

Assignment 7: Imaginary Surfaces and Airport Geometric Design Standards

Date Due: October 31, 2025

Instructor: Trani

Problem 1

This problem analyzes possible FAR Part 77 imaginary surface violations. The single runway airport has a 8,750-foot precision runway (see Figure 1). Three objects identified near the runway are proposed by two developers and a telecommunications company.

- a) Use the CAD program of your choice to construct the top view of the five imaginary surfaces. Provide the dimensions of each surface.

Full drawing is OK.

1/2 drawing (only showing one runway end) is OK too.

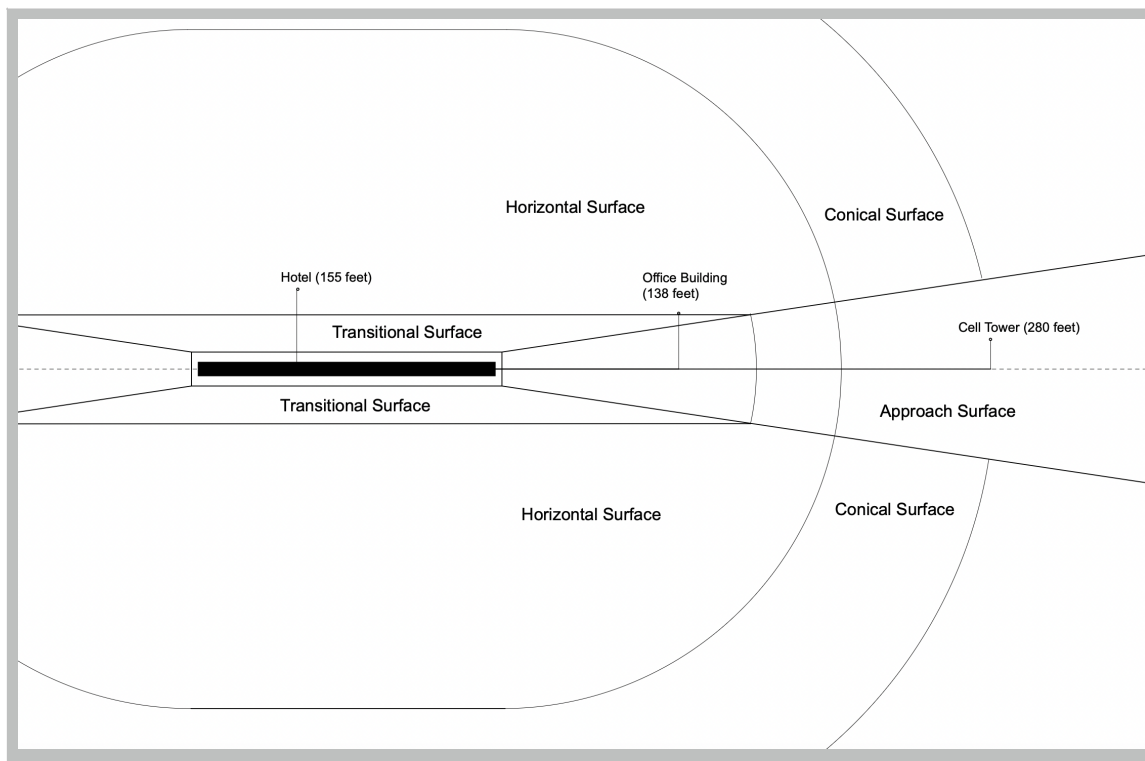


Figure 1.1. Imaginary Surfaces.

- b) Study three objects shown in Figure 1 to see if the objects violate any imaginary surface. State the FAR Part 77 imaginary surface applicable to each object. Also, state if the objects are obstacles to navigation.

