

Assignment 2: Runway Length Analysis

Date Due: September 9, 2022

Instructor: Trani

Reading Assignment: Review Chapters 1 and 2 of the FAA Advisory Circular 150/5325-4b. Also review the course notes Aircraft Runway Length Estimation.

Problem 1

Design the runway length for a new General Aviation airport to be constructed at a site located 2,500 feet above sea level. Data from a temperature survey indicates a mean daily maximum temperature of the hottest month of the year is 80 degree F. The airport is expected to serve single, multi-engine piston aircraft, and turboprop aircraft with less than 10 passenger seats. All aircraft weigh less than 12,500 lbs. at maximum takeoff gross weight. Use 100% of the fleet below 12,500 lbs is expected to be served at the airport.

- a) Use the appropriate design charts in the FAA 150/5325-4b to find the recommended runway length required to serve the aircraft fleet listed in Table 1.
- b) Revise the solution to part (a) if the runway is also expected to support turboprop aircraft with more than 10 passenger seats. An example of such aircraft is the Raytheon King Air **B300 which carries up to 12 passengers plus two pilots.**
- c) Comment on the change in runway length required with the King Air B300.




Figure 1. Raytheon King Air B300 (A. Trani).

Problem 2

Use the recently developed Small Aircraft Runway Length Analysis Tool (SARLAT) to **design a new runway** to be constructed at a site located 3,300 feet above mean sea level conditions. The average of the maximum daily temperatures of the hottest month of the year is 83 degrees F. The airport is expected to serve single, multi-engine piston, turboprop and jet powered aircraft (see Table 1). In your analysis, consider all the aircraft listed in the second column (Typical aircraft).

Table 1. Aircraft Fleet Mix for Problem 2.

Aircraft Type	Typical Aircraft	Sample Picture
Single Engine Piston	Cessna 177 Cessna 172 Cirrus SR 20	 <p>na 177 Cardinal (RG). ADG I</p>
Multi-engine Piston	Cessna 421C	
Turboprop Aircraft	Socata TBM 850 Beechcraft King Air B200GT	

Aircraft Type	Typical Aircraft	Sample Picture
Jet Aircraft	Honda Jet 420	

- a) Find the required runway length needed to satisfy the runway performance requirements of the fleet mix in Table 1. For the critical aircraft, list the following runway lengths: 1) dry runway takeoff distance, 2) wet runway takeoff distance, 3) dry landing distance, and 4) wet landing distance.

Note: The FAA Airport Improvement Program (AIP) pays for a **dry takeoff runway** and a **wet landing runway**. Find the runway length that could be supported through the FAA AIP Program. State the critical aircraft.

- b) If the airport client wants to pay additionally for a runway that satisfies wet takeoff and landing conditions, estimate the runway length needed. State the critical aircraft.
- c) Show the SARLAT bar chart of runway length requirements for each individual aircraft for your solution.
- d) Name the single-engine, piston-powered aircraft of the fleet mix that requires the longest runway length.

Problem 3

Use the Small Aircraft Runway Length Analysis Tool (SARLAT) to **evaluate a runway extension** for an airport to serve large turboprop and business jet aircraft. The existing airport has a 4,550 foot runway and an airfield elevation of 2,200 feet above mean sea level conditions. The runway has a grade of 0.3%. The average of the maximum daily temperature of the hottest month of the year is 80 degrees Fahrenheit. Table 2 shows the existing aircraft fleet mix operating at the airport.

Table 2. Existing Aircraft Fleet Mix for Problem 3.

Aircraft Type	Aircraft	Percent of Fleet Mix (%)
Piston	Cessna 172	60
Piston	Beechcraft Baron 58	20
Turboprop	Socata TBM 850	20
Total		100

The airport manager would like to improve the airport business by attracting business jets (Cessna Citation 560 XL) and large turboprops (King Air B350ER). **Your job is to estimate the benefit of increasing the runway length by 1,000 feet to accommodate the larger aircraft.** Table 3 illustrates the future fleet mix for the airport once business jets and the turboprops are added to the mix.

Table 3. Future Aircraft Fleet Mix for Problem 3.

Aircraft Type	Aircraft	Percent of Fleet Mix (%)
Piston	Cessna 172	40
Piston	Beechcraft Baron 58	15
Turboprop	Beechcraft B200GT	15
Turboprop	Beechcraft B350ER	10
Turboprop	Socata TBM 850	10
Jet	Cessna 560 560 XL	10
Total		100

Yellow rows indicate new aircraft to be attracted to the airport after runway extension.

- For dry runway conditions, find the takeoff weight and useful load for the Beechcraft King Air B350ER and the Cessna 560XL operating from the existing runway (i.e., 4,550 feet).
- If the runway is extended to 5,550 feet, find the improved useful load parameters for the Beechcraft King Air B350ER and the Cessna 560XL.
- Comment on the significance of adding 1,000 feet to the existing runway. Use the table below that applies to the Beechcraft King Air B350ER. More specifically, estimate the additional aircraft range that can be flown in the King Air B350ER after the runway extension.

Table assumes a full load of passengers except when mission range requires off loading passengers to carry more fuel.

For example: a mission range of 300 nm carrying 10 passengers is equivalent to 61.5% useful load for this aircraft.

Mission Range (nm)	Maximum Number of Passengers	Useful Load (%)
100	10	50.4
150	10	53.5
200	10	56.4
300	10	61.5
600	10	73.7
1000	10	87.0
1316	10	97.4
1400	10	100.0
1500	9	100.0
1600	8	100.0
1700	7	100.0
1800	6	100.0
1900	5	100.0
2223	3	100.0

Problem 4

Refer to the figure on page 69 of the “ Aircraft Runway length Estimation” notes to answer the following questions. The figure contains the takeoff field length (takeoff runway length) for a Boeing 777-300ER (see Figure 2) operating under hot airport temperature conditions (ISA + 27 deg. Celsius).

- a) For a flight from Dubai to Paris, with a takeoff weight of 650,000 lbs, find the takeoff field length required. Dubai is at sea level conditions.
- b) One day the airline operates the same flight from Dubai to Paris but carries additional belly cargo (commercial aircraft can carry cargo in special containers) that increase the takeoff weight to 725,000 lbs. Estimate the takeoff field length required.
- c) Comment on the results obtained in parts (a) and (b).
- d) Find the maximum operational takeoff weight departing Salt Lake City (~4,230 feet) on a hot summer day using the same chart.
- e) For part (d) find the runway length needed departing Salt Lake City on a hot summer day.



Figure 2. Boeing 777-300ER (A. Trani).