Assignment 7: Airport Geometric Design Standards

Solution
Instructor: Trani

Problem 1

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 A321neo and the standard Airbus A321.

a) 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.

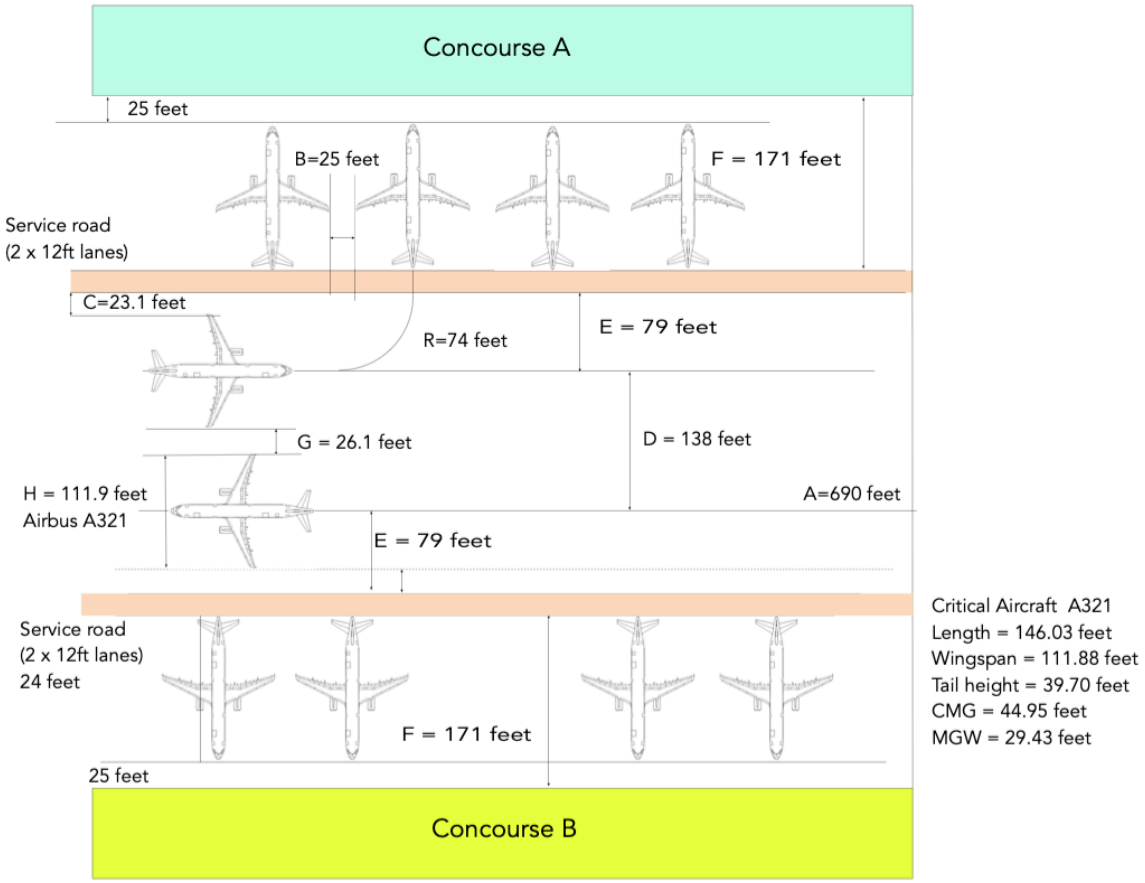


Figure 1. Airport Taxilane Configuration Solution for Problem 1.

Table 1. Critical Dimensions for Figure 1.

Dimension (Letter)	Dimensions (feet)	Remarks
A	690	Total distance from face of terminal to another terminal
B	25.0	Table 5-1 using ADG III practice
C	23.1	Using Airbus A321 wingspan and 79 feet distance to moveable object
D Taxilane to Taxilane	138.0	For critical wingspan in ADG III (118 feet) Table 4-1 in FAA AC 150/5300-13B
E Taxilane to Fixed or Movable Object	79.0	For critical wingspan in ADG III (118 feet) Table 4-1 in FAA AC 150/5300-13B
F Aircraft Length	171.03	Aircraft Length + 25 feet
R Radius of Turn	74.0	Assumes a maximum steering angle of 50 degrees with and without differential thrust
Service Roads	24	Per service road (4 lanes total)
Clearance from Nose to Terminal Building	25.0	

b) Estimate the steering angle and wingtip radius of the Airbus A321neo for the centerline radius R selected in part (a) of the problem. Consult Section 4 of the Airbus A321neo airport design document.

Radius is 74 feet for nose landing gear (NLG).

