# Assignment 2: Runway Length Analysis for Small Aircraft

**Date Due: September 13, 2024** 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).

## Problem 1

Use the Small Aircraft Runway Length Analysis Tool (SARLAT 2) to **design a runway** at a new airport located 2,950 feet above mean sea level conditions. The average maximum daily temperature of the hottest month of the year is 88 degrees Fahrenheit. Table 1 shows the representative aircraft at the airport. To obtain the SARLAT 2 tool, follow the links in the class notes.

a) Find the required runway length to satisfy the fleet mix's runway performance requirements in Table 1. Show the SARLAT bar chart of runway length requirements for each aircraft. The recommended runway length should be rounded to the nearest 100 feet.

b) 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.

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

d) With 65% useful load on takeoff, find the maximum distance that can be flown with the Bombardier Challenger 350 with the average passengers (4 passengers) and two pilots.

e) If the Bombardier Challenger 350 operator loads the plane at 65% useful load but with ten passengers instead, find the maximum distance that can be flown. Comment on the differences between parts (d) and (e).

f) Find the percent of the flights in the US that can be flow with the King Air B350 operated at 60% 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 Departures / Arrivals | Picture |
|---|---|---|---|---|
| Piston | Beech Bonanza 36 | 100 | 1200 / 1200 |   |
| Piston | Beechcraft Baron 58 | 100 | 545 / 545 |   |

| Aircraft Type | Aircraft | Useful Load (%) | Annual Departures / Arrivals | Picture |
|---|---|---|---|---|
| Turboprop | Beechcraft King Air B350 | 65 | 450 / 450 |  |
| Jet | Bombardier Challenger 350 | 65 | 300 / 300 |  |
| Jet | Cessna 560XL | 75 | 380 / 380 |  |

## Problem 2

Use the Small Aircraft Runway Length Analysis Tool (SARLAT 2) to **evaluate the existing runway** of a small airport in Southwest Virginia. The **existing airport (near Abingdon, VA)** has a 4,471-foot runway, and the airfield elevation is 2,087 feet above mean sea level conditions. The runway has a grade of 0.5%. Find the maximum daily temperature for the hottest month of the year using the Climate Explorer website (https://crt-climate-explorer.nemac.org/). Consider climate change effects (i.e., higher emissions) in the analysis. Table 2 shows the aircraft fleet mix operating at the airport.

*Table 2. Aircraft Fleet Mix for Problem 2.*

| Aircraft Type | Aircraft | Annual Departures / Arrivals | Picture |
|---|---|---|---|
| Piston | Cessna 172 | 3000 / 3000 |   |
| Turboprop | Beechcraft King Air B200GT | 500 / 500 |   |
| Jet | Cessna Citation Latitude | 340 / 340 |   |
| Jet | Honda Jet 420 | 300 / 300 |   |

For **existing runway length conditions** answer the following:

a) For dry runway conditions, find the **takeoff weight** and **useful load** possible for the Beechcraft King Air B200, the Honda Jet 420, and the Cessna Citation Latitude operating from the existing runway.

b) Using the existing runway condition, how many nautical miles can the Honda Jet fly with four passengers (and two pilots)?

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

c) If the runway is extended to 5,500 feet, find the useful load parameters for the Beechcraft King Air B200, the Honda Jet 420, and the Cessna Latitude. Comment on the distances that can be flown with the new runway compared to part (b).

d) Can a Bombardier Challenger 350 operate from the upgraded runway if the runway is extended? Explain.

**Problem 3**

Use the SARLAT tool to estimate the takeoff runway length needed for the Bombardier Challenger 605 (CL60) (see Figure 1).

a) Find the required runway length at **sea level conditions**, a design temperature condition of 85 degrees Fahrenheit, a 70% load factor, and zero runway grade.

b) Repeat part (a) for the same temperature condition but airport elevations of 2000, 4000, and 6000 feet. Comment on the trends observed. Does runway length increase linearly with airport elevation?

c) If the Challenger 605 operates at Rocky Mountain Airport (KBJC) with 70%, compare the takeoff runway length needed to that of part (a).

d) Find the runway length required if the runway in part (a) has a 1% grade. Comment.


*Figure 1. Bombardier Challenger 605 (A. Trani).*

**Problem 4**

True or false questions.

| Question | True / False |
|---|---|
| Flaps increase lift on takeoff. | |
| Large flap settings are used in the takeoff phase. | |
| As aircraft takeoff weight increases, the runway length required decreases. | |
| Engine thrust decreases with altitude. | |
| Takeoff speeds increase at higher airport elevations. | |
| For a constant airspeed, lower air density increases lift. | |
| Liftoff speed increases at higher takeoff weight. | |
| Twin-engine commercial aircraft are certified to be flown safely with one engine failed provided the aircraft is flown at the safe climb speed ($V_2$). | |