

Assignment 2: Runway Length Analysis for Small Aircraft

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 2.0.1) per instructions provided in Canvas.

Problem 1

Use the critical aircraft for runway length using the Small Aircraft Runway Length Analysis Tool (SARLAT) to **design a runway** at an airport located 3,010 feet above mean sea level conditions. The mean maximum daily temperature of the hottest month of the year is 86 degrees Fahrenheit. Table 1 shows the representative aircraft at the airport.

Table 1. Aircraft Fleet Mix for Problem 1.

Aircraft Type	Aircraft	Takeoff Useful Load (%)	Annual Operations
Piston	Cessna 182	100	5,600
Piston	Beech Baron 55	100	1,350
Piston	Cessna 340	100	530
Turboprop	Beechcraft King Air B200	90	560
Turboprop	Pilatus PC12	100	560
Jet	Cessna Citation M2	80	460
Jet	Embraer Phenom 300	80	395
Total Operations			9455

Steps using the Runway Design Case:

- 1) *Define the scenario name*
- 2) *Enter the fleet mix for all three aircraft classes (piston, turboprop, and jet). Make sure you match the takeoff useful load required. For this example, I use the default takeoff useful load factors. Also, use the default landing load factors. For Part (a) make sure no Part 135 operations are set (see example below).*

Aircraft Mix

Piston

Aircraft Name	Annual Operations	Takeoff Useful Load (%)
BE36 - Beech Bonanza 36	0	100
BE55 - Beechcraft 55 Baron	1350	100

Turboprop

Aircraft Name	Annual Operations	Trip Distance with Average Passenger Load (nm)	Takeoff Useful Load (%)	Part 135	Landing Weight (% of MALW)
BE20 - Beechcraft King Air B200GT	560	755	90	No	77

Jet

Aircraft Name	Annual Operations	Trip Distance with Average Passenger Load (nm)	Takeoff Useful Load (%)	Part 135	Landing Weight (% of MALW)
E55P - Phenom 300	395	1294	80	No	83

Sample fleet mix definition for Problem 1.

3) Define the airport environmental factors (see below)

SARLAT - Runway Design

Jet

Annual Operations: 9725

RESET

Environmental Factors

Pressure Altitude (Field Elevation) (ft)

3010

Specify the runway's pressure altitude (field elevation).

Air Temperature (F)

86

Specify the runway's mean daily maximum temperature of the hottest month of the year.

Wind Speed (kts)

0

Headwind is negative. Tailwind is positive.

Runway Information

Runway Gradient (%)

0

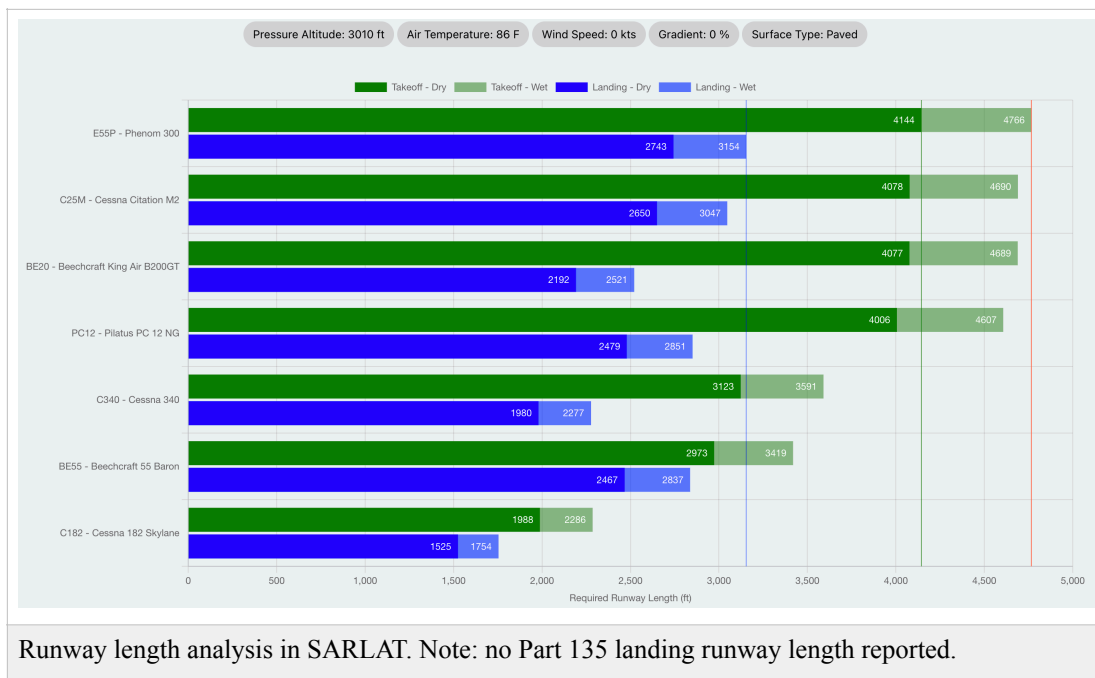
Downhill is negative. Uphill is positive.

