Assignment 3: Runway Length

Date Due: September 17, 2021 Instructor: Trani

Problem 1

Use the experimental Small Aircraft Runway Length Analysis Tool (SARLAT) demonstrated in class to design the runway length for a new General Aviation airport to be constructed at a site located 2,560 feet above sea level. Data from a temperature survey yields a mean daily maximum temperature of the hottest month of 85 degree F. The aircraft fleet mix expected to operate at the airport is shown in Table 1. The airport is expected to serve single, multi-engine piston aircraft and turboprop aircraft like the Pilatus PC-12 and the Beechcraft King Air B200 (see Table 1). In your analysis, consider all the aircraft listed in the second column of the table. Use the default load factors in the SARLAT tool.

Table 1. Expected Aircraft Fleet at Proposed General Aviation Airport. Aircraft in Boldface Text are shown in the Picture.

Aircraft Type	Representative Aircraft	Sample Picture
Single Engine Piston	**Cirrus SR-22** Cessna 182 Cessna Columbia 400	
Multi-engine Piston	**Beechcraft Baron 58** Cessna 402B	

Aircraft Type	Representative Aircraft	Sample Picture
Turboprop Aircraft	**Beechcraft King Air B200** Pilatus PC-12	

a) Report the **dry pavement takeoff and landing** conditions for each aircraft.

b) Report the **wet pavement takeoff and landing** conditions for each aircraft.

c) Copy the graph from the application (PNG file) and include in your report.

d) The Federal Government (through FAA) helps public airports to pay for the runway infrastructure. Based on economic analyses, the Federal Government will fund a **wet landing runway and dry takeoff runway** as part of the Airport Improvement Program funds. Find the critical aircraft and the runway length needed for this airport that meets the AIP criteria.

e) For the same scenario above, the airport client would like to attract business jet customers similar to the Cessna CitationJet 3 and The Embraer Phenom 300. Recalculate the runway length needed. Do light jets require more runway than turboprops and piston-powered aircraft? Comment.

Problem 2

An airline is discussing future operations from Reagan National Airport (DCA) airport with the Metropolitan Washington Airport Authority (MWAA). The airline plans to use the Boeing 737-9 Max with characteristics shown in Table 2 in routes from DCA to Seattle-Tacoma (SEA) and San Diego (SAN). For this analysis, use the latest version of the Boeing 737-9 Max documents for airport design (https://www.boeing.com/commercial/airports/plan_manuals.page).

Table 2. Aircraft Considered in the DCA Airport Evaluation.

Aircraft Considered
Boeing 737-9 Max with CFM LEAP-1B engines. Aircraft maximum design takeoff weight is 194,700 lb. 193 seats in a two-class layout. **Note:** Boeing does not publish the operating empty weight (OEW) for the Boeing 737-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 a good way to estimate the value of OEW indirectly because the y-axis in the payload-range diagram is OEW + Payload. For the Boeing 737-9Max the OEW is approximately 104,000 lbs. Verify this number.

a) Find the average stage length to be flown between each one of the critical 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 aircraft operating the critical route. Determine if DCA has enough runway length to support both flights. Remember to calculate the required takeoff and the landing distances in the analysis.

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

Problem 3

A new airport will be constructed at a site located 3,500 feet above sea level. Temperature data collected at the site shows the mean daily maximum temperature of the hottest month to be 26 degrees Celsius. Table 1 shows the design aircraft. Figure 1 shows a picture of the design aircraft.

Table 2. Aircraft for Airport in Problem 3.

Aircraft	*Engine*	*Remarks*
Boeing 747-8 (passenger version) 987,000 Maximum Takeoff Weight	*GEnx 2B engines*	*Passenger configuration with a total of 513 seats*

Figure 1. Boeing 747-8 Passenger Version (A.A. Trani).

a) Find the runway length required to satisfy FAA and EASA regulations to operate the critical aircraft without takeoff restrictions from the new airport. This implies the airline will be able to depart at the maximum takeoff gross weight from the airport.

b) What is the flap setting expected during the takeoff at maximum takeoff weight?

c) 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 2 Instrument Landing System (ILS) with visibility minima of 1200 feet RVR.

d) Draw all 4 basic runway protection areas to scale using Autocad or any drawing program of your choice (top view is required). Comment on the size of the runway protection zones need at the airport.