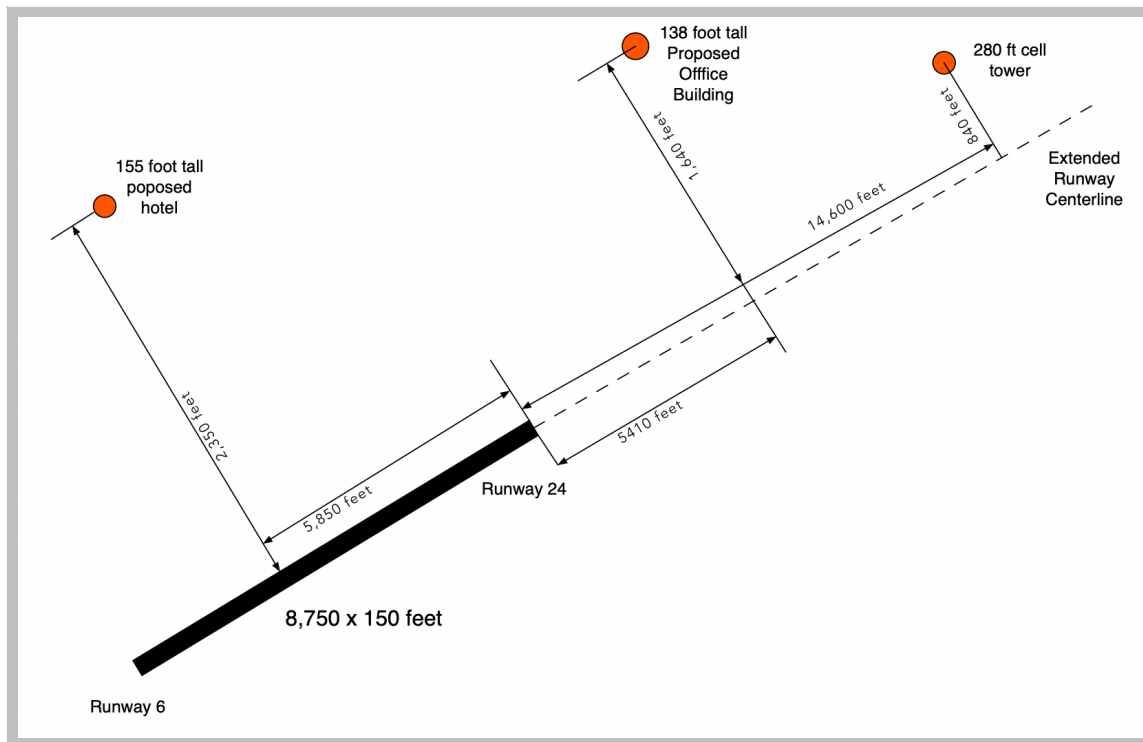


Figure 1. Objects Identified Near the Existing Runway. Drawing not to Scale.

- 1) 155-foot hotel is an obstruction. Penetrates the **horizontal surface (150 feet maximum)**.
- 2) 138 foot office building analysis. At the location of the proposed building, the approach surface has a width of:

Width = 500 feet + 5210 (0.15) = 1281.5 feet

The proposed building is inside the horizontal surface. **The building is not an obstruction to navigation.**

- 3) 280-foot cell tower is in the approach surface.

The critical height of approach surface at cell tower location is:
 $h = 10000/50 + (14600 - 10200)/40 = 200 + 110 = 330$ feet

The cell tower does not violate the approach surface.

However, according to the general criteria below (also part of the FAR Part 77 standards), **the cell tower is an obstruction** since it may be within 3 miles of the ARP point (not given). To assess the violation to the general rule you need to know the airport reference point.

Obstructions to Navigation

In the **United States**, an object constitutes an obstruction to navigation if:

- If 200 ft. above ground level or 200 ft. above the airport elevation (whichever is greater) up to 3 miles (for runway lengths > 3200 ft.) from the airport.
- Increase 100 ft. every mile up to 500 ft. at 6 miles from the ARP (airport reference point)

A new finger-pier terminal building is required at an international airport (see Figure 2). The idea is to provide eight gates that can accommodate aircraft up to the size of a Boeing 787-10 (see Figure 3).

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- The diagram illustrates the layout of an aircraft parking apron. Key dimensions and labels include:
- A**: Total width of the apron.
 - B**: Width of the apron between the yellow service roads.
 - C**: Width of the yellow service roads (labeled as "Dual service road 12 ft per lane").
 - D**: Distance between the aircraft nose and the building wall (specified as 30 feet).
 - E**: Distance from the existing taxiway to the first yellow service road.
 - F**: Distance from the existing taxiway to the building wall.
 - G**: Distance from the building wall to the yellow service road.
 - H**: Distance from the yellow service road to the existing taxiway.
 - I**: Distance from the building wall to the yellow service road.
 - K**: Distance from the yellow service road to the existing taxiway.
 - R1**: Radius of the curved yellow service road.
- Other labels include "Existing Taxiway Papa" at the top and "Terminal Building" at the bottom.

The problem can be approached in two ways. Both methods are acceptable for the homework.

- Unless space is not available, use Method 2 as it provides flexibility to the airport operations. The Boeing 787-10 is TDG 6.

