Assignment 6: Geometric Design Standards

Solution

Problem #1

A new airport is expected to serve new generation commercial transport aircraft such as the Boeing 787-800 and the Airbus A350-900.The airport located at 3,200 feet above sea level conditions expected to have an 10,500 foot runway and an instrument landing system with an approach procedure with visibility minima down to 1/2 miles (ILS Category I equivalent approach). The airport will have a new ILS landing system.

a) Determine the dimensions of the complete runway and taxiway layout shown in Figure 1 (for the new airport). Clearly indicate the FAA standards used including the tables consulted in the FAA advisory circular 150/5300-13A.

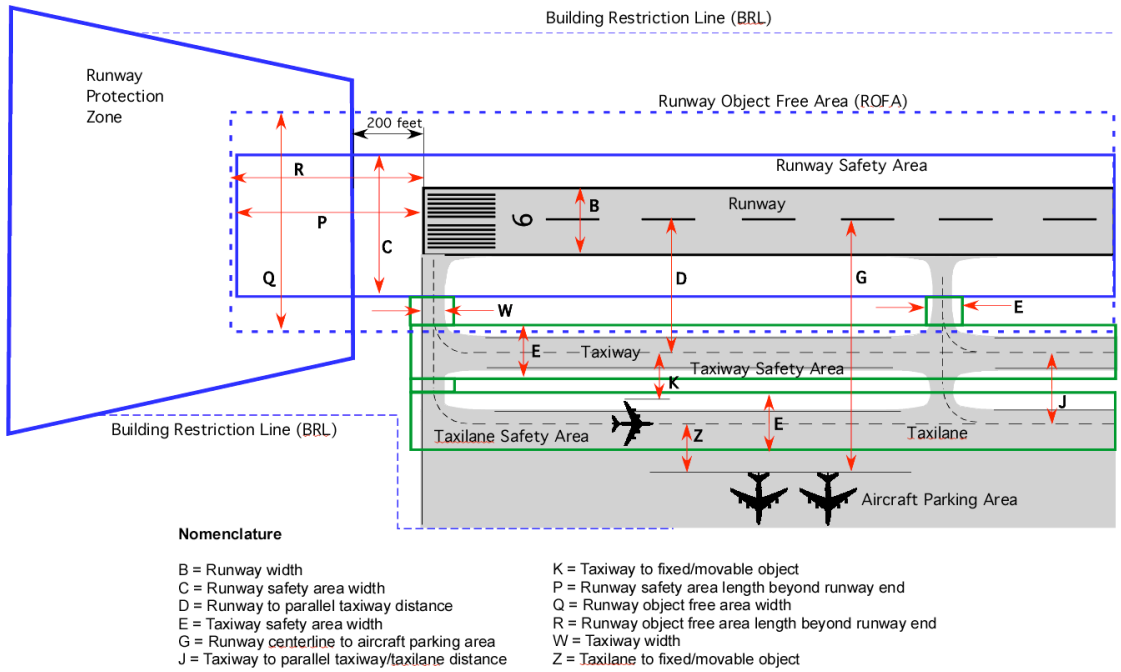

Figure 1. Simplified Airport Layout for Problem 1.

Both aircraft belong to ADG group V (wingspan up to 213 feet). Use approach speed category D to find the critical runway design code (RDC).

Use the interactive form in the FAA advisory circular (Table 4-8) to find all dimensions. Some of the most relevant are shown below:

Distance D - taxiway to runway centerline distance is 450 feet for ADG V and airport elevation of 1345 feet above mean sea level conditions (see footnote # 3 on Table 3-8). Note that the airport is expected t operate with visibility minimums of 1/2 mile. If the visibility minimums are reduced to less than 1/2 mile, the distance increases to 500 feet.

2. The runway to taxiway/taxilane centerline separation standards are for sea level. At higher elevations, an increase to these separation distances may be required to keep taxiing and holding aircraft clear of the inner-transitional OFZ (refer to paragraph 308.c). Using this standard to justify a decrease in runway to taxiway/taxilane separation is not permitted.
3. For ADG-V, the standard runway centerline to parallel taxiway centerline separation distanc is 400 feet for airports at or below an elevation of 1,345 feet; 450 feet for airports between elevations of 1,345 feet and 6,560 feet; and 500 feet for airports above an elevation of 6,560 feet.
4. For aircraft approach categories A/B, approaches with visibility less than ½-statute miles, runway centerline to taxiway/taxilane centerline separation increases to 400 feet.
5. For ADG-V, approaches with visibility less than ½-statute mile, the separation distance increases to 500 feet. See footnote 7.

