Quiz 2 - Take Home

Open Notes and Internet

Instructor: A.A. Trani

Solution

Instructions

Create a solution file using the word processor of your choice. Convert to PDF and submit to Canvas. Include all screen captures of all your work including aircraft manufacturer's tables and figures, FAA nomographs and others.

Honor Code Pledge

The information provided in this exam is my own work. I have not received information from another person while doing this exam.

_____ (your signature/name)

Problem 1 (30 Points)

You can rely on Google Earth or Google Maps to measure distances at the Atlanta International Airport (ATL) to help you solve this problem.

The first part of the problem analyzes an End-Around-Taxiway (called taxiway W) at the Atlanta International Airport (see Figure 1). Runway 8R/26L is a precision runway with visibility minima below 1/2 mile. Taxiway W is **depressed** below the elevation of runway 8R. The difference in elevation (see Figure 1) avoids a violation to the Part 77 approach surface of runway 8R/26L when aircraft taxi on taxiway W while an aircraft departs from runway 26L (see Figure 1 for top and side views of the end-around-taxiway and the runway).

The airport designer constructed the end-around-taxiway **allowing ADG III aircraft** to taxi on taxiway W without interrupting the departure operations on runway 26L (see Figure 1).

a) Estimate the height H (see Figure 1) to satisfy the condition that the Part 77 approach surface is not violated when the critical aircraft (ADG III) taxies on taxiway W.

Critical height of ADG III aircraft is 45 feet.

Part 77 approach surface raises 26.3 feet above the runway threshold elevation. Note the primary surface starts 200 feet from the end of the runway. Slope is 50:1 because the runway is a precision runway (see the runway markings).

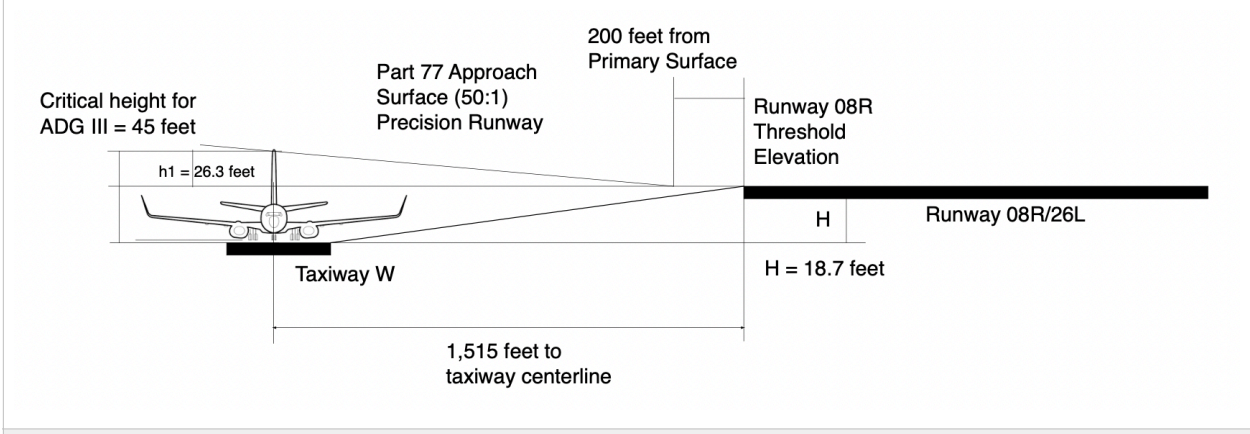

Figure 1. End-Around-Taxiway (EAT) W at Atlanta International Airport.

b) Calculate the slope of the RSA and ROFA beyond the runway threshold 8R to satisfy the required height H in part (a). Assume the slope between the end of the blast pad area and the taxiway W is constant.

The runway blast pad area for runway 08R is 400 feet (good for ADG V). Note that a blast pad area has a maximum slope of -3% and varies from 0-3% (down) (see FAA AC 150/5300-13B).

Distance from runway end to centerline of taxiway W is 1,515 feet.

Solution 1: Assume the blast pad is flat (zero slope)

Distance from runway end to centerline of taxiway W is 1,115 feet. (Total distance minus the 400 foot blast pad distance).

Resulting average slope is 1.67%

Solution 2: Assume the blast pad has a slope consistent to achieve the change in height at taxiway W.

Distance from runway end to centerline of taxiway W is 1,515 feet.

H = 18.7 feet (elevation difference between runway elevation and end-around-taxiway centerline elevation).

Resulting average slope is 1.23%

Both slopes are below the -3% maximum permissible according to the design guidelines (see Figure 2a).

