Quiz 1 (Take Home Part)

Due Date: April 9, 2014 at close of business day (via email)

Instructor: Trani

Instructions

Write your solutions in the exam paper if possible. Otherwise attach extra sheets and please place your name in every extra sheet.

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 (35 points)

An airport with a single 8,850 ft. runway is shown in Figure 1. The airport is located 2,300 feet above mean sea level. The airport has commercial service with 20 flights per day using Boeing 757-200 and Airbus A320 aircraft. Today, the runway is a **non-precision runway with a GPS approach to both runway ends**.

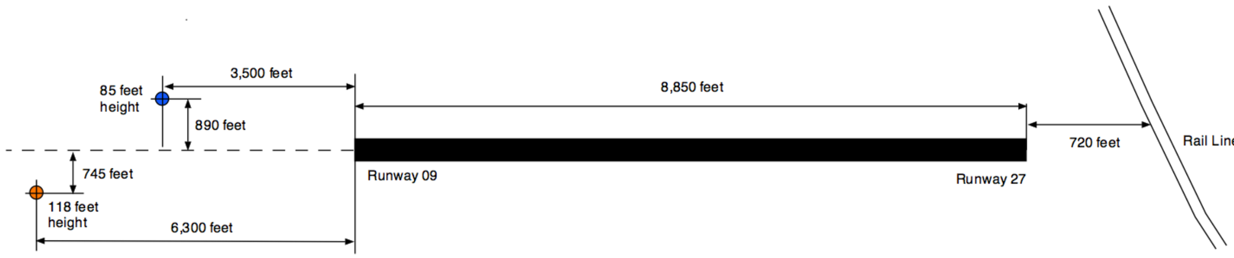


Figure 1. Runway Configuration for Problem 1.

1) For runway 09, calculate if the two obstacles shown in Figure 1 are instructions to navigation. Object 1 is an antenna (blue), object 2 (orange color) is a new hotel built near the airport .

a) Non-precision runway. The imaginary surfaces are shown in the table below. For the problem solution I will use the column labeled D since it offers the best approach characteristics and typical of commercial operations.

DIM	ITEM	DIMENSIONAL STANDARDS (FEET)					
		VISUAL RUNWAY		NON-PRECISION INSTRUMENT APPROACH			PRECISION INSTRUMENT APPROACH
					B		
		A	B	A	C	D	
A	WIDTH OF PRIMARY SURFACE AND APPROACH SURFACE WITH AT INNER END	250	500	500	500	1,000	1,000
A	RADIUS OF HORIZONTAL SURFACE	5,000	5,000	5,000	10,000	10,000	10,000
		VISUAL APPROACH		NON-PRECISION INSTRUMENT APPROACH			PRECISION INSTRUMENT APPROACH
					B		
		A	B	A	C	D	
A	APPROACH SURFACE WIDTH AT END	1,000	1,000	2,000	3,500	4,000	16,000
A	APPROACH SURFACE LENGTH	5,000	5,000	5,000	10,000	10,000	*
A	APPROACH SLOPE	20:1	20:1	20:1	34:1	34:1	*

A- UTILITY RUNWAYS
B- RUNWAYS LARGER THAN UTILITY
C- VISIBIITY MINIMUMS GREATER THEN 3/4 MILE
D- VISIBILITY MINIMUMS AS LOW AS 3/4 MILE
*- PRECISION INSTRUMENT APPROACH SLOPE IS 50:1 FOR INNER 10,000 FEET AND 40:1 FOR AN ADDITIONAL 40,000 FEET

The angle made by the approach surface is 0.15 radians. The antenna is inside the approach surface. At 3300 feet from the primary runway, the approach surface edge is 995 feet from the extended runway centerline. At 3300 feet from primary surface, the elevation of the approach surface is 97.06 feet (at 34:1 slope). The antenna is not an obstacle.

b) The hotel is not an obstacle to navigation either. The hotel is located inside the approach surface. At 6100 feet from the primary runway, the approach surface edge is 1415 feet from the extended runway centerline. At 6100 feet from primary surface, the elevation of the approach surface would be 179.4 feet (at 34:1 slope). However, the horizontal surface is 150 feet in height so it is the dominant surface at 6300 feet from the runway threshold. The hotel is not an obstacle to navigation.

2) Using the declared distance concept, find the Landing Distance Available (LDA) when landings occur on runway 09. In your analysis provide full Runway Safety Area (RSA) protection.

LDA is 8,850 - (1000-720) = 8,570 feet

3) If runway 09 is improved with an ILS system, will such a change affect the LDA available? Explain.

If an ILS is present, the approach surface becomes 50:1. The antenna is a violation of the approach surface (66 feet allowed at 3300 feet). The hotel is not in violation of the approach surface if the ILS is installed. If the ILS is installed, the runway threshold for 09 will have to be displaced by 950 feet to satisfy FAR Part 77 precision approach surface criteria. This will have an effect in the LDA.

To complete the problem correctly, Check new 62.5: 1 surfaces as well.

Problem #2 (30 points) - Short Answers

a) For the Boeing 757 described in Problem 1 estimate the maximum crosswind component used for Wind Rose analysis.

20 knots (ADG IV-C)

b) If the aircraft in Problem 1 has an approach speed of 141 knots, find the yaw angle (B) the aircraft should fly relative to the wind (see Figure 2).

The relative angle between wind vector and the aircraft speed is found to be:

B = atan(20/141) = 0.1409 radians (8.07 degrees)

Figure 2. Definition of Yaw Angle.

c) Estimate the minimum distance from the runway centerline to the holding line prior to entering the runway.

250 feet + increase 1 foot for each 100 feet above sea level conditions. This translates into:

Holding distance = 250 + 2300/100 * 1 = 273 feet from runway centerline.

d) Find the Building Restriction line for a precision runway if a 90 foot is used to drive the building restriction.

