Assignment 2: Runway Length Analysis for Small Aircraft

Date Due: September 12, 2025 Instructor: Trani

Reading Assignment: Review Chapters 1 and 2 of the FAA Advisory Circular 150/5325-4b. Also, review the course notes on aircraft runway length estimation (http://128.173.204.63/cee4674/cee4674_pub/runway_calculations_Aircraft_upTo_60000lbs.pdf).

To do this homework, you need to download and install the Small Aircraft Runway Length Analysis Tool (SARLAT version 2.0.013) per instructions provided in Canvas.

Problem 1

Use the Small Aircraft Runway Length Analysis Tool (SARLAT 2) to **design a runway** at a new airport located 2,050 feet above mean sea level conditions. The average maximum daily temperature of the hottest month of the year is 85 degrees Fahrenheit. Table 1 shows the representative aircraft at the airport.

a) Find the required runway length to satisfy the fleet mix's runway performance requirements in Table 1. List the following runway lengths for the critical aircraft: 1) dry runway takeoff distance and 2) wet runway landing distance. These are the distances the FAA Airport Improvement Program (AIP) supports in runway improvement projects. Provide your recommended runway length to serve the fleet mix in Table 1. The recommended runway length should be rounded to the nearest 100 feet (if the answer is above 30 feet).

b) Show the SARLAT bar chart of runway length requirements for each aircraft for your solution.

c) Find the maximum distance that can be flown with a Gulfstream 450 operated at 75% useful load on takeoff with the average passenger load of 6 passengers and two pilots.

d) Find the maximum distance that can be flown with a Gulfstream 450 operated at 75% useful load on takeoff with the 14 passengers and two pilots.

e) Using solutions (c) and (d) estimate the change in aircraft range for each passenger added.

f) Find the percent of the flights in the US that can be flow with the King Air B350 operated at 75% useful load. Use the **Stage Length Analysis** procedure in SARLAT 2.

Table 1. Aircraft Fleet Mix for Problem 1.

Aircraft Type	Aircraft	Useful Load (%)	Annual Operations	Picture
Piston	Cessna 172	100	3,400	

Aircraft Type	Aircraft	Useful Load (%)	Annual Operations	Picture
Piston	Beech Baron 58	100	1200	
Turboprop	Beechcraft King Air B350	75	800	
Jet	Cessna Citation Latitude	75	680	
Jet	Gulfstream 450	75	820	

Problem 2

Use the Small Aircraft Runway Length Analysis Tool (SARLAT 2) to **evaluate the existing runway** at Bolinder Field/Tooele Valley Airport (TVY) in Utah. Table 2 shows the aircraft fleet mix operating at the airport.

1) Use airnav.com to summarize the following information for the airport:

- Longest runway length available
- Airfield elevation
- Runway gradient (use the two published runway end elevations to make your calculation)

2) Use the Climate Explorer website to estimate the design temperature conditions for the airport. The link to the Climate Explorer is on our interesting web site page (http://128.173.204.63/cee5614/sites_ce_5614.html#Weather). Use the temperature profile for Salt Lake City (the closest metropolitan area to TVY).

- Find the historical maximum daily temperature for the hottest month of the year.
- Consider climate change effects (i.e., higher emissions) and find the future design temperature. Use the future temperature profile for years 2035-2065.

Table 2. Existing Aircraft Fleet Mix for Problem 2.

Aircraft Type	Aircraft	Annual Departures / Arrivals	Picture
Piston	Cessna 182	5,300	
Piper PA-28-161	Piper Cherokee 161	4,800	
Turboprop	King Air B300	890	

Aircraft Type	Aircraft	Annual Departures / Arrivals	Picture
Turboprop	Beechcraft King Air B200GT	560	

For **existing runway length conditions** and the **historical design temperature** answer the following:

a) For dry runway conditions, find the **takeoff weight** and **useful load** possible for the Beechcraft King Air B200 and the Beechcraft King Air B300 operating from the existing runway.

b) Using the existing runway length at TVY, find the maximum distance that can be flown by a Beechcraft B300 with the average passenger load and two pilots?

c) Considering climate change future temperature projections and dry runway conditions, find the takeoff weight and useful load possible for the Beechcraft King Air B300 operating from the existing runway. Comment on any changes compared to part (a).

Problem 3

The airport described in **Problem 2** is planning a possible runway expansion to accommodate mid-size turbofan-powered aircraft such as the Cessna Citation Longitude and the Hawker 800XP. Table 3 shows information for two aircraft identified in the new airport master plan.

Table 3. Additional Fleet Mix for Problem 2.

Aircraft Type	Aircraft	Annual Operations	Picture
Jet	Hawker 800XP	910	

Aircraft Type	Aircraft	Annual Operations	Picture
Jet	Cessna Citation Longitude	1,600	

Provide answers to the airport client for a **proposed runway extension.**

a) Find the **runway extension** needed to allow both all turbofan-powered aircraft to operate at a useful load of 65%. In the analysis consider dry runway conditions and future climate change temperature conditions (2035-2065).

b) With the proposed runway extension, how far can a Hawker 800XP fly with five passengers and two pilots?

c) With the proposed runway extension, what percent of the US flights by Cessna Citation Latitude are covered?

Problem 4

Use the SARLAT tool to estimate the takeoff runway length needed for the Gulfstream G200 (GALX) (see Figure 1).

a) Find the required runway length (dry takeoff or wet landing whichever is higher) at **sea level conditions**, a design temperature condition of 85 degrees Fahrenheit, a 70% load factor, and zero runway grade.

b) Repeat the analysis performed in part (a) for the same temperature condition but airport elevations of 1500, 3000, and 4500 feet. Plot the runway length required versus airfield elevation. Comment on the trend observed.

Figure 1. Gulfstream G200 (A. Trani).

Problem 5

Please answer true or false.

Question	True / False
Increased aircraft weight decreases aircraft acceleration on the runway during takeoff.	
Piston engine performance improves at higher airport elevations.	
Long runways are needed at higher airport elevations.	
Departing an upslope runway increases runway length needed.	
Landing speeds increase at higher elevation airports.	
For a constant airspeed, higher air density increases the aircraft wing lift.	
Liftoff speed decreases at higher takeoff weight.	
Use of flaps decreases approach speed but increases aircraft drag.	