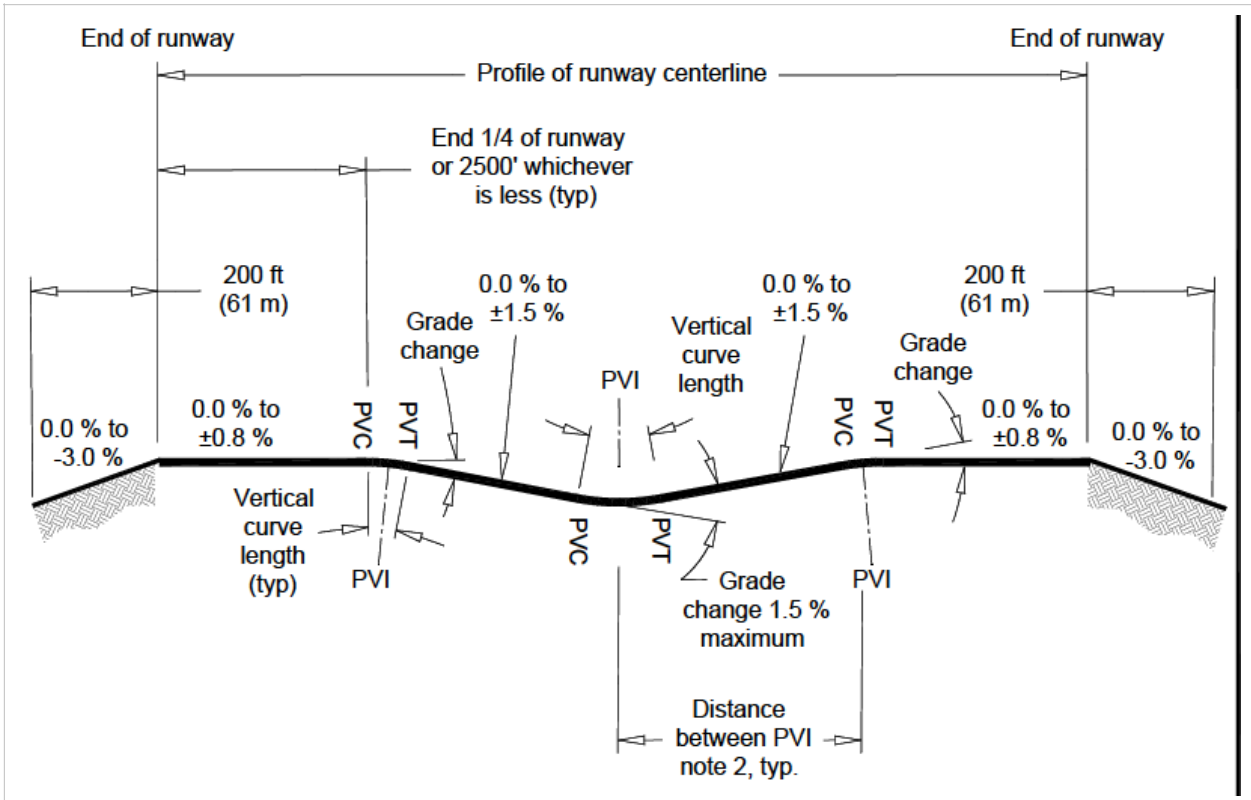

Figure 2a. Transverse Design of Runways for AAC Groups C and D.

A more realistic assessment of the slopes of RSA and ROFA is needed if consideration is given that the Taxiway W taxiway safety area (TSA) needs to have drainage design considerations (See Figure 2b). The new solution yields a slope of 1.77% from the runway blast pad area to the edge of the taxiway TSA.

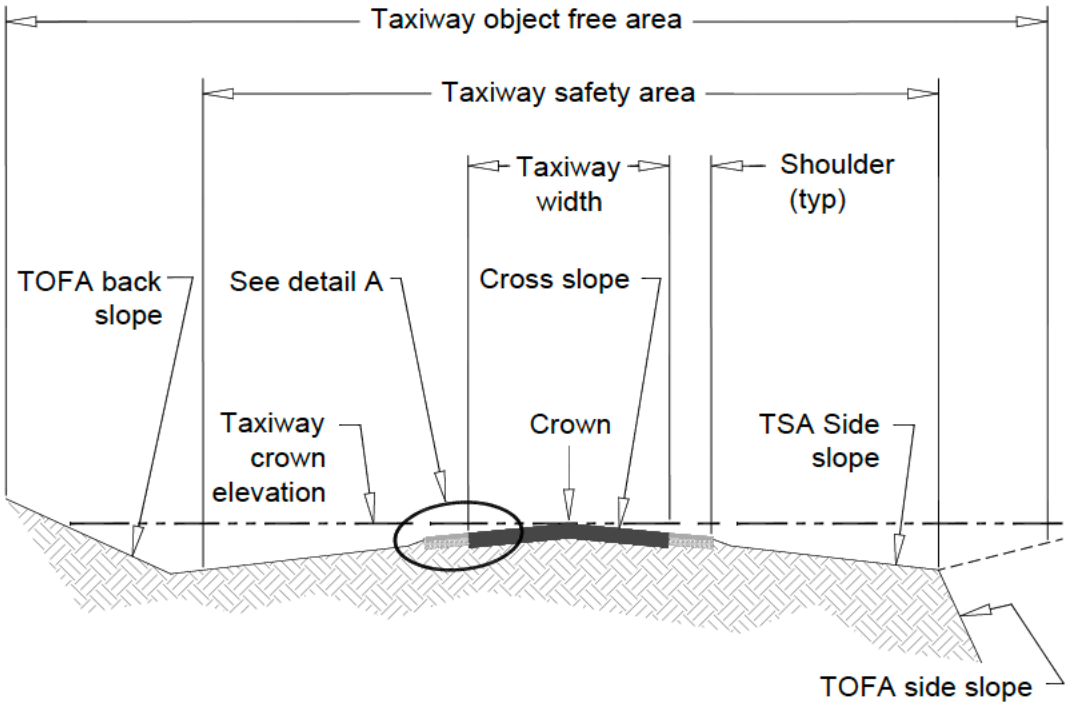

Figure 2b. Transverse Design of Taxiways (FAA AC 150/5300-13B)