Figure 1.1 Footnotes for Table 3-8. Runway to Taxiway Distance for ADG V.

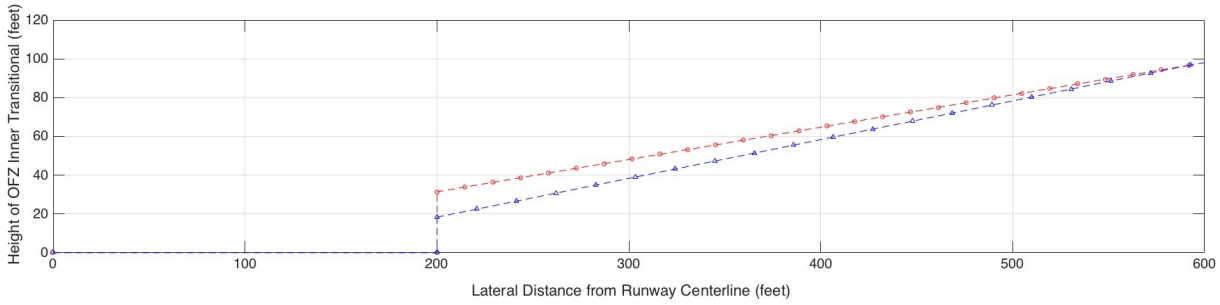

Figure 1.2 Inner Transitional OFZ Analysis for Airbus A350-900.

Check inner transitional surface since the airport is not at sea level conditions. Use the critical wingspan of the A350-900 (212.4 feet). Figure 1.2 illustrates the inner transitional OFZ analysis. Check that the tail of an Airbus A350-900 or the Boeing 787-800 will not penetrate the inner transitional OFZ.

At 450 feet from the runway centerline, the critical height of the inner transitional OFZ is 73.1 feet tall. The tail of the Airbus A350-900 is 57.1 feet (see table in Airbus A350-900 document). The tail height of the Boeing 787-800 is 55.5 feet. The 450 foot distance satisfies the inner transitional OFZ.

b) Find the width and size of the runway and taxiway shoulders and blast pad areas needed at this airport.

150 feet for runway width. 35 feet for runway shoulders.

iii) Find the closest perpendicular distance to the runway to place an 80-foot tall hangar on the North side of the airport (top of the diagram). In this analysis consider both Inner Transitional OFZ and FAR Part 77 surfaces. Explain which set of criteria is the most critical.

The transitional surface of FAR Part 77 is more critical in this case. The closest distance for the hangar (called building restriction line) is (500 ft + 80*7) **1060 feet. T**he FAR Part 77 surface is critical.

