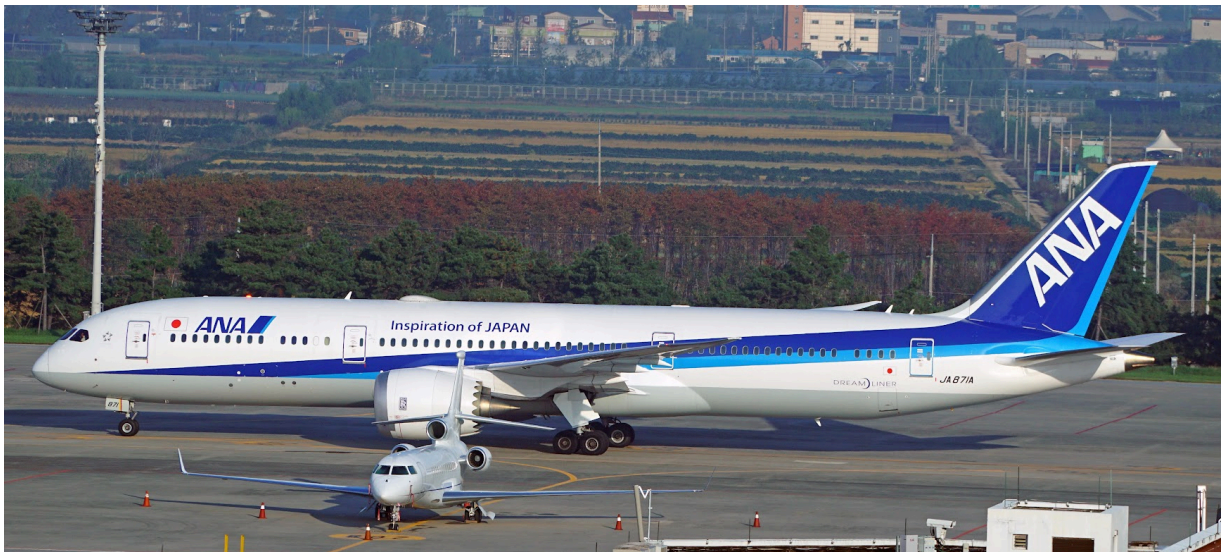
Assignment 3: Runway Length Calculations

Date Due: September 16, 2022 Instructor: Trani

Problem 1

Evaluate future operations at Mexico City International Airport (MMMX) using the Boeing 787-9 (see picture below). The airline in questions wants to fly to Tokyo Narita Airport (NRT). The temperature at Mexico City can be found at Weather Spark: https://weatherspark.com/y/5674/Average-Weather-in-Mexico-City-Mexico-Year-Round.

Table 1. Aircraft Considered in the Mexico City Airport Evaluation. All Nippon Airways Boeing 787-9 Dreamliner Taxiing at Gimpo Airport (South Korea). Source: A. A. Trani.

Aircraft Considered
Boeing 787-9 with Rolls-Royce engines. Aircraft maximum design takeoff weight is 560,000 lb. 246 seats in a three-class layout. You can find the seating configurations of most airlines at SeatGuru (https://www.seatguru.com/airlines/ANA/ANA_Boeing_787-9_V3.php). **Note:** Boeing does not publish the operating empty weight (OEW) of the Boeing 787-9 aircraft in the tables (all other Boeing aircraft publish OEW in the tables in section 2 of the airport planning documents). However, The payload range diagram for this aircraft provides the value of OEW indirectly because the y-axis in the payload-range diagram is OEW + Payload. For the Boeing 787-9 the OEW is approximately 280,000 lbs.


a) Find the typical distance flown length between Mexico City and Tokyo. Use the Great Circle Flight Path mapper link provided in our interesting web sites (http://www.gcmap.com//). Add 6% to the distances estimated by the Great Circle mapping application to account for real Air Traffic route conditions and to account for possible weather deviations.

b) Find the Desired Takeoff Weight (DTW) to fly the Mexico City- Tokyo (Narita) route. Assume a 100% passenger load factor in your analysis (i.e., all seats are full). Clearly state the fuel weight, operating empty weight and payload carried. Use the passenger weights discussed in class.

c) Find the mean daily maximum temperature of the hottest month (design temperature) using the Weather Spark web site cited above.

d) Find the runway length needed for each one of the aircraft operating the critical route. Determine if Mexico City has enough runway length to support both flights. Remember to calculate the required takeoff and the landing distances in the analysis. You can find runway length information about international airports in Wikipedia. For Mexico City use the link : https://en.wikipedia.org/wiki/Mexico_City_International_Airport.

e) If the runway length estimated in part (d) exceeds the runway length available at MMMX, find the runway length extension needed to support the proposed flights.

f) A new airport opened five months ago near Mexico City (Felipe Angeles Airport - NLU). Can the runways at NLU better support the long-range operations to Japan? Comment.