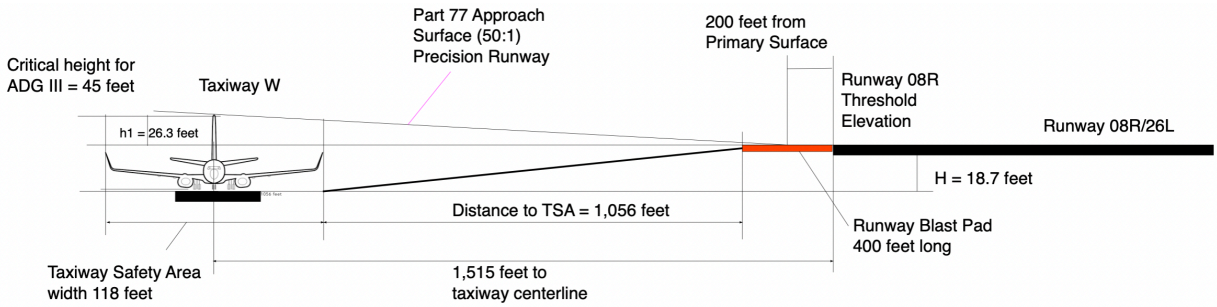

Figure 2c. Improved Design for Taxiway W. Slope from Runway Blast Pad to the Edge of TSA is 1.78%.

c) A 125-foot antenna is located 2.1 nautical miles from the runway threshold 08R and aligned with the extended runway centerline. Determine if the antenna is an obstruction to navigation.

At 2.1 nautical miles from the runway threshold (12,760 feet) the antenna is 12,560 feet into the approach surface of a precision runway (12,560 feet from the end of the primary surface). The antenna is not an obstruction to navigation. At 10,000 feet from the runway, the maximum permissible height is 150 feet or the horizontal surface (see Figure 3).

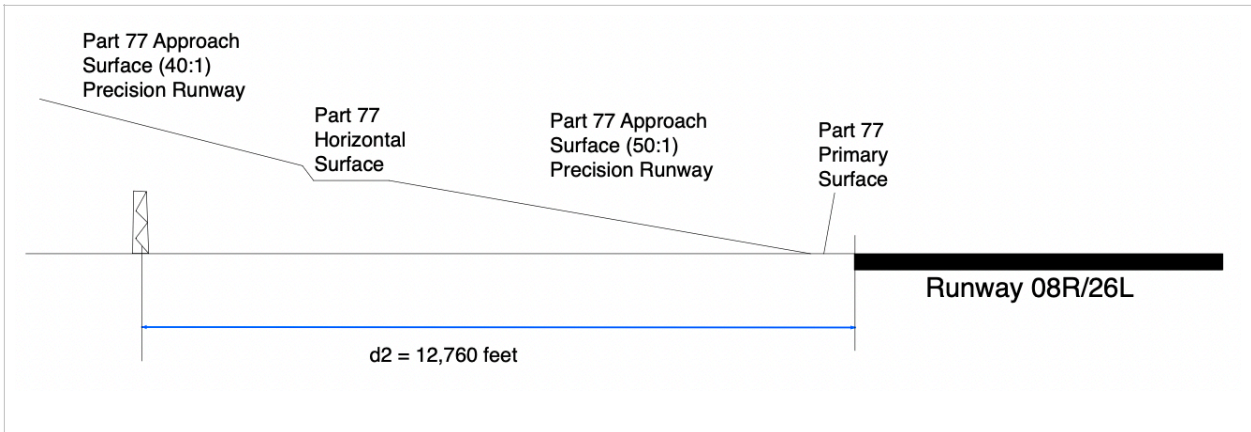

Figure 3. Antenna Located 2.1 nm from Runway End.

d) Figure 2 shows the location of a 12-story hotel (Renaissance Concourse Hotel) on the North side of ATL airport. The hotel is estimated to be 125 feet tall to the roof. The hotel management wants to install a 28-foot antenna to improve internet service at the hotel. Determine if the antenna will be considered an obstruction to navigation. Tell me the critical

The hotel roof lies 1,500 feet from the centerline of runway 8R. Hotel lies at the intersection of the transition surface and the horizontal surface. The 28-foot antenna would raise the height of the building to 153 feet. Hence the antenna is an obstruction to navigation because it pierces the transition and horizontal surfaces..

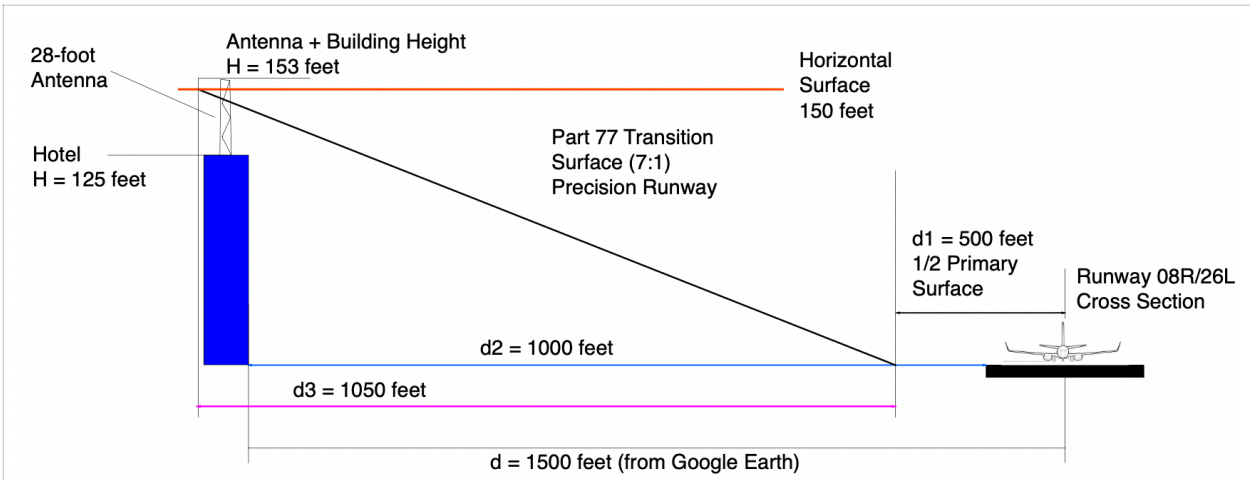

Figure 4. Location of Renaissance Concourse Hotel near Runway 8L/26R at the Atlanta International Airport and Proposed 28-Foot Antenna.