Steering angle is 75 feet

Wingtip radius is 108 feet

c) Compare the dimensions of your design at the gate with the typical gate layout dimensions recommended by Airbus for the A321neo (Section 5 in the manufacturer airport design document). Comment on any differences.

Airbus is more generous with the dimensions of the ramp layout dimensions for a typical gate. Figure 2 shows that Airbus recommends 167 feet as the width of the ramp area for the Airbus A321. Airbus allows a 25 foot clearance on both sides of the aircraft (50 feet from the nearest aircraft). The FAA recommended clearance for two A321s parked side by side is 25 feet from the nearest aircraft.

Overall, the Airbus recommendation is the ideal ramp layout allowing ground vehicles to move efficiently around the aircraft while on the ground. Not all airports have the space to provide such generous ramp area. Figure 3 shows an example of the ramp space provided at Los Angeles International Airport for an Airbus A321.

d) Estimate the length of the 50 feet/second engine exhaust contours for the Airbus A321neo with Pratt and Whitney PW1100G engines assuming that the pilot applies engine breakaway power (12% maximum takeoff 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).

235 feet behind the engine (see Figure 4).

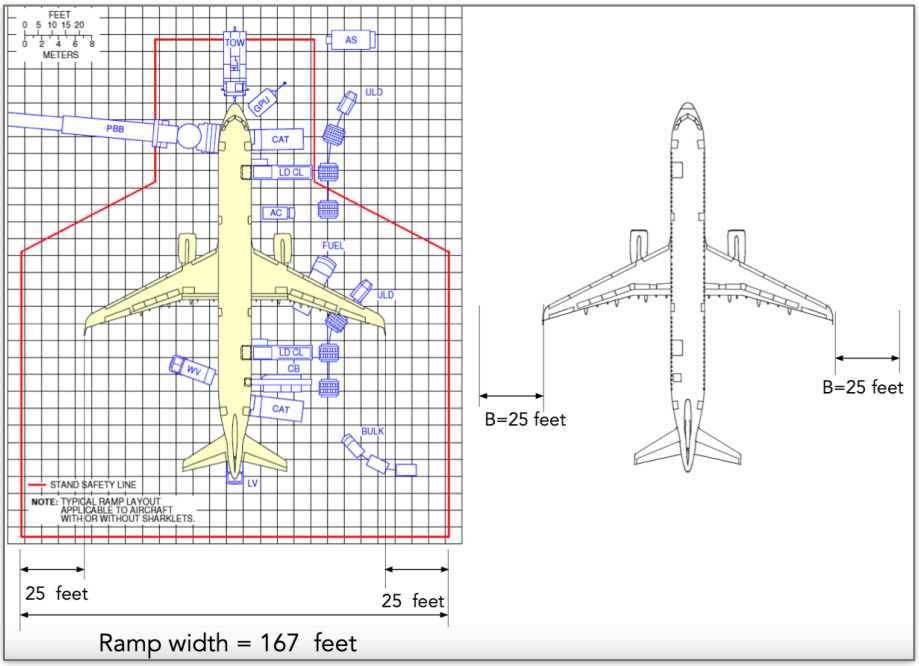


Figure 2. Gate-Ramp Layout Geometry. Source: Airbus and the Author.

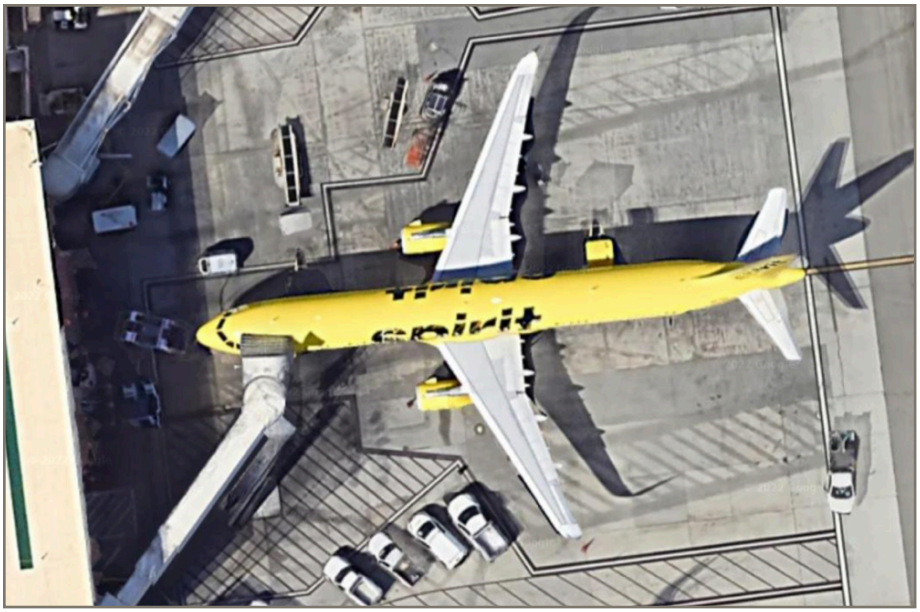


Figure 3. Los Angeles International Airport Ramp-Gate Position for Airbus A321. The Hash Lines is the Safety Area Between Adjacent Aircraft. Source: Google Maps.