Surface Type

Paved

Environmental airport parameters for Problem 1.

4) Run the scenario.



C25M - Cessna Citation M2 is the critical aircraft and requires 4078 ft of runway to be fully accommodated in the full range of specified operating conditions.

Aircraft Name	Engine Type	Aircraft Design Group (ADG)	Aircraft Approach Category (AAC)	Taxiway Design Group (TDG)	Takeoff Useful Load (%)	Landing Useful Load (%)	Annual Operations	Cumulative Annual Operations	Takeoff Dry (ft)	Takeoff Wet (ft)	Landing Dry (ft)	Landing Wet (ft)
E55P - Phenom 300	Jet	II	B	1B	80	83	395	395	4144	4766	2743	3154
C25M - Cessna Citation M2	Jet	I	B	1A	80	87	460	855	4078	4690	2650	3047
BE20 - Beechcraft King Air B200GT	Turboprop	II	B	2A	90	77	560	1415	4077	4689	2192	2521
PC12 - Pilatus PC 12 NG	Turboprop	II	A	2A	100	100	830	2245	4006	4607	2479	2851

Critical aircraft for runway length report in SARLAT. 86 deg. Fahrenheit, 3,010 foot-elevation.

- a) Find the **critical aircraft for runway length** to satisfy the fleet mix runway performance requirements in Table 1. **Assume no Part 135 operations at the airport.**

*The Cessna Citation M2 is the critical aircraft (highlighted in yellow). The Phenom 300 requires a longer runway on takeoff. However, the number of operations of the Phenom 300 is 395, below the 500 annual operations required for **regular use**.*

List the following runway lengths for the **critical aircraft** for runway length:

- a. Dry runway for takeoff distance

4,078 feet

- b. Wet runway for landing distance

3,047 feet

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).

Round the **runway length needed to 4,100 feet** (above 30 feet round up to 100).

- b) Show the SARLAT bar chart and output table of runway length requirements for all aircraft considered in the analysis.

See bar chart graphic above.

- c) Find the maximum distance that can be flown (called mission distance) with the Embraer Phenom 300 operated at the desired useful load of 80% (takeoff) with the average passenger load of four passengers and two pilots. **Use the runway length found in Part (a) for the critical aircraft.**

Use the SARLAT Evaluation Analysis using the runway length obtained in part (a). Select the Phenom 300 in the Evaluation Analysis. The analysis is shown below.

The Phenom 300 can depart the 4,100-foot long dry runway at 79% useful load and travel 1,269 nautical miles carrying four passengers and two pilots.

Environmental Factors

Pressure Altitude (Field Elevation) (ft)

3010

Specify the runway's pressure altitude (field elevation).

Air Temperature (F)

86

Specify the runway's mean daily maximum temperature of the hottest month of the year.

Wind Speed (kts)

0

Headwind is negative. Tailwind is positive.

Runway Information

Capture Entire Screen

Runway Length (ft)

4100

Specify the current runway length.