Problem 2 (40 Points)

Figures 10 and 11 show two design runway configurations to be studied. The critical aircraft at the airport is the Embraer 190 (see Figure 12). The airport is planned to have an Instrument Landing System category 1 with approaches down to 200 feet decision height and 2400 feet runway visual range. The airport is to be constructed at a site located 925 feet above sea level conditions.

e) Find the RDC class for the airport.

RDC includes: ADG III, AAC C, RVR 2400 feet.

f) Determine the minimum distance between centerline distance between runway and taxiway "Bravo".

400 feet is the minimum recommend by ADG III and AAC C. Appendix G shows the recommended distances between a runway centerline to the taxiway centerline.

RUNWAY SEPARATION					
Runway centerline to:					
Parallel runway centerline	H	*Refer to paragraph 3.9*			
Holding Position [8]		250 ft	250 ft	250 ft	250 ft
Parallel taxiway/taxilane centerline [2]	D	400 ft	400 ft	400 ft	400 ft

g) Use the Runway Exit Design Model (REDIM 4) to determine the runway occupancy time for the configuration shown in Figure 3. Table 1 has the aircraft fleet mix at the airport. Report the following results:

a. Weighted average ROT (seconds)

In my solution, I used the airport temperature to be 60 deg. F. Weighted average ROT 63.7 seconds

Runway Occupancy Times (63.7 s - Std Dev: 18.6 s) - All

(Exam2 Simplified)

Aircraft Name	E1	E2	E3	E4
BE58	38.4s	52.2s	69.0s	98.5s
C172	54.2s	71.3s	98.5s	143.5s
C25B	33.8s	45.0s	59.0s	82.3s
C56X	32.3s	43.0s	56.4s	78.9s
E170		38.5s	50.7s	72.9s
E190		39.1s	51.5s	73.2s
GLF5		45.6s	59.1s	81.9s

Figure 5. ROT Table Reported by REDIM 4.

b. Percent of the critical aircraft (E190) using Exit E3

We can expect 57.3% of the Embraer 190 to exit at E3. Figure 6 shows the runway exit assignment.

Runway Exit Aircraft Assignment - All

(Exam2 Simplified)

Aircraft Name	E1	E2	E3	E4	Aircraft Mix
BE58	12.9%	39.5%	32.9%	14.8%	18.0%
C172	45.4%	31.7%	15.2%	7.7%	19.9%
C25B	1.6%	27.1%	47.5%	23.9%	9.8%
C56X	0.7%	21.5%	51.9%	25.9%	4.8%
E170		5.0%	54.2%	40.8%	10.4%
E190		4.8%	57.3%	38.0%	22.0%
GLF5		10.6%	55.2%	34.1%	15.1%
Exit Mix	11.5%	20.3%	42.7%	25.5%	

Figure 6. Runway Assignment Table Reported by REDIM 4.

c. The highest utilization exit

Runway exit E3 is expected to service more than 42% of the landings at the airport (see Figure 7). E3 is located 5675 feet from the runway threshold.