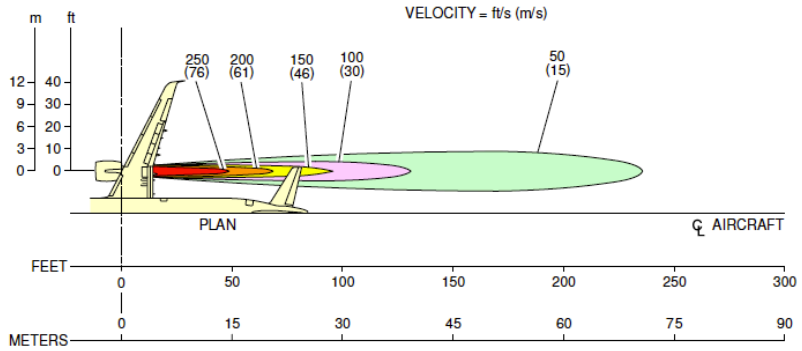


Figure 4. Airbus A321 Exhaust velocity Profiles. Source: Airbus.

Problem 2

An airport is expected to have a 135-degree taxiway-taxiway connector (see Figure 2).

a) Specify the dimensions of the 135-degree taxiway connector if the design aircraft is an Airbus A321neo. You can use the FAA taxiway design fillet tool to simplify your analysis. For this design use the minimum centerline radius required by FAA. If the FAA taxiway design tool does not work on your computer, use the tables in Appendix J of the FAA Advisory Circular 150/5300-13B to implement your design.

b) Draw your solution in the CAD application of your choice (no hand sketches accepted).

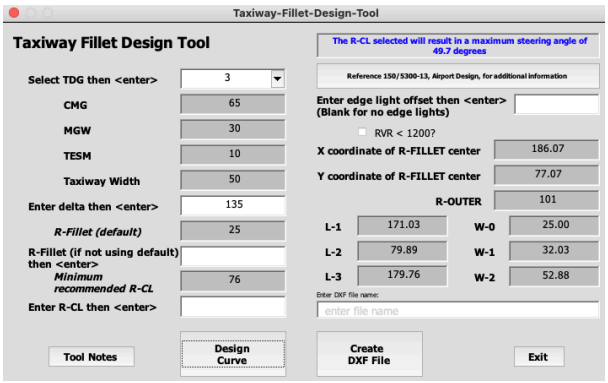
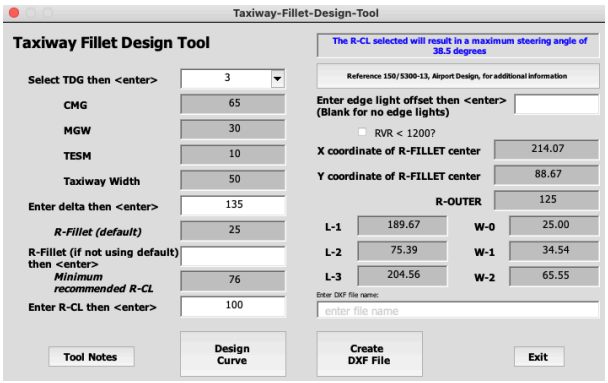
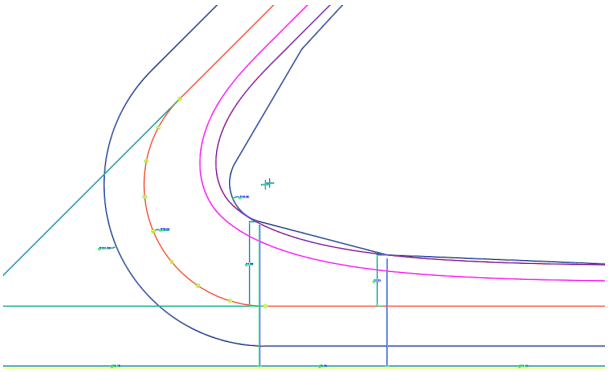
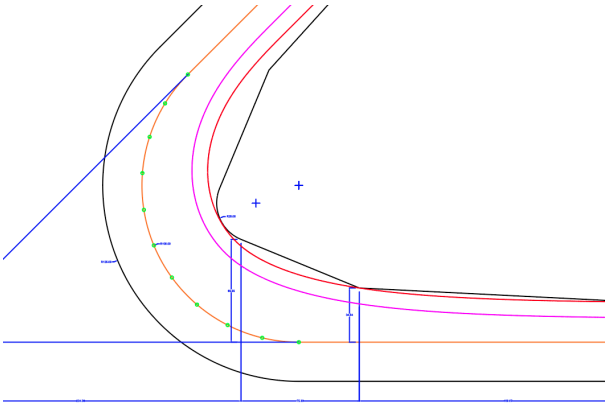
Solution with Minimum Radius (76 feet)	Solution with Centerline Radius of 100 feet
	
