800 landing IAD airport runway 1R. Is the reported speed consistent with the approach speeds reported in the FAA AC 150/5300-13a? Comment.
b) Find the median (50%) speed at the Point of Curvature (i.s., start of the turn) for Boeing 737-800 landing at IAD airport runway 1R and using high-speed exit K4.
c) Find the median (50%) speed at the Point of Curvature (i.s., start of the turn) for Boeing 737-800 landing at DCA airport runway 19 and using right-angle exit F.
d) Compare the median speeds of parts (b) and (c). Are the exit speeds different? Comment.

Problem 4

The purpose of this analysis is to locate **two high-speed exits** for a 2800 meter-long runway at an airport with a fleet mix shown in Table 1. The critical aircraft is a Boeing 737-800. The runway designed to be 2,800 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, select 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.

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

Aircraft	Landing Technical Characteristics
Boeing 737-800 	Mean approach speed = 142 knots Approach speed std deviation = 3.0 knots Free roll time = 2.0 seconds Mean touchdown distance = 545 m Std. Dev. Touchdown distance = 65 m Mean braking rate = -2.05 m/s-s Std. Dev. braking rate = 0.25 m/s-s Transition segment deceleration = 0.35 m/s-s
Cessna 750 	Mean approach speed = 129 knots Approach speed std deviation = 2.4 knots Free roll time = 2.0 seconds Mean touchdown distance = 520 m Std. Dev. Touchdown distance = 55 m Mean braking rate = -1.95 m/s-s Std. Dev. braking rate = 0.25 m/s-s Transition segment deceleration = 0.4 m/s-s
Bombardier Q400 	Mean approach speed = 115 knots Approach speed std deviation = 2.3 knots Free roll time = 2.0 seconds Mean touchdown distance = 428 m Std. Dev. Touchdown distance = 53 m Mean braking rate = -1.72 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) Use the FAA airport design templates and draw the high-speed runway exit geometry assuming the runway-taxiway centerline distance is 600 feet. State the Taxiway Design Group used in the analysis.
c) Tell me the percent of Boeing 737-800 aircraft that could take the first and the second high-speed exits selected.

Bonus Point (3 points of 20 total in homework). Draw the runway taxiway entrance taxiway for the problem.