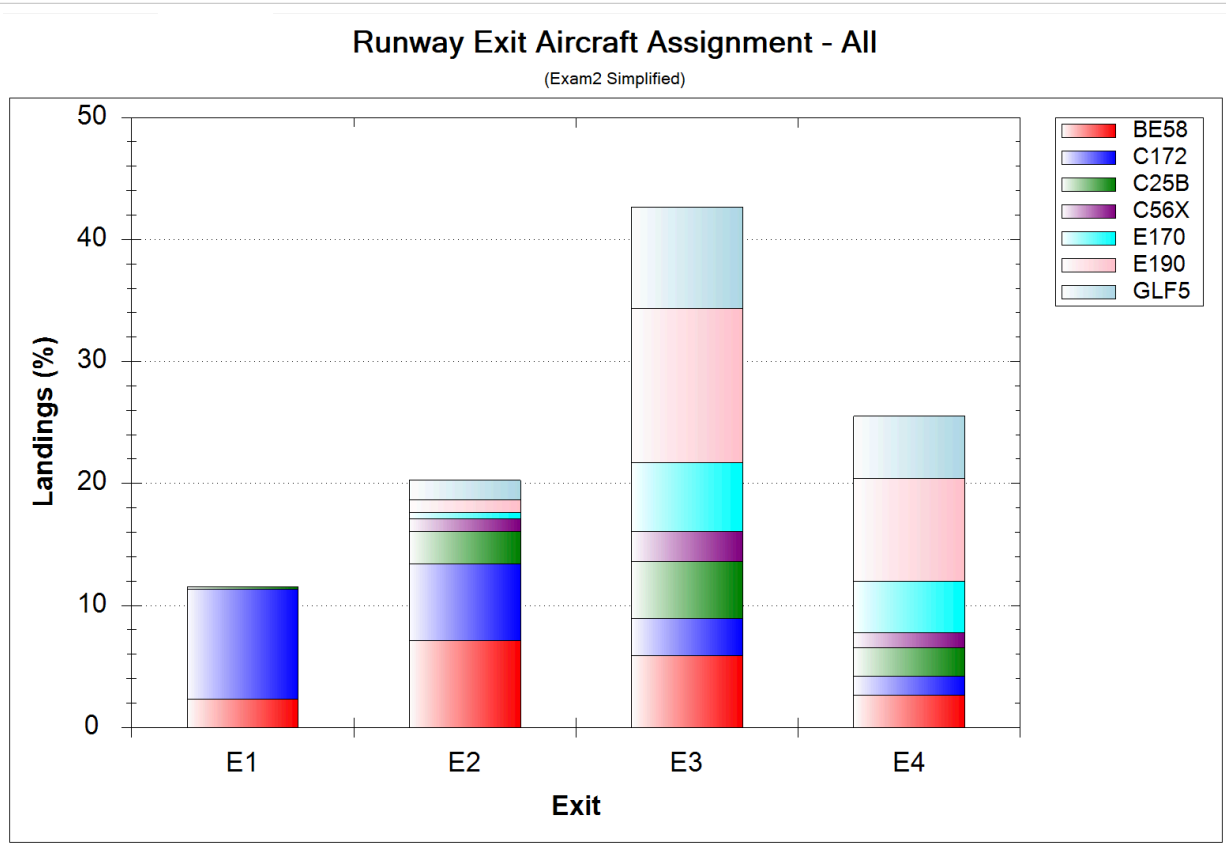

Figure 7. Runway Utilization Reported by REDIM 4.

d. Show the runway utilization table produced by the model.

Figures 6 and 7 shows the runway exit utilization.

h) A second design configuration is being considered. Figure 4 shows the alternative configuration with two standard acute angle runway exits (labeled E3 and E4). Determine the runway occupancy time for the configuration shown in Figure 4. Table 1 has the aircraft fleet mix at the airport. Report the following results:

a. Weighted average ROT (seconds)

The weighted runway occupancy time is 54.8 seconds.

Runway Occupancy Times (54.8 s - Std Dev: 13.6 s) - All

(Exam2 Configuration 2)

Aircraft Name	E1	E2	E3	E4	E5	E6
BE58		38.6s	55.1s	61.0s	76.4s	95.5s
C172	30.6s	53.6s	77.2s	86.2s	106.6s	128.7s
C25B		33.3s	49.4s	55.4s	65.6s	79.7s
C56X		31.6s	46.8s	52.9s	63.4s	76.4s
E170			40.4s	46.4s	57.6s	69.6s
E190			40.5s	46.7s	57.4s	69.5s
GLF5		30.5s	45.2s	51.0s	65.6s	78.8s

Figure 8. ROT Table Reported by REDIM 4 for Configuration 2.

b. Report the percent of aircraft using both acute-angle runway exits

48% of the landings are expected to use runway exit E3.

25% of the landings are expected to use runway exit E4. Figure 8 shows the runway exit assignment reported by the model.

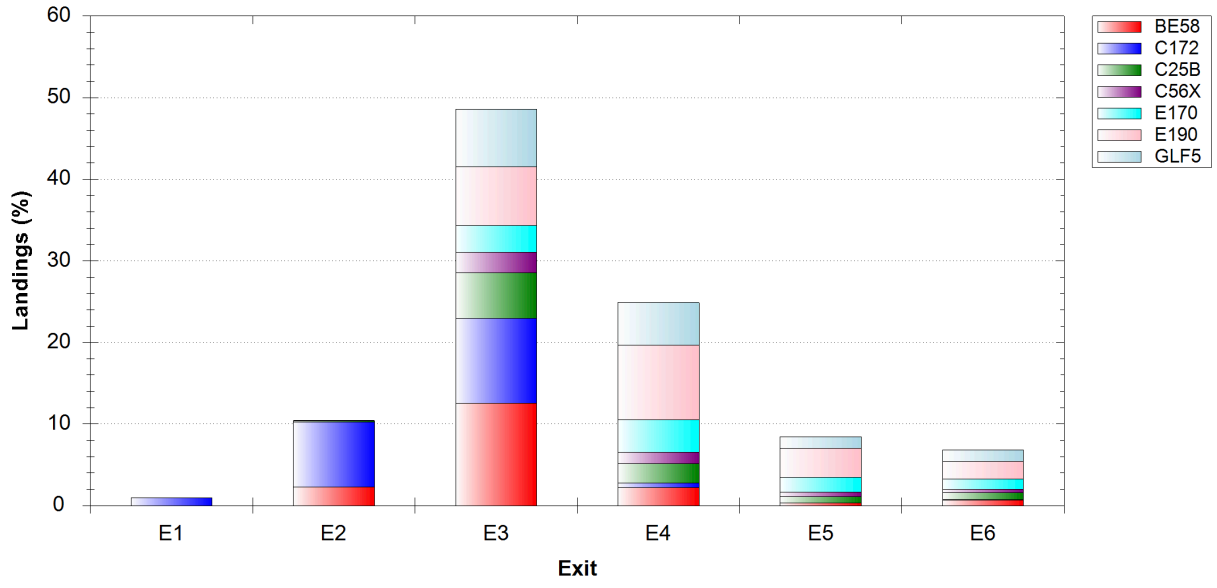

Figure 9. Runway Assignment Reported by REDIM 4 for Configuration 2.

c. The highest utilization exit

Runway exit E3 achieves the highest utilization with 48% of the landings using the high-speed exit.

d. Show the runway utilization table produced by the model.

i) The airport client would like to know if the high-speed exits are necessary. The peak hour landing rate at the airport is 35 aircraft per hour. Make a recommendation based on the reductions in ROT and the expected traffic.

The airport has 35 hourly landings per hour. 30 landings per hour is a good threshold to construct high-speed exits. I would recommend the construction of both high-speed exits.