Depends on where is the building to be placed.

a) For example, if the building is to be constructed perpendicular to the runway:

The building restriction line is driven by the transitional surface. The primary surface extends 500 feet from runway centerline. Then apply a 7:1 slope to reach 90 feet. This results in 1,130 feet from runway centerline.

b) For example, if the building is to be constructed on the approach surface:

The building restriction line would be 3,260 feet from the end of the runway (using 34:1 slope).

Problem # 3 (35 points)

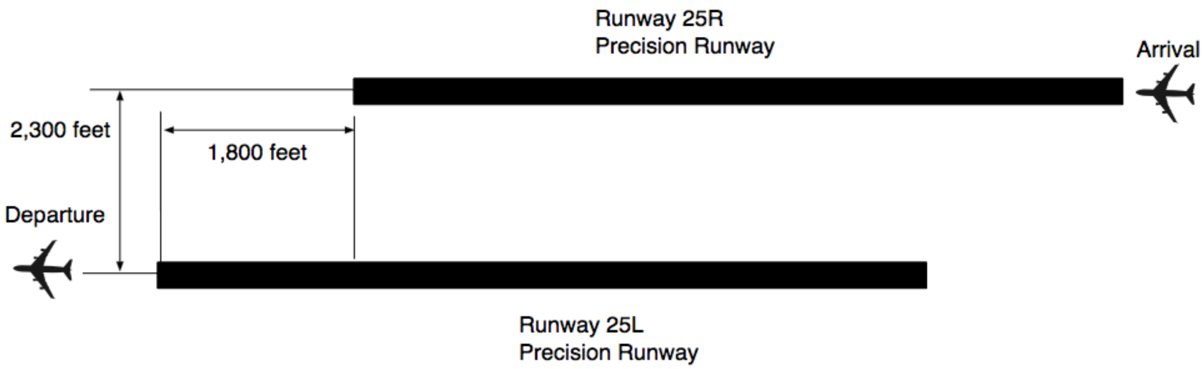


Figure 3. Runway Configuration for Problem 3.

An airport has a runway configuration as shown the Figure 3.

a) Find the Pareto capacity diagram under IMC conditions if the following parameters are known.

The airport has a standard airport surveillance radar (ASR) which tracks aircraft up to 50 nautical miles form the airport site. The radar has a scan rate of 4 seconds. Tables 1 and 2 show the typical ATC separations at the airport under IMC conditions. Three aircraft groups operate at the airport. The airport has the following technical parameters: a) in-trail delivery error of 18 seconds (because there is a radar at the site), b) departure-arrival separation for both VMC and IMC conditions is 2 nautical miles, c) probability of violation is 5%. Arriving aircraft are "vectored" by ATC to the final approach fix located 11 miles from the runway threshold (see Figure). Arrivals follow in-trail after crossing the final approach fix. The airport aircraft mix, runway occupancy times and approach speeds are shown in Table 1.

Show me sample calculations for both opening and closing cases so that I know that you can do such calculations by hand.

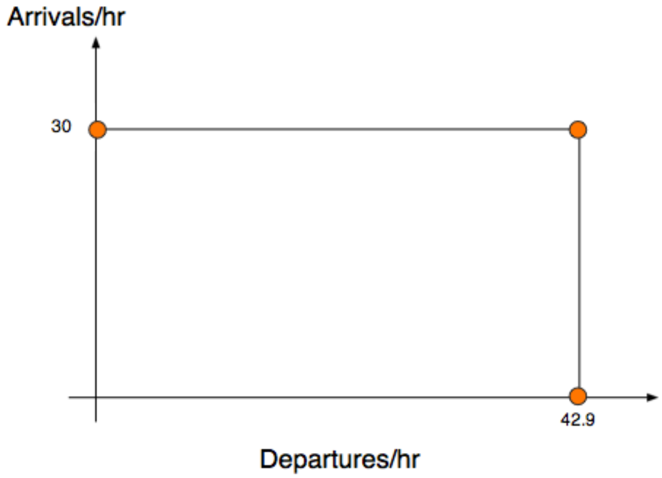
Use the Excel spreadsheet calculator provided in class if desired. Note that both runway can be operated independently because the runway ends are stagger more than 1,000 feet.

IMC analysis

Saturation arrival capacity = 30 operations/hr

Stauration departure capacity = 42.9 operations/hr

The Pareto diagram is a rectangle as shown below.



Pareto Diagram for IMC Conditions.

Table 1. Airport Arrival Occupancy Times and Fleet Mix for Problem 1.

	Small	Large	B757	Heavy	Superheavy
ROT (s)	48	51	60	65	75
Percent Mix (%)	0	40	40	20	0
Vapproach (knots)	125.0	135.0	141.0	153.0	150.0

Table 2. Minimum arrival-arrival separations under IMC conditions. Values in are nautical miles. Values Shown Do Not Include Buffers.

Minimum Separation Matrix (nm)		Arrivals-Arrivals			
	Trailing Aircraft (Header Columns)				
Lead (column 1)	Small	Large	B757	Heavy	Superheavy
Small	3	3	3	3	3
Large	4	3	3	3	3
B757	5	4	3	3	3
Heavy	6	5	4	3	3
Superheavy	8	8	8	8	8

Table 3. Minimum departure-departure separations under IMC conditions. Values in are seconds.

Departure-Departure Separation Matrix (seconds)					
	Trailing Aircraft (Header Columns)				
Lead (column 1)	Small	Large	B757	Heavy	Superheavy
Small	60	60	60	60	60
Large	90	60	60	60	60
B757	120	120	60	90	90
Heavy	120	120	120	120	90
Superheavy	150	120	120	120	120