Table 3-8. Runway design standards matrix

Aircraft Approach Category (AAC) and Airplane Design Group (ADG): *(select from pull-down menu at right)*		D – V			
		Visibility Minimums			
ITEM	**DIM[1]**	Visual	Not Lower than 1 mile	Not Lower than 3/4 mile	Lower than 3/4 mile
Runway Design					
Runway Length	A	*Refer to paragraphs 302 and 304*			
Runway Width	B	150 ft	150 ft	150 ft	150 ft
Shoulder Width		35 ft	35 ft	35 ft	35 ft
Blast Pad Width		220 ft	220 ft	220 ft	220 ft
Blast Pad Length		400 ft	400 ft	400 ft	400 ft
Crosswind Component		20 knots	20 knots	20 knots	20 knots
Runway Protection					
Runway Safety Area (RSA)					
Length beyond departure end [10, 11]	R	1000 ft	1000 ft	1000 ft	1000 ft
Length prior to threshold [12]	P	600 ft	600 ft	600 ft	600 ft
Width	C	500 ft	500 ft	500 ft	500 ft
Runway Object Free Area (ROFA)					
Length beyond runway end	R	1000 ft	1000 ft	1000 ft	1000 ft
Length prior to threshold [12]	P	600 ft	600 ft	600 ft	600 ft
Width	Q	800 ft	800 ft	800 ft	800 ft
Runway Obstacle Free Zone (ROFZ)					
Length		*Refer to paragraph 308*			
Width		*Refer to paragraph 308*			
Precision Obstacle Free Zone (POFZ)					
Length		N/A	N/A	N/A	200 ft
Width		N/A	N/A	N/A	800 ft
Approach Runway Protection Zone (RPZ)					
Length	L	1700 ft	1700 ft	1700 ft	2500 ft
Inner Width	U	500 ft	500 ft	1000 ft	1000 ft
Outer Width	V	1010 ft	1010 ft	1510 ft	1750 ft
Acres		29.465	29.465	48.978	78.914
Departure Runway Protection Zone (RPZ)					
Length	L	1700 ft	1700 ft	1700 ft	1700 ft
Inner Width	U	500 ft	500 ft	500 ft	500 ft
Outer Width	V	1010 ft	1010 ft	1010 ft	1010 ft
Acres		29.465	29.465	29.465	29.465
Runway Separation					
Runway centerline to:					
Parallel runway centerline	H	*Refer to paragraph 316*			
Holding position [8, 9]		250 ft	250 ft	250 ft	280 ft
Parallel Taxiway/Taxilane centerline [2, 5]	D	----------	See	footnote 3	----------
Aircraft parking area	G	500 ft	500 ft	500 ft	500 ft
Helicopter touchdown pad			Refer to	AC 150/5390-2	

Notes:

Problem #2

The airport authority wants to know if the objects near an airport constitute obstacles to navigation. The proposed location of the these objects is shown in Figure 2. Determine if each object is an obstruction to navigation. State which surface is the most critical for the location of each object. The runway shown in Figure 2 is a 2,500 meter **non-precision** runway to be operated with visibility minimums as low as 3/4 of mile.

For a non-precision runway with runway visibility minima as low as 3/4 mile use the dimensions stated in column in the table below.

Antenna: At 5100 feet from the start of the approach surface the critical height is 150 feet (34:1 slope). The antenna does not violate the approach surface not the horizontal surface.

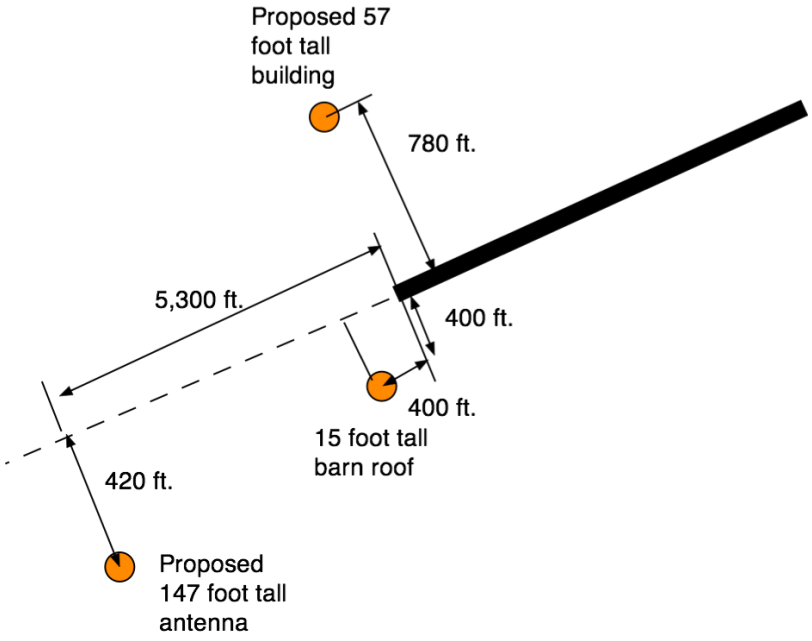

Figure 2. Potential obstructions to navigation for Problem 2.

Table with Dimensional Standards for FAR Part 77 Imaginary Surfaces.

OBSTRUCTION IDENTIFICATION SURFACES
FEDERAL AVIATION REGULATIONS PART 77

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

- A - UTILITY RUNWAYS
- B - RUNWAYS LARGER THAN UTILITY
- C - VISIBILITY MINIMUMS GREATER THAN 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

Building: The width of the primary surface and approach surface is 1000 feet at the inner end (500 feet on each side of the runway centerline). The building is located 780 feet from the centerline. This means 280 feet from the end of the primary surface. In 280 feet the transitional surface rises 40 feet (critical height). The building is an obstruction to navigation.