Runway Gradient (%)

0.0

Downhill is negative. Uphill is positive.

Surface Type

Paved

Runway Takeoff and Landing Restrictions											
		Pressure Altitude: 3010 ft		Air Temperature: 86 F		Wind Speed: 0 kts		Runway Length: 4100 ft		Gradient: 0.0 %	
										Surface Type: Paved	
Aircraft Name	Aircraft Mix	NBAA IFR Maximum Range		Useful Load (Takeoff Weight)		Landing at NBAA Minimum IFR Reserves					
						Part 91		Part 135 EOD		Part 135/91K	
		Dry	Wet	Dry	Wet	Dry	Wet	Dry	Wet	Dry	Wet
Jet											
E55P - Phenom 300	100%	100 % FLIGHTS IN NAS 1269 nm / 4 pax	93 % FLIGHTS IN NAS 886 nm / 4 pax	79 % 16948 lbs	64 % 15930 lbs	✓	✓	✓	✓	✗	✗

SARLAT Evaluation Analysis for Phenom 300 Departing from a 4,100-foot long runway at 86 deg. Fahrenheit and 3,010 feet airport elevation.

- d) For the Cessna Citation M2, find the percent of the flights that can be flown using the runway length found in Part (a).

Since the Cessna Citation M2 is the critical aircraft for runway length, the percent of flights covered can be calculated directly from the input you provided to SARLAT (see below). An alternative method is to run a Runway Evaluation Analysis using the Cessna M2.

The Cessna Citation M2 can depart the 4,100-foot long dry runway at 80% useful load (same as the input because the M2 is the critical aircraft) and travel 719 nautical miles carrying three passengers and one pilot. Flying 719 nautical miles covers 91% of the historical flights in the NAS.

Runway Takeoff and Landing Restrictions											
		Pressure Altitude: 3010 ft		Air Temperature: 86 F		Wind Speed: 0 kts		Runway Length: 4100 ft		Gradient: 0.0 %	
										Surface Type: Paved	
Aircraft Name	Aircraft Mix	NBAA IFR Maximum Range		Useful Load (Takeoff Weight)		Landing at NBAA Minimum IFR Reserves					
						Part 91		Part 135 EOD		Part 135/91K	
		Dry	Wet	Dry	Wet	Dry	Wet	Dry	Wet		
Jet											
C25M - Cessna Citation M2	100%	91 % FLIGHTS IN NAS 719 nm / 3 pax	74 % FLIGHTS IN NAS 506 nm / 3 pax	80 % 9976 lbs	68 % 9526 lbs	✓	✓	✓	✓	✗	✗

SARLAT Analysis for the Cessna Citation M2 departing from a 4,100-foot long runway at 86 deg. Fahrenheit and 3,010 feet airport elevation.

- e) Repeat the analysis in Part (a) using the **average annual temperature** at the airport (72 degrees Fahrenheit). Is the critical aircraft for runway length the same? Comment.

Change the temperature in the Runway Design Case and repeat Part a.

The critical aircraft for runway length under average temperature conditions is the Beechcraft King Air B200.

- a. Dry runway for takeoff distance

3,936 feet

- b. Wet runway for landing distance

2,458 feet

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).