50-degree steering angle	38.5-degree steering angle
	

Figure 5. 135-degree Turn Taxiway-Taxiway Intersection for Airbus A321neo. Left: Intersection with Minimum Centerline Radius (76 feet). Right: Intersection with 100-foot Centerline Radius.

Problem 3

An airport is expected to have two parallel taxiways as shown in Figure 3. Taxiway Romeo is designed for aircraft of the size of the Airbus A380. Taxiway Alpha is limited to aircraft such as the Airbus A330-900.

a) Specify the dimensions in Figure 3 to satisfy the FAA design requirements. Before solving the problem, read Section 4.5.2 of the FAA Advisory Circular 150/5300-13B.

The method is outlined in FAA AC 150/5300-13B

1. Establish the TOFA/taxilane object free area (TLOFA) dimension of the more demanding ADG. (TOFA for ADG VI is 335 feet)

2. Establish the maximum wingspan of the lesser ADG. Maximum ADG V wingspan is 213 feet (note that the Airbus A330-900 is not the most critical aircraft in the ADG V group).

3. Determine the composite taxiway separation value by adding half the OFA of the more demanding ADG to half the wingspan of the lesser ADG.

Composite separation distance between taxiway centerlines = 335/2 + 213/2 = 274 feet.

b) Find the dimensions of the taxiway shoulders in the design.

30 feet for both ADG VI and V. See Figure 6.

c) Find the taxiway edge safety margin used in the design.

14 foot safety margin for ADG V and VI.

d) State the dimensions of the Taxiway OFA and Taxiway Safety Area (TSA) for both taxiways.

TOFA ADG VI is 335 feet. TOFA for ADG V is 285 feet. TSA for ADG VI is 262 feet and 214 feet for ADG V.

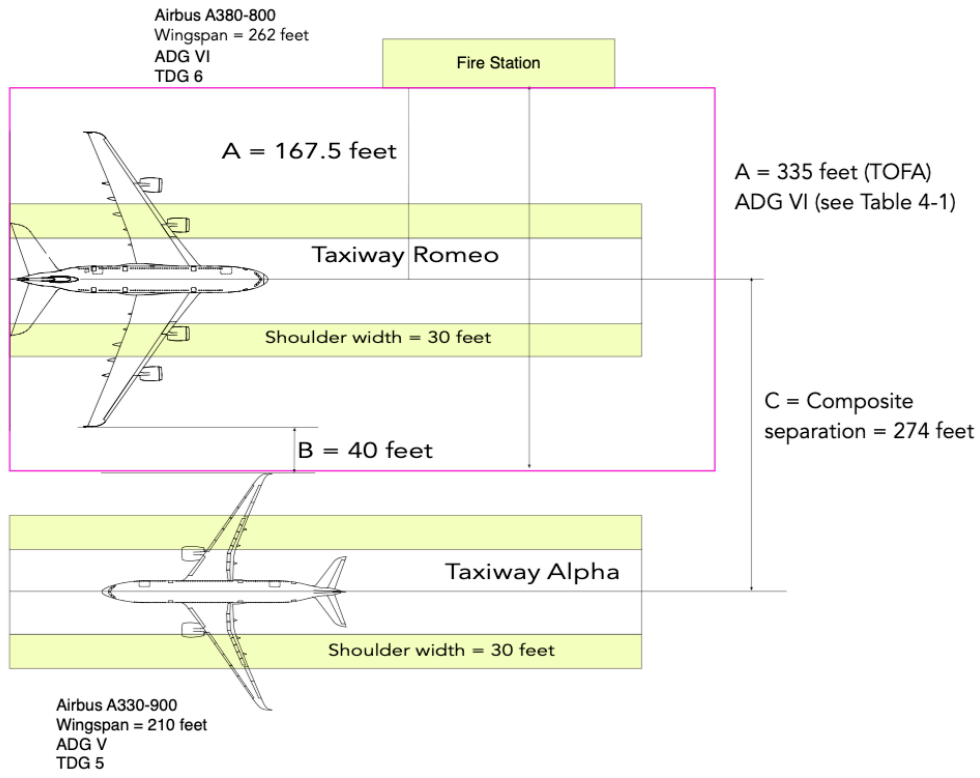


Figure 6. Taxiway Design for Problem 3.