Item	Dimension (feet)	Rule Used
A	$A = 4(213) + 25 \times 5 = 977$ feet	Four wingspans + five wingtip to wingtip distances
B	$B = 30 + 224.1 + 2(12) + 1/2 \times 270 = 413.1$ feet	30 feet (D) + fuselage length + 2 x service road + $1/2 \times$ TLOFA

C	$C = 1/2 (270) = 135$ feet or $C = 1/2 (214) = 107$ feet Or $C = 1/2 (75) = 37.5$ feet	1/2 TLOFA or 1/2 TSA Or 1/2 taxiway width (least preferred dimension)
D	30 feet (given)	
E	$E = B - D = 413.1 - 30 = 383.1$ feet	Fuselage length + 2 x service road + 1/2 TLOFA
F	$F = 1/2 (75) = 37.5$ feet	1/2 taxiway width
G	$1/2 (214) + 25 = 132$ feet	1/2 wingspan + wingtip to wingtip distance
H	$H = 25$ feet	wingtip to wingtip distance
I	$I = 1/2 (285) = 142.5$ feet Or $I = 1/2 (270) = 135$ feet	1/2 TOFA Or 1/2 TLOFA
K	$K = 214 + 25 = 239$ feet	Critical wingspan + wingtip to wingtip distance
R1	$R1 = 126$ feet (minimum for 50 degrees steering angle)	Look at Figure 4.2.3 in Boeing 787 Airport Planning Document.

b) Estimate the steering angle and wingtip radius of the Boeing 787-10 for the centerline radius R1 selected in part (a) of the problem. Consult Section 4 of the corresponding Boeing airport design and planning document.

126 feet minimum and 50 degrees steering angle.



Figure 3. Boeing 787-10 in Tow at Chicago O'Hare International Airport (A. Trani).

Problem 3

- a) Use the **FAA Taxiway Fillet Design Tool** to design a 125-degree taxiway-taxiway connector for the Airbus A330-900neo (see Figure 3). Your design should include all dimensions needed to construct the taxiway fillets (three segment lengths L-1, L-2, L-3; three taxiway widths W-0, W-1, W-2, W-3; and two radii dimensions R-Fillet and R-Outer. For your design, use a 180-foot centerline radius.

The Airbus A330-900 is TDG 5. The dimensions W0-W2, L1-L3 and the radii are shown below.

Taxiway_Fillet_Design_Tool-V3-02

Taxiway Fillet Design Tool

Select TDG then <enter>

CMG

MGW

TESM

Taxiway Width

Enter delta then <enter>

R-Fillet (default)

R-Fillet (if not using default) then <enter>

Minimum recommended R-CL

Enter R-CL then <enter>

The R-CL selected will result in a maximum steering angle of 32.6 degrees

Reference 150/5300-13, Airport Design, for additional information

Enter edge light offset then <enter>

RVR < 1200?

X coordinate of R-FILLET center

Y coordinate of R-FILLET center

R-OUTER

L-1	330.76	W-0	37.50
L-2	124.34	W-1	51.48
L-3	267.86	W-2	103.30

Enter DXF file name:

Tool Notes
Design Curve
Create DXF File
Exit

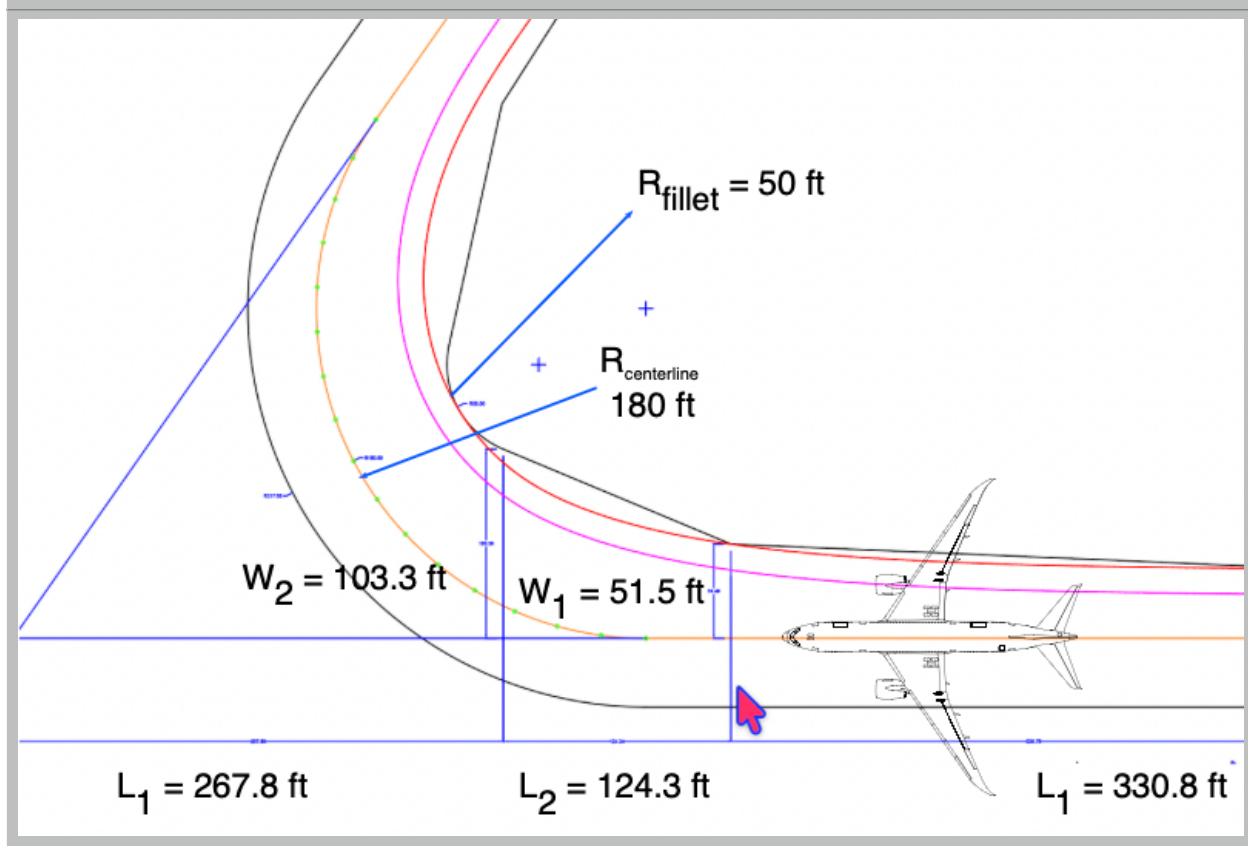


Figure 3.1. ADG V 125-Degree Taxiway-Taxiway Junction.

- b) Tell me the steering angle produced in the design of part (a). Is it acceptable?

32.6 degrees. It is acceptable (below 50 degrees).

- c) For the A330-900neo what does FAA require the minimum centerline radius on the 125-deg. Taxiway junction?

113 feet

- d) Find the steering angle required for the design implemented in part (a).

32.6 degrees.

- e) Use the **FAA FAA Taxiway Fillet Design Tool** to produce a simple CAD drawing of the taxiway-taxiway connector design in part (a). Show the detailed geometry in the CAD software with dimensions (no hand sketches accepted). You can export the DXF file produced by the FAA Taxiway Design Tool.

Note: 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. You must still draw the solution in part (a) using CAD.



Figure 4. Airbus A330-900neo at Atlanta Hartsfield-Jackson International Airport (A. Trani).

Figure 4. Airbus A330-900neo at Atlanta Hartsfield-Jackson International Airport (A. Trani).

Problem 4

An airport is expected to have two parallel taxiways to serve ADG V aircraft taxiing in opposite directions. Specify the following dimensions:

- a) Distance between parallel taxiway centerlines.

The largest wingspan of ADG V is <214 feet. The distance between parallel taxiway centerlines is 249.5 feet. See Table 4-1 in FAA AC 150/5300-13B.

- b) Find the minimum distance between the taxiway centerline and a fix or movable object.

142.5 feet (see Table 4-1)

- c) Find the dimension of the taxiway shoulder used in the design.

30 feet is applicable to TDG 5 and 6 groups. All ADG V aircraft fall in TDG 5 and 6.

- d) Find the taxiway edge safety margin used in the design.

14 feet according to Table 4-1 (applicable to both groups TDG 5 and 6).

- e) State the dimensions of the Taxiway Object Free Area (OFA) and Taxiway Safety Areas (TSA).

For ADG V the TOFA is 285 feet.

- f) Find the dimensions (length and width) of the runway blast pad area.

Blast pad dimensions is 400 feet (length) by 280 feet (width) according to Table G-12 in the FAA AC 150/5300-13B.