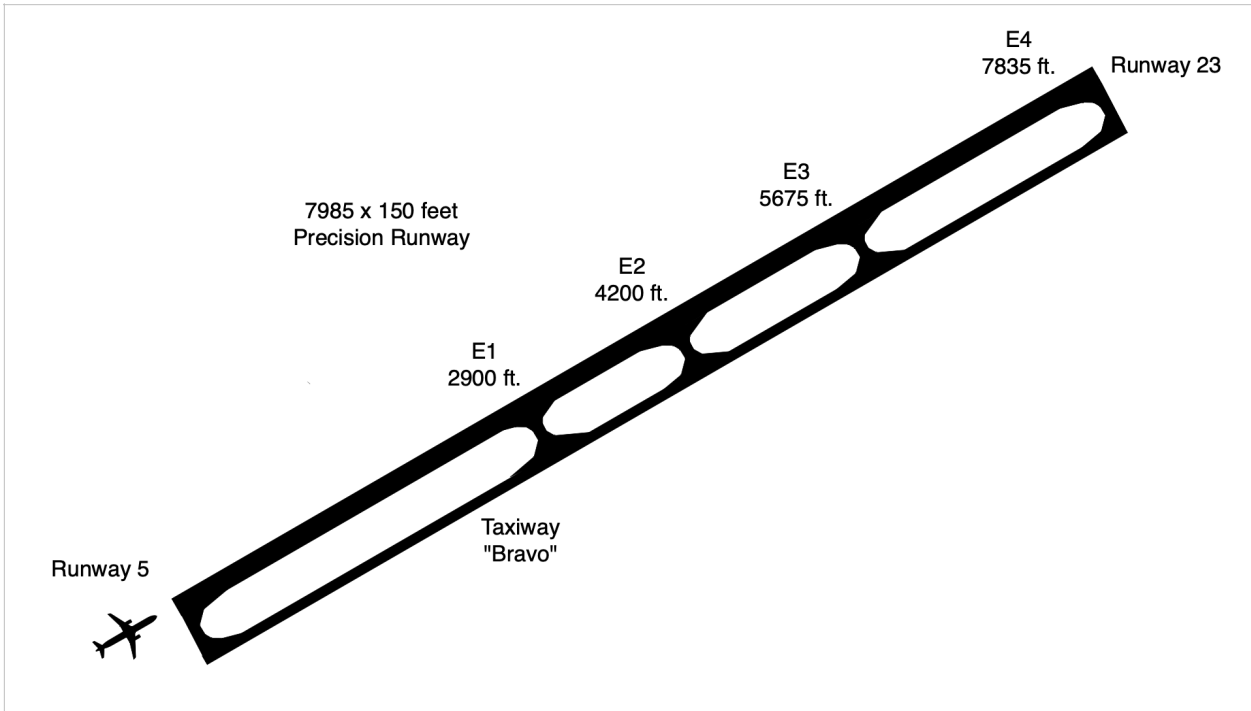

Figure 10. Runway Configuration # 1 for Problem 2.

Table 1. Aircraft Fleet Mix for Problem 2.

Aircraft ID	Aircraft	Fleet Mix (%)
C172	Cessna 172	20
BE58	Beechcraft Baron 58	18
C25B	Cessna Citation CJ2	10
C56X	Cessna Citation Excel	5
GLF5	Gulfstream G-V	15
E170	Embraer 170	10
E190	Embraer 190	22
Totals		100

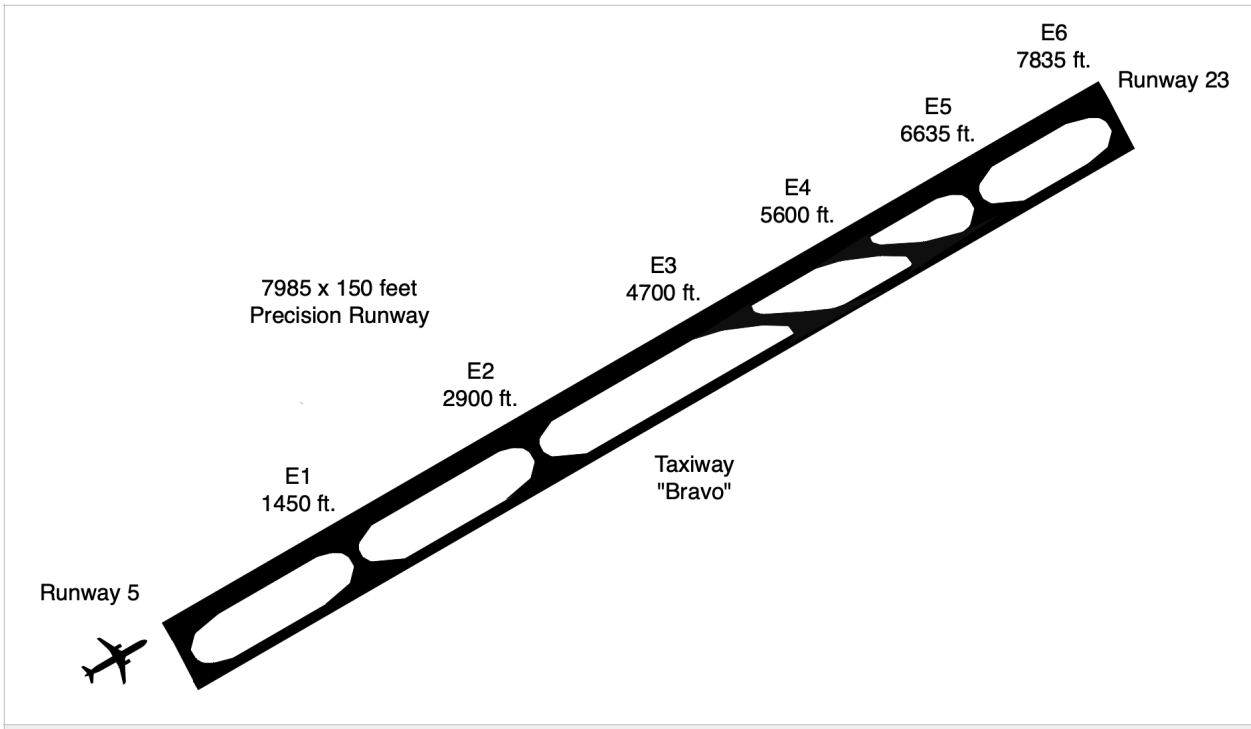

Figure 11. Runway Configuration # 2 for Problem 2.