Problem 2

A new airline is discussing future operations from Roanoke/Blacksburg Regional Airport (ROA) airport. The airline plans to use the Boeing 737-8 (also called Boeing 737-8 Max) with characteristics shown in Table 2. The airline would like to fly from ROA to Dallas Love Field (DAL) and to Denver (DEN). For this analysis, use the latest version of the Boeing 737-8 Max documents for airport design (Revision G published on May 2022).

Table 2. Aircraft Considered in the ROA Airport Evaluation. Picture Source: A.A. Trani.

Aircraft	*Engine*	*Remarks*
Boeing 737-8 (Max) with CFM LEAP-1B28B1 engines. Aircraft maximum design takeoff weight is 179,800 lb. 178 seats in a two-class layout. **Note:** Boeing does not publish the operating empty weight (OEW) of the Boeing 737-8 Max series aircraft in the tables (all other Boeing aircraft publish OEW in the tables in Section 2 of the airport planning documents). However, The payload range diagram for this aircraft provides the value of OEW indirectly because the y-axis in the payload-range diagram is OEW + Payload. For the Boeing 737-8 Max the OEW is approximately 104,000 lbs.		
		

a) Find the adjusted distance to be flown between the two Origin-Destination airport pairs. Use the Great Circle Flight Path mapper link provided in our interesting web sites (http://www.gcmap.com//). Add 6% to the distances estimated by the Great Circle mapping application to account for real Air Traffic route conditions and to account for possible weather deviations from the shortest flight path.

b) Find the Desired Takeoff Weight (DTW) to fly the two proposed routes. Assume a 100% passenger load factor in your analysis (i.e., all seats are full). Clearly state the fuel weight, operating empty weight and payload carried. Use the passenger weights discussed in class.

c) Find the mean daily maximum temperature of the hottest month (design temperature) using the Climate Explorer website (https://crt-climate-explorer.nemac.org/climate_graphs).

d) Find the runway length needed for each one of the routes. Determine if ROA has enough runway length to support both flights. Remember to calculate the required takeoff and the landing distances in your analysis.

e) If the runway length estimated in part (d) exceeds the runway length available at ROA, find the runway length extension needed to support the proposed flights.

f) If the runway length estimated in part (d) is less than the runway length available at ROA, find the additional cargo that can be carried for each flight (to DFW and DEN).

Problem 3

Perform a runway length analysis for an existing airport located 4,200 feet above sea level. The airport has a 3,500 meter long runway (11,480 feet). Temperature data collected at the site shows the mean daily maximum temperature of the hottest month to be 22.8 deg. Celsius (73 degrees Fahrenheit). Table 3 shows the design aircraft - the Airbus A350-900.

Table 3. Airbus A350-900 in Tow at Atlanta Hartsfield-Jackson International Airport. Picture Source: A.A. Trani.

Aircraft	*Engine*	*Remarks*
Airbus A350-900	*Rolls-Royce engines*	*Maximum Takeoff Weight is 280,000 kilograms. 330 seat configuration.*

a) Find the maximum allowed takeoff weight of the aircraft for the existing airport conditions (3,500 meter runway constraint and 73 degrees F.).

b) Estimate the runway extension needed to allow the aircraft to depart at maximum takeoff weight. State the maximum takeoff weight.

c) Find the maximum aircraft range with all seats full. Assume the value suggested in class of 100 kilograms per passenger.

d) Find the dimensions of the runway safety area (RSA), runway protection zones (RPZ), runway object free areas (ROFA) and obstacle free zone (including dimensions of the inner transitional surface) for the runway at the new airport. The new runway is expected to have a Category 1 Instrument Landing System (ILS) with visibility minima of 2200 feet RVR.

Problem 4

Use Google Earth and Airnav.com to learn about the runway features of the Virginia Tech/Montgomery County Executive Airport (BCB). The current airport is designed for Runway Design Code (RDC) group C-II and visibility minima no less than one mile. The airport has approach capability with 1 mile visibility conditions. Last summer, the airport expanded the runway to 5,500 feet and the airport infrastructure was designed for RDC C-II category which includes medium size corporate jets like the Bombardier Challenger 350 and the Cessna Citation X.

a) Compare the RSA and ROFA dimensions of the existing airport and a future BCB airport that may serve B-III operations allowing larger business aircraft like the Bombardier Global Express 5000 (see Figure 1). Comment on the changes needed for the upgrade.

b) Compare the dimensions of the approach and departure RPZ surfaces of the existing and the future airport design standard. Comment.

c) Why is the airport able to receive Global Express flights today? Comment.

Figure 1. Bombardier Express 5000 Landing at BCB (A.A. Trani).