Barn Roof: The barn is located inside the approach surface since it is located 400 feet from the runway centerline and more than 200 feet from the primary surface.At 200 feet from the inna end of the approach surface, the critical height is 5.9 feet! (200/34). The barn is an obstruction to navigation.

Problem #3

Consider the following situation at the Atlanta Jackson-Hartsfield International Airport. Use Google Earth and Airnav Systems as needed to solve the problem. The Marriott Renaissance Concourse Hotel is shown in Figure 3. The hotel has great views of the Northern runways of this airport. Determine the highest permissible elevation of the hotel to comply with FAA design standards. State what surfaces did you check in your analysis.

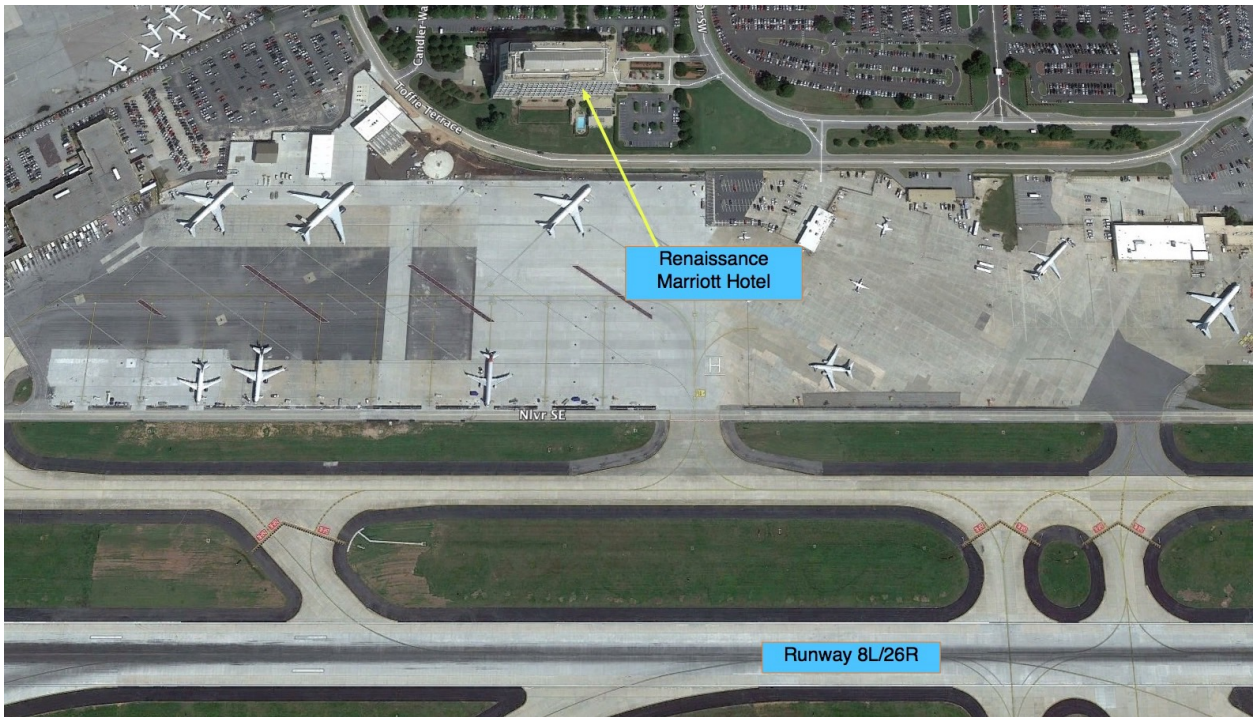

Figure 3. Northern Side of the Atlanta International Airport.

The distance from the runway centerline to the hotel base is estimated to be 1490 feet. Since all runways at ATL are precision runways, we use precision category standards in the analysis. Primary surface semi-width is 500 feet (primary surface width is 1000 feet). The plane that intersects the horizontal surface and the transitional surface is located 1550 feet from the runway centerline. However, the hotel is located 1490 feet so it will be under the transitional surface. At 1490 feet the transitional surface rises 141.42 feet. That would be critical height of the hotel.