Figure 12. Critical Aircraft for Problem 2. Embraer 190 Landing at DCA Airport (A. Trani).

Problem 3 (30 Points)

After reviewing both preliminary designs (Figures 3 and 4), the design team tasks you to specify and draw in CAD, a bypass taxiway bay configuration as shown in Figure 6.

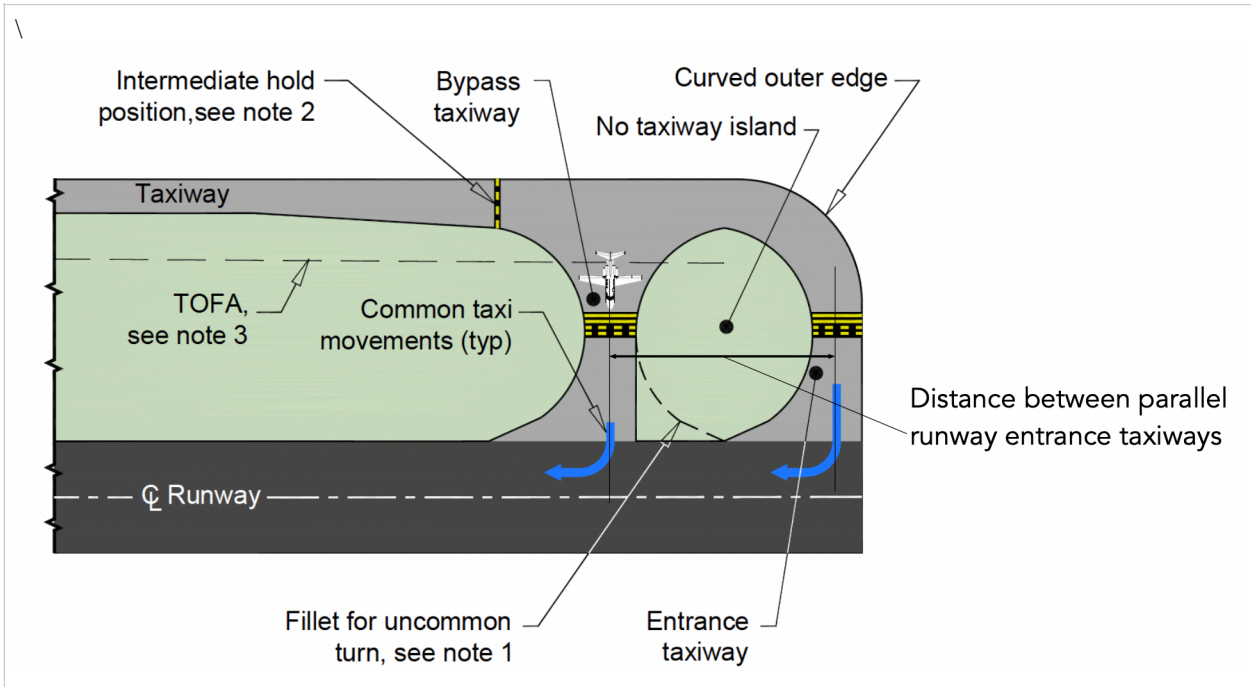

Figure 13. Runway Entrance Taxiways with Bypass Taxiway.

a) Specify the dimensions of both runway entrance taxiways for runway end 24. Use either tables in the FAA Advisory Circular or the FAA Taxiway Design Tool. You **must specify all the fillet dimensions and taxiway widths of the fillet**. For the design use a **centerline radius of 120 feet** instead of the minimum required by the FAA.

Use the FAA taxiway design tool with a centerline radius of 120 feet to obtain the dimensions of the runway entrance taxiway.