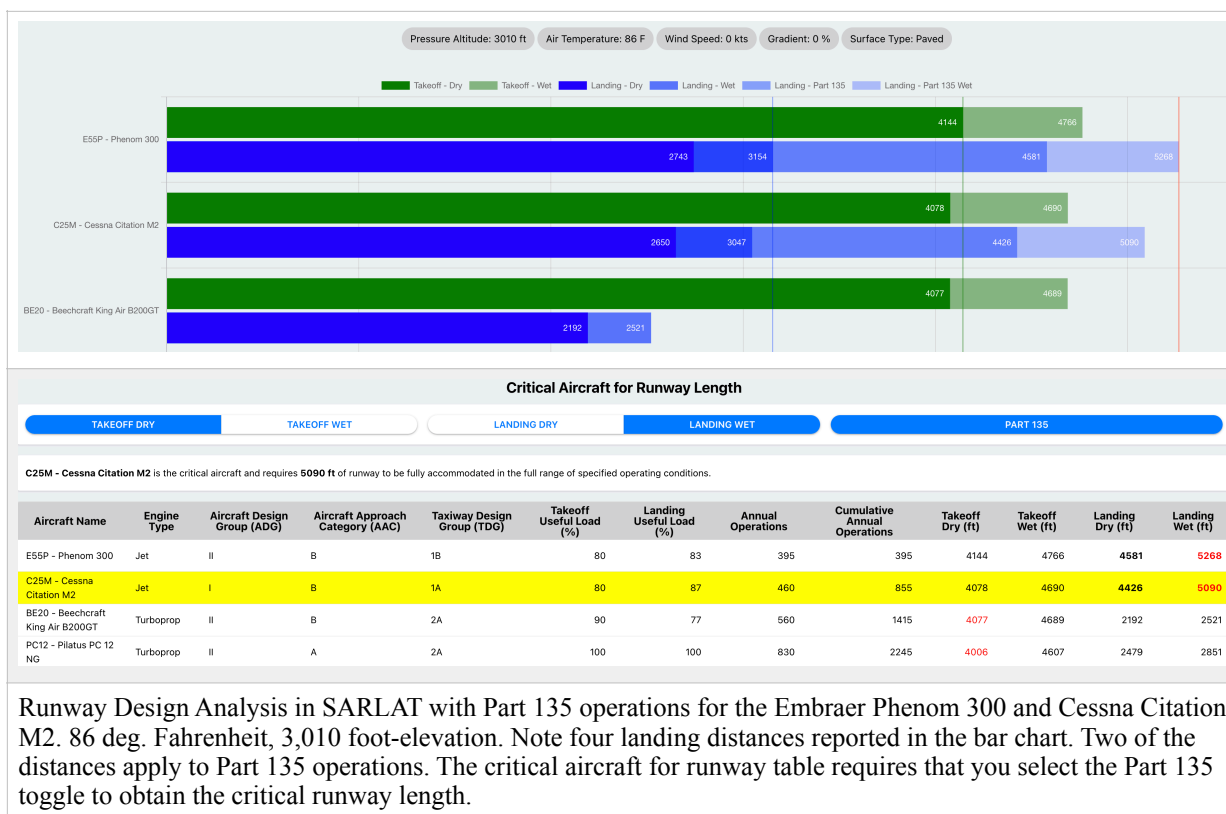
Round the **runway length needed to 4,000 feet** (above 30 feet round up to 100).



- f) The airport manager would like to know the runway length requirements if the Phenom 300 and the Cessna Citation M2 are operated under Part 135 rules (for landing). Run the analysis using the **design temperature (86 degrees Fahrenheit)** and comment on the runway length requirements considering Part 135 operational rules.

Aircraft Mix					
Piston					
Turboprop					
Jet					
Aircraft Name	Annual Operations	Trip Distance with Average Passenger Load (nm)	Takeoff Useful Load (%)	Part 135	Landing Weight (% of MALW)
C25M - Cessna Citation M2	460	719	80	Yes	87
E55P - Phenom 300	395	1294	80	Yes	83

Runway Design Analysis in SARLAT with Part 135 operations for the Embraer Phenom 300 and Cessna Citation M2. 86 deg. Fahrenheit, 3,010 foot-elevation.



Select the Part 135 toggle in the critical aircraft for runway length table. The critical aircraft for runway length considering Part 135 operations is the Cessna Citation M2. Note that the takeoff distance is not affected by Part 135 operations. Only the landings are corrected compared to Part 91 operations.

- a. Dry runway for takeoff distance

4,078 feet

- b. Wet runway for landing distance considering Part 135 rules

5,090 feet

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).

Round the runway length needed to 5,100 feet (above 30 feet round up to 100).