You should also check the inner transitional OFZ surface. ATL receives Airbus A380 from Korean Air. Runway 8L/26R is a Category II runway (see Flightaware for approach procedures to the runway). The solutions for Category 1 and 2 are presented in Figure 4. The FAR Part 77 surface is more critical. the inner transitional OFZ reaches 150 feet at a point 900 feet from the runway centerline.

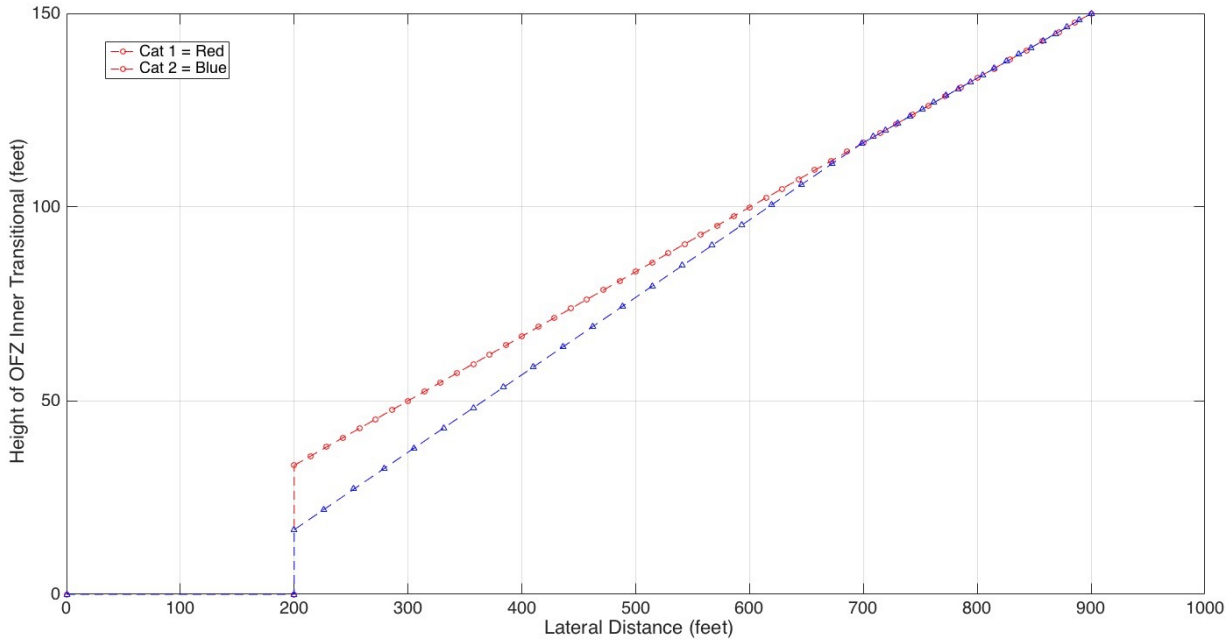

Figure 4. Inner Transitional Surface for Atlanta International Airport Runway 8L/26R. A380 is Used as Critical Aircraft.

Problem 4. Airport Geometric Design Forensics

A ground collision between an Airbus A380 and a Bombardier CRJ-700 at JFK International Airport illustrates the importance of complying with geometric design standards at airports. According to the accident report, the A380 was taxiing on taxiway Alpha (see Figure 5) while the Regional Jet (CRJ-700) was waiting at one of the holding positions across taxiway Mike as shown in the figure. The video of the accident is at: https://www.youtube.com/watch?v=WJCqBQLTWmw.

Figure 5. Geometry of Taxiways Alpha (A) and Mike (M) near JFK Terminal 2.

a) Determine the relevant geometric design standards to check if taxiway Alpha at JFK meets the FAA design criteria for the Airbus A380.

Some of the geometric design standards for ADG VI are not met. For example, the distance between taxiway Alpha and the parallel taxiway (called "Bravo") is 286 feet. The ADG VI standard should be 324 feet according to ADG group criteria. However, according to the TDG cirteria (Table 4-2 in the FAA AC), the distance between two parallel taxiway should be 350 feet. Use **350 feet** or the highest of the two criteria per FAA guidance. JFK operates under a Modification of Standard (MoS) to allow A380 operations at the airport. Read more at: http://www.faa.gov/airports/engineering/nla_mos/. Figure 6 shows some of the relevant issues at JFK.