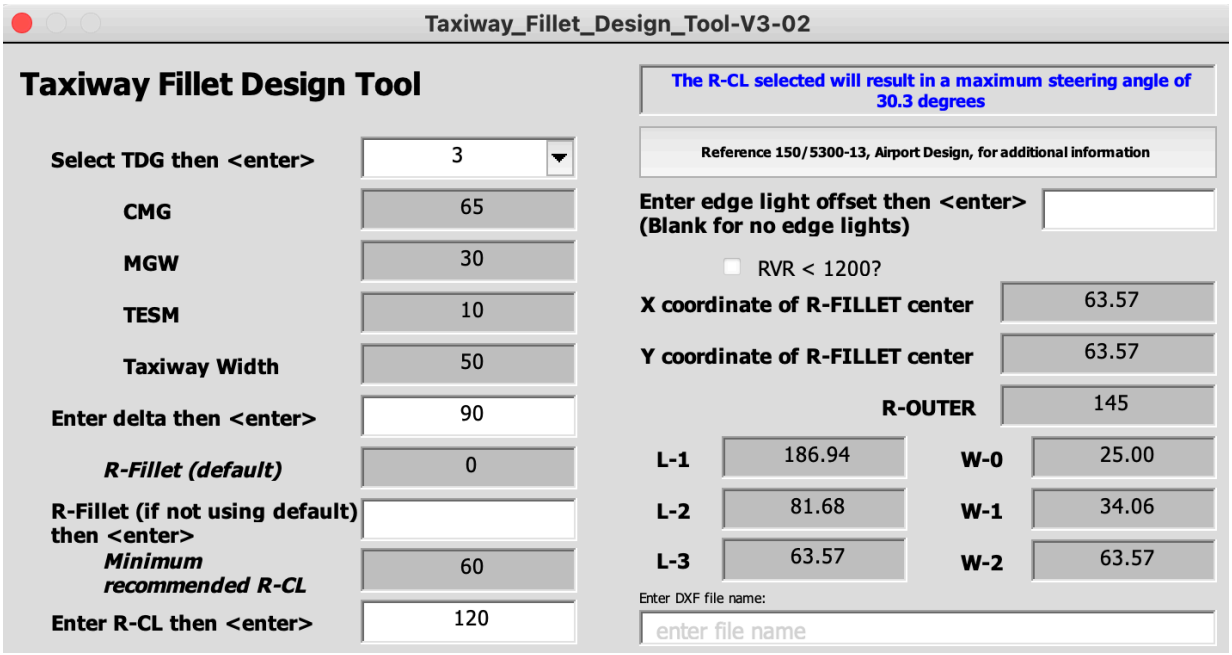

Figure 14. Runway Entrance Taxiway Dimensions for TDG 3.

b) Determine the distance required between the two parallel runway entrance taxiways (see Figure 6) to provide safe separation for the critical aircraft.

The distance between two critical aircraft is defined as the minimum distance between two parallel taxiways for TDG 3 and ADG II.

Item	ADG					
	I	II	III	IV	V	VI
Taxiway and Taxilane Separation						
Taxiway centerline to parallel taxiway centerline [1]	70 ft (21.3 m)	101.5 ft (30.9 m)	144.5 ft (44 m)	207 ft (63 m)	249.5 ft (76.1 m)	298.5 ft (91 m)

Figure 15. Distance Between Parallel Taxiways to be Used as Runway Entrance Taxiways. 144.5 feet for ADG III.

c) Draw to scale the solution using the CAD software of your choice. No sketches will be accepted.

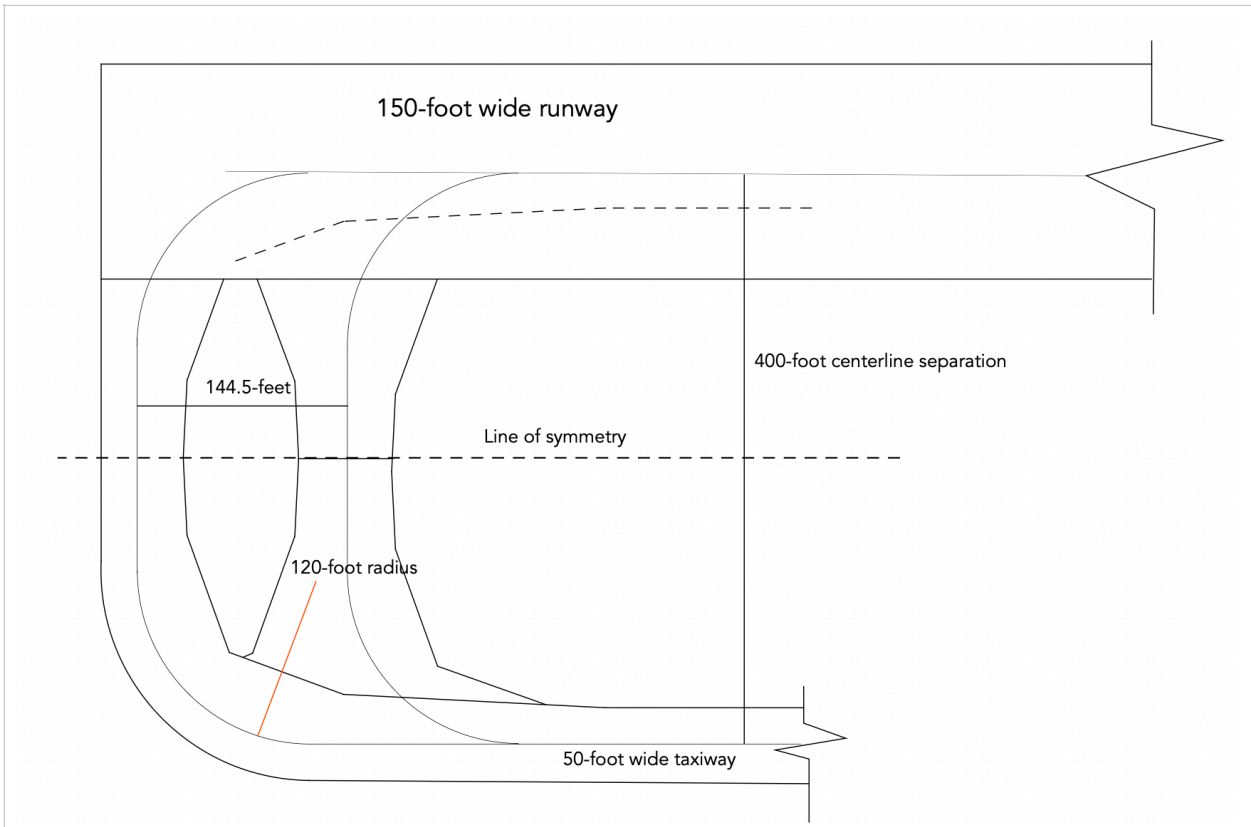

Figure 16. Runway Entrance Taxiways with Bypass Taxiway.