Problem 2

Use the Small Aircraft Runway Length Analysis Tool (SARLAT) to **evaluate the existing runway** at **Richmond-Chesterfield Executive Airport (FCI)** in Virginia. Table 2 shows a simplified aircraft fleet mix operating at the airport.

Task 1

Use [airnav.com](http://www.airnav.com) to summarize the following information for the airport:

- Runway length is 5,500 feet (runway 15/33)
- Airfield elevation is 236.1 feet
- Runway gradient is estimated taking the two runway end points:

Runway 15 threshold - 236.1 ft.

Runway 33 threshold - 198.8 ft.

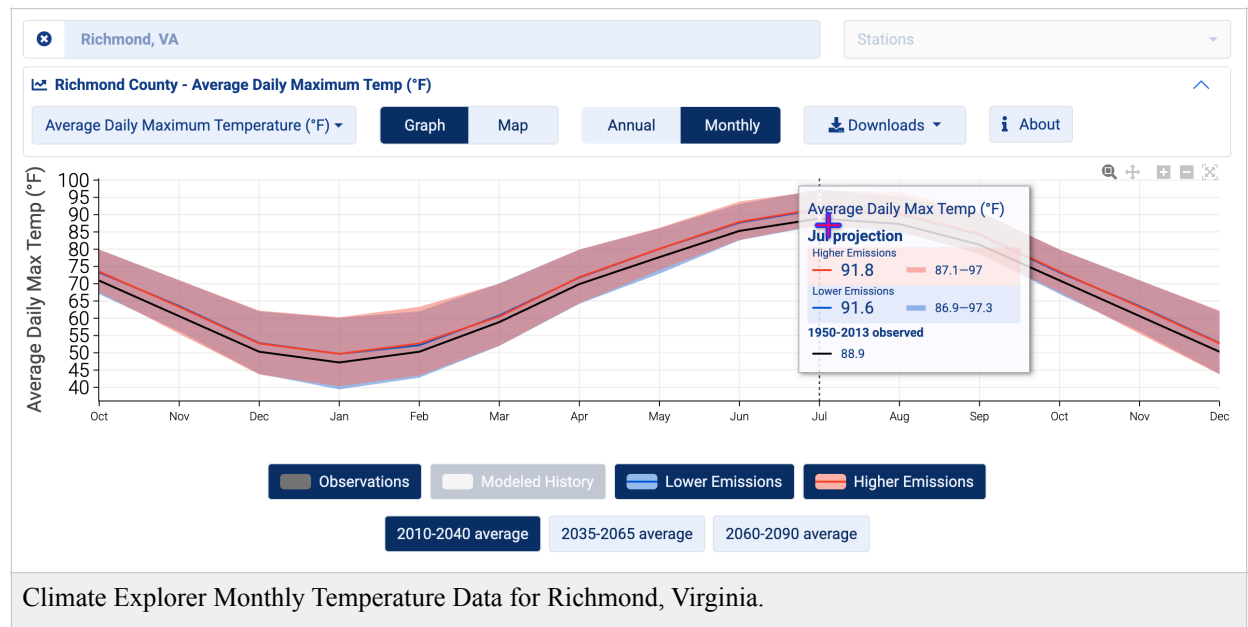
Difference in elevation = 37.3 feet

Equivalent grade = $37.3/5500 * 100 = 0.678 \%$

Use 0.7% in SARLAT

Task 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 Richmond (the closest metropolitan area to FCI).



- Find the historical maximum daily temperature for the hottest month of the year.

In July the average maximum daily temperature is 88.9 degrees Fahrenheit. We use 89 deg. Fahrenheit in the Evaluation Analysis.

- b. In a separate section of your analysis, consider future climate change effects (i.e., higher emissions) to find the future design temperature. Use the temperature profile for years 2035-2065.

Using higher emissions in the 2035-2065 time period, the design temperature is 94.6 degrees Fahrenheit. We use 95 deg. Fahrenheit in the Evaluation Analysis.

Table 2. Existing Aircraft Fleet Mix for Problem 2.

Aircraft Type	Aircraft	Annual Operations
Piston	Cessna 172	5,870
Piston	Piper Cherokee 161	4,800
Piston	Cirrus SR22	2,400
Piston	Cessna 421	460
Turboprop	King Air B350ER	1130
Turboprop	Pilatus PC12	870
Turboprop	Socata TBM 850	320
Jet	Cirrus SF50	1020
Jet	Cessna Citation 560XLS	960
Jet	Gulfstream 350	510

SARLAT - Runway Evaluation

Pressure Altitude (Field Elevation) (ft)

236

Specify the runway's pressure altitude (field elevation).

Air Temperature (F)

89

Specify the runway's mean daily maximum temperature of the hottest month of the year.

Wind Speed (kts)

0

Headwind is negative. Tailwind is positive.

Runway Information

Runway Length (ft)

5500

Specify the current runway length.

Runway Gradient (%)

0.7

Downhill is negative. Uphill is positive.

SARLAT Evaluation Analysis Inputs.

Task 3

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

- a) Find the aircraft that are limited in takeoff weight operating from FCI on a **wet runway**.

Aircraft Name	Aircraft Mix	NBAA IFR Maximum Range		Useful Load (Takeoff Weight)		Landing at NBAA Minimum IFR Reserves					
						Part 91		Part 135 EOD		Part 135/91K	
		Dry	Wet	Dry	Wet	Dry	Wet	Dry	Wet		
Piston											
C172 - Cessna 172 Skyhawk	31%			100 % 2300 lbs	100 % 2300 lbs	✓	✓				
C421 - Cessna 421 Golden Eagle	2%			100 % 7450 lbs	100 % 7450 lbs	✓	✓				
SR22 - Cirrus SR 22	13%			100 % 3600 lbs	100 % 3600 lbs	✓	✓				
P28A - Piper 28 161 Cherokee	25%			100 % 2325 lbs	100 % 2325 lbs	✓	✓				
Turboprop											
B350 - Beechcraft King Air 350ER	6%	100 % FLIGHTS IN NAS 1643 nm / 5 pax	100 % FLIGHTS IN NAS 892 nm / 5 pax	93 % 16066 lbs	65 % 14366 lbs	✓	✓			✓	✓
PC12 - Pilatus PC 12 NG	5%			100 % 10450 lbs	100 % 10450 lbs	✓	✓			✓	✓
TBM8 - Socata TBM 850	2%			100 % 7394 lbs	100 % 7394 lbs	✓	✓			✓	✓

SARLAT Evaluation Analysis Results for Piston and Turboprop Aircraft.

Runway Takeoff and Landing Restrictions											
Pressure Altitude: 236 ft Air Temperature: 89 F Wind Speed: 0 kts Runway Length: 5500 ft Gradient: 0.7 % Surface Type: Paved											
Aircraft Name	Aircraft Mix	NBAA IFR Maximum Range		Useful Load (Takeoff Weight)		Landing at NBAA Minimum IFR Reserves					
		Dry	Wet	Dry	Wet	Part 91		Part 135 EOD		Part 135/91K	
						Dry	Wet	Dry	Wet	Dry	Wet
Jet											
C56X - Cessna 560 XL	5%	100 % FLIGHTS IN NAS 1620 nm / 4 pax	100 % FLIGHTS IN NAS 1620 nm / 4 pax	100 % 20200 lbs	100 % 20200 lbs	✓	✓	✓	✓	✓	✗
SF50 - Cirrus Vision SF50	6%	100 % FLIGHTS IN NAS 758 nm / 3 pax	88 % FLIGHTS IN NAS 581 nm / 3 pax	100 % 6000 lbs	88 % 5709 lbs	✓	✓	✓	✓	✓	✓
GLF4 - Gulfstream G350	3%	100 % FLIGHTS IN NAS 3066 nm / 6 pax	100 % FLIGHTS IN NAS 2354 nm / 6 pax	83 % 66246 lbs	67 % 61554 lbs	✓	✓	✗	✗	✗	✗

SARLAT Evaluation Analysis Results for Jet Aircraft.

For historical design temperature conditions (89 deg. Fahrenheit):

The Beechcraft King Air B350ER can operate at 65% useful load (takeoff weight 14,366 lbs.) while departing from a wet runway at FCI.

The Cirrus SF50 can operate at 88% useful load (takeoff weight 5,709 lbs.) while departing from a wet runway at FCI.

The Gulfstream G350 can operate at 67% useful load (takeoff weight 61,554 lbs.) while departing from a wet runway at FCI.

- b) For dry runway conditions, find the **takeoff weight** and **useful load** possible for the Hawker 800XP and the Beechcraft King Air B350 operating from the existing runway.

For dry runway conditions at FCI.

The Beechcraft King Air B350ER can depart at 93% of the useful load (takeoff weight is 13,623 lbs.)

The Hawker 800XP was not given in the original fleet mix. However, it is very easy to introduce the aircraft into a new evaluation analysis to answer the question.

Runway Takeoff and Landing Restrictions													
Pressure Altitude: 236 ft		Air Temperature: 89 F		Wind Speed: 0 kts		Runway Length: 5500 ft		Gradient: 0.7 %		Surface Type: Paved			
Aircraft Name	Aircraft Mix	NBAA IFR Maximum Range		Useful Load (Takeoff Weight)		Landing at NBAA Minimum IFR Reserves							
						Part 91		Part 135 EOD		Part 135/91K			
		Dry	Wet	Dry	Wet	Dry	Wet	Dry	Wet	Dry	Wet		
H25B - Hawker 800XP	3%	100 % FLIGHTS IN NAS 1571 nm / 5 pax		96 % FLIGHTS IN NAS 1167 nm / 5 pax		76 %	62 %	✓	✓	✓	✓	✗	✗
				25134 lbs	23431 lbs	✓	✓	✓	✓	✗	✗		

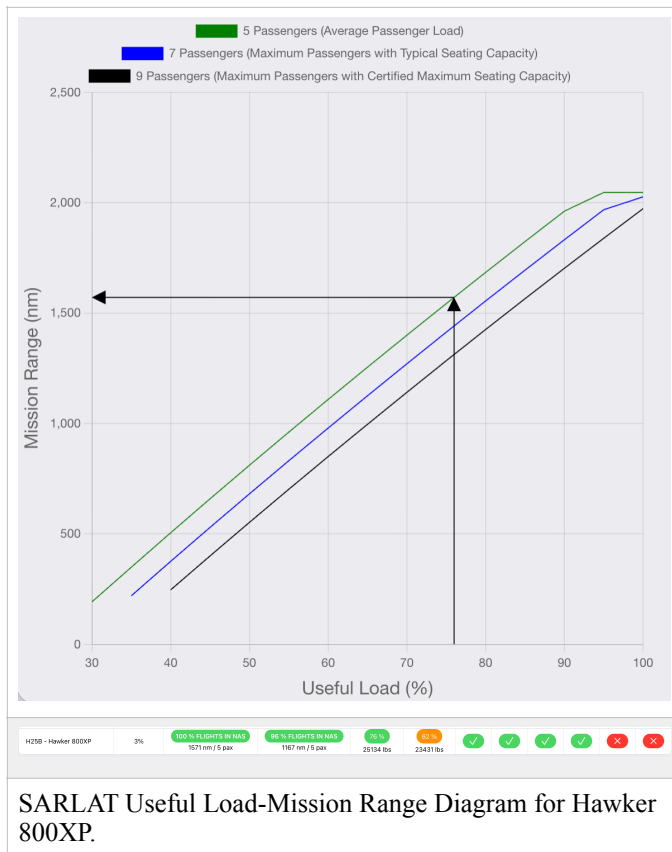
SARLAT Evaluation Analysis Results for the Hawker 800XP. 89 deg. Fahrenheit.

SARLAT Evaluation Analysis Results for the Hawker 800XP. 89 deg. Fahrenheit.

The Hawker 800XP can depart FCI (dry runway) at 76% of the useful load (takeoff weight is 25,134 lbs.)

