

## Assignment 7: Geometric Design Standards

### Solution

#### Problem #1

A new airport is expected to serve Boeing 787-800 aircraft (see picture below). the runway length is expected to be 2,900 meters. The airport is located at an elevation of 3,460 feet above sea level conditions. The airport will have an instrument landing system and serve approaches with visibility minima down to 1/2 miles (ILS Category I equivalent approach).

Aircraft belongs to group D-V.

- a) The width and length of runway blast pad area. **220 x 400 feet**
- b) The width of the runway and taxiway shoulders. **35 and 25 feet**
- c) Distance from the runway to a parallel **taxiway** if high-speed runway exits are to be constructed. **600 feet recommended.**
- d) Distance from the runway to a parallel **taxiway** if only right-angle runway exits are to be provided. **450 feet.**  
**Note that airport elevation is 3,460 feet thus requires 50 more feet that at sea level conditions.**
- e) Distance from runway centerline to holding line on a right-angle runway exit. **280 feet + 3,460/100 feet = 315 feet**
- f) Width of taxiway safety area. **214 feet**
- g) Minimum distance from the taxiway centerline to a fixed object. **160 feet**
- h) Minimum perpendicular distance from the runway centerline to a fixed object with height 45 meters. **This dimension is driven by the 7:1 transitional surface. 1,534 feet required.**
- i) The width of a dual taxilane between two terminal concourses. Account for one service road on each terminal (for a total of four 12-foot lanes). **570 feet**



Figure 1. Boeing 787-800 at SFO International Airport (A.A. Trani)

## Problem #2

A 2,900 meter long runway at an airport has three longitudinal grades (**from right to left**): at 0.45%, -0.67% and 0.55% with the points of intersection located at metric stations 780 and 1,890 from the right threshold. Assume the right threshold is station 0+00.

a) Test the suitability of this runway to be used at airport with Boeing 787-800 operations. Comment on your answers.

The runway meets all criteria to support commercial flights. Slopes are below 1.5%, changes in grade are also below 1.5%. First quarter of each runway end is below 0.8%, etc.

b) Design the second transition curve for this runway using a symmetric parabola. Specify the elevations (every 10 meters) as a function of the station (in meters). Refer to the formulas in the handout Geometric Design to create a symmetrical parabola. Use Excel or Matlab to simplify your work. You are allowed to use the Matlab script provided in class.

Two vertical curves measuring 1120 and 1220 feet are needed for the runway.

c) Find the transverse grade for this runway. Also state the typical grade of the shoulders for maximum drainage.

The transverse grade of the runway should be between 1-1,5% with a typical grade of the shoulder of around 3% (5% maximum).

## Problem #4

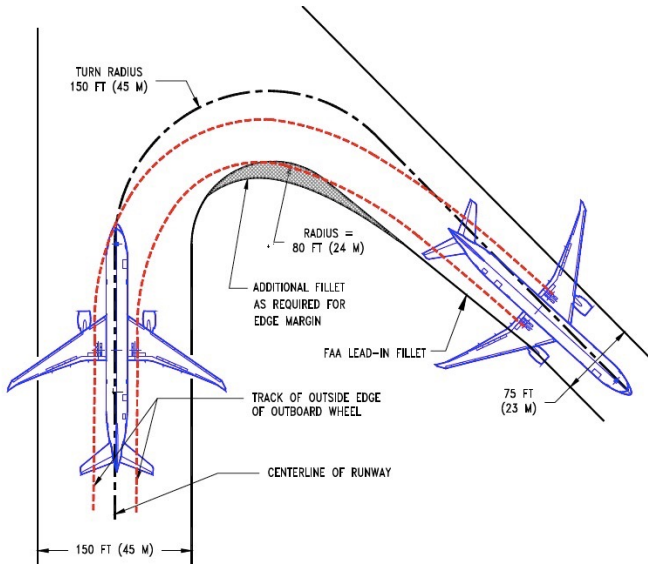
a) Design a 120 degree, taxiway-taxiway intersection for the Boeing 777-300ER using the latest FAA criteria for taxiway-taxiway intersections considering the aircraft ADG and TDG groups.

Boeing 777-300ER belongs to TDG group 6. The dimensions needed for the design are presented in FAA AC 5300-13 Table 4-7 and reproduced below.

TDG 6								
Dimension (See Figure 4-13, Figure 4-14, Figure 4-15, and Figure 4-16)								
$\Delta$ (degrees)	30	45	60	90	120	135	150	180 <sup>3</sup>
W-0 (ft)	37.5	37.5	37.5	37.5	37.5	37.5	37.5	37.5
W-1 (ft)	46	46	52	56	60	57	55	60
W-2 (ft)	60	71	82	85	95	102	107	105
W-3 (ft)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	184
L-1 (ft)	300	300	345	365	400	363	360	395
L-2 (ft)	111	157	137	125	110	145	165	120
L-3 (ft)	16	30	47	129	246	373	594	141
R-Fillet (ft)	0	0	0	60	60	60	60	75
R-CL (ft)	150	150	150	130	155	165	170	175
R-Outer (ft)	400	300	265	200	207	210	212	N/A

Note: Values in the table are rounded to the nearest foot. 1 foot = 0.305 meters.

c) Compare your solution to the solution stated in the Boeing Document with Aircraft Characteristics for Airport Planning. Comment on any discrepancies observed.



The Boeing solution recognizes that an extra fillet is needed for the Boeing 777-300ER to execute a turn greater than 90 degrees. It is important however, to state that the figures shown in the Boeing documents still show the old FAA design with fillet lengths of 250 feet. The new design standards require higher lead in fillet lengths. This perhaps prompted by the evolution of larger aircraft with longer wheelbase length such as the Boeing 777-300.

## Problem #5

Examine the information about the ATL International Airport in Arnav, Google Earth and the the FAA airport diagrams link on our web site to answer the following short questions.

a) In 2013 Korean Airlines introduced Airbus A380 service between Atlanta and Seoul. Find the most likely runway to be used for A380 operations. Use runway dimensions (length and width), shoulder dimensions and taxiways leading to Terminals E and F (see map) to make this assessment.

Runway 9L-27R is probably the only runway that meets the criteria for A380 operations using a Modification of Standard (MOS). The A380 requires 200 foot wide runways. Runway 9L-27R is 150 feet wide. However, the runway has extra wide shoulders that would be needed to offer similar margins as the 200 foot wide runway with 40 foot shoulders.

b) Are there any gates at Terminal F (based on Google Earth) to service an Airbus A380? Comment.

There are no single gates that can accommodate the A380 according to the Google Earth satellite picture. However, the airport uses two adjacent gates in Terminal E to service the A380 operations today.

c) Using maximum flexibility to the airline, is the service ATL-ICN a challenge to the Airbus A380 in the summer months? Comment.

Runway 9L-27R is over 12,000 feet long. According to the A380 airport design documents, it needs between 10,000 and 11,000 foot runways to operate the Atlanta Seoul trip length. The airport is capable of handling the aircraft from a runway length perspective.