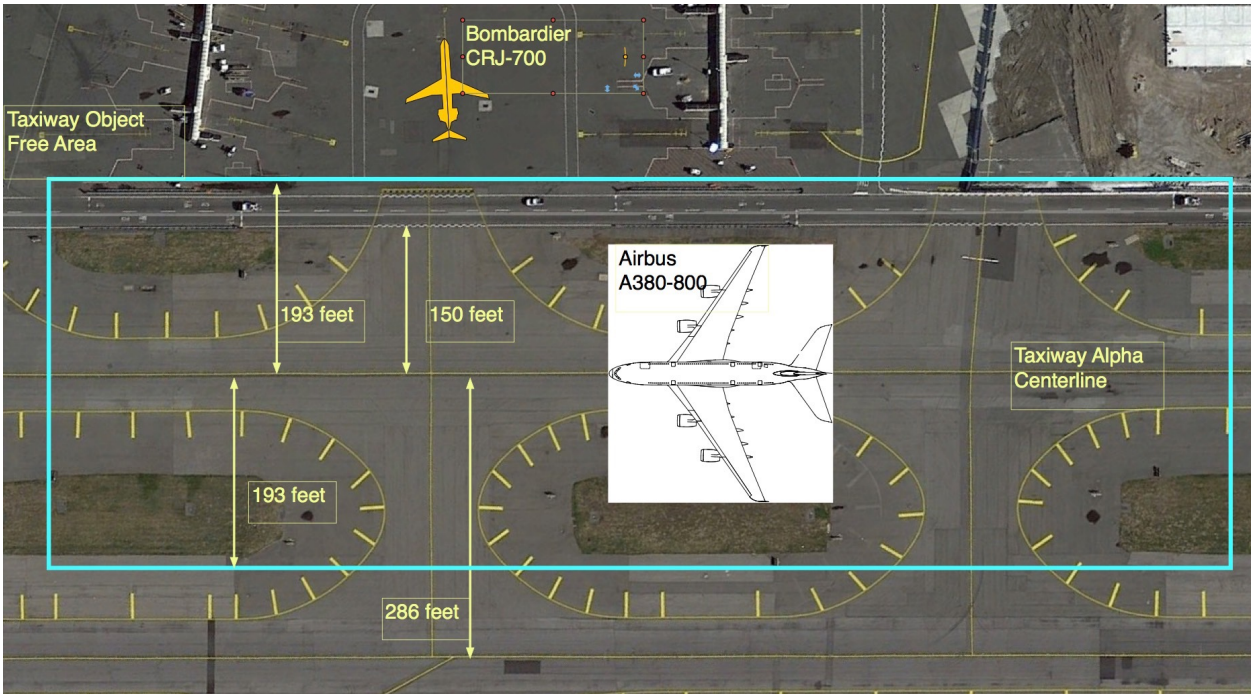

Figure 6. Geometry and Dimensions of some of the Elements on Taxiway Alpha at JFK Airport.

b) Find the minimum distance from taxiway Alpha centerline to the closest fixed object.

193 feet according to Table 4-1 in FAA AC/5300-13A.

c) Find the minimum distance from taxiway Alpha centerline to the building restriction line. Does Terminal 2 meet the criteria? Assume Terminal 2 is 40 feet tall.

Use the inner transitional OFZ criteria and FAR Part 77 to see if the building is on the way.

Inner transitional OFZ for JFK (Runway 31L has a Category 2 ILS approach procedure). Building is 1260 feet from runway 31L centerline. The building does not violate the inner transitional OFZ.

FAR Part 77 transitional surface. At 1260 feet the critical height of the Part 77 surface is 108.6 feet (runway 31L is a precision runway). The building is not a problem for that surface either.

d) If the Bombardier CRJ-700 was waiting for its gate at the queue position, was there any risk of collision? Explain.

Pilot of the CRJ probably parked the aircraft too far from the required position. Contributing factors were the poor visibility (rain) and perhaps the markings on the pavement.

e) Find if taxiway Alpha and taxiway Bravo (i.e., parallel taxiway meet the A380 design criteria).

No. The distance should be 350 feet for ADG. VI.