- c) Using the existing runway length at FCI, find the maximum distance that can be flown by a Hawker 800XP with seven passengers and two pilots departing on a wet runway.

With five passengers and two pilots, the Hawker 800XP can fly 1,571 nm departing FCI on a dry runway. With seven passengers, the aircraft can only fly 1,400 nautical miles. The diagram below shows the useful load-mission range diagram for the Hawker 800 XP.



d) Can the Cessna 560XL operate at FCI under Part 135 rules if the runway is wet?

The Cessna 560XL can operate under Part 135 from a dry runway at FCI. However, the aircraft is restricted to operate under Part 135 if the runway is wet.

Task 4

Considering **climate change conditions** answer the following:

- a) Using the existing runway length at FCI, find the maximum distance that can be flown by a Hawker 800XP with seven passengers and two pilots departing on a wet runway. Comment on change in maximum distance compared to part (c).

Change the design temperature to reflect Climate Change conditions. Use 95 deg. Fahrenheit in the Evaluation Analysis. Add the Hawker 800XP to the fleet mix to estimate the takeoff limitations for the aircraft. The evaluation results with the higher temperature are shown below.

Under higher temperature conditions, the Hawker 800XP is limited to 71% and 57% useful loads under dry and wet conditions, respectively.

With five passengers and two pilots, the Hawker 800XP can fly 1,429 nm departing FCI on a dry runway. With seven passengers, the aircraft can fly ~1,270 nautical miles. The diagram below shows the useful load-mission range diagram for the Hawker 800 XP.

A change in six degrees Fahrenheit, reduces the mission range of the Hawker 800XP by 142 nautical miles.

Aircraft Name	Aircraft Mix	NBAA IFR Maximum Range		Useful Load (Takeoff Weight)		Landing at NBAA Minimum IFR Reserves					
		Dry	Wet	Dry	Wet	Part 91		Part 135 EOD		Part 135/91K	
						Dry	Wet	Dry	Wet	Dry	Wet
C56X - Cessna 560 XL	5%	100 % FLIGHTS IN NAS 1620 nm / 4 pax	100 % FLIGHTS IN NAS 1620 nm / 4 pax	100 % 20200 lbs	100 % 20200 lbs	✓	✓	✓	✓	✓	✗
SF50 - Cirrus Vision SF50	5%	99 % FLIGHTS IN NAS 729 nm / 3 pax	65 % FLIGHTS IN NAS 387 nm / 3 pax	98 % 5948 lbs	75 % 5409 lbs	✓	✓	✓	✓	✓	✗
GLF4 - Gulfstream G350	3%	100 % FLIGHTS IN NAS 2847 nm / 6 pax	100 % FLIGHTS IN NAS 2125 nm / 6 pax	78 % 64823 lbs	62 % 60221 lbs	✓	✓	✗	✗	✗	✗
H25B - Hawker 800XP	3%	100 % FLIGHTS IN NAS 1429 nm / 5 pax	91 % FLIGHTS IN NAS 1020 nm / 5 pax	71 % 24488 lbs	57 % 22864 lbs	✓	✓	✓	✓	✗	✗

SARLAT Evaluation Analysis Results for the Hawker 800XP. 95 deg. Fahrenheit.

- b) For **dry runway conditions**, find the **takeoff weight** and **useful load** possible for the Hawker 800XP and the Beechcraft King Air B350 operating from the existing runway. Comment on the useful load changes compared to Part (c).

The Beechcraft King Air B350ER can depart at 86% of the useful load (takeoff weight is 15,622 lbs lbs.)

The Hawker 800XP can depart at 71% of the useful load (takeoff weight is 24,488 lbs.)

- c) Overall, how does increased temperature in the future (with climate change) may affect aircraft operations in the future?

Problem 3

The airport described in **Problem 2** is planning a possible runway expansion to accommodate larger jet aircraft such as the Gulfstream G200 and the Bombardier Global Express 6000. 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
Jet	Gulfstream G200	410
Jet	Bombardier Global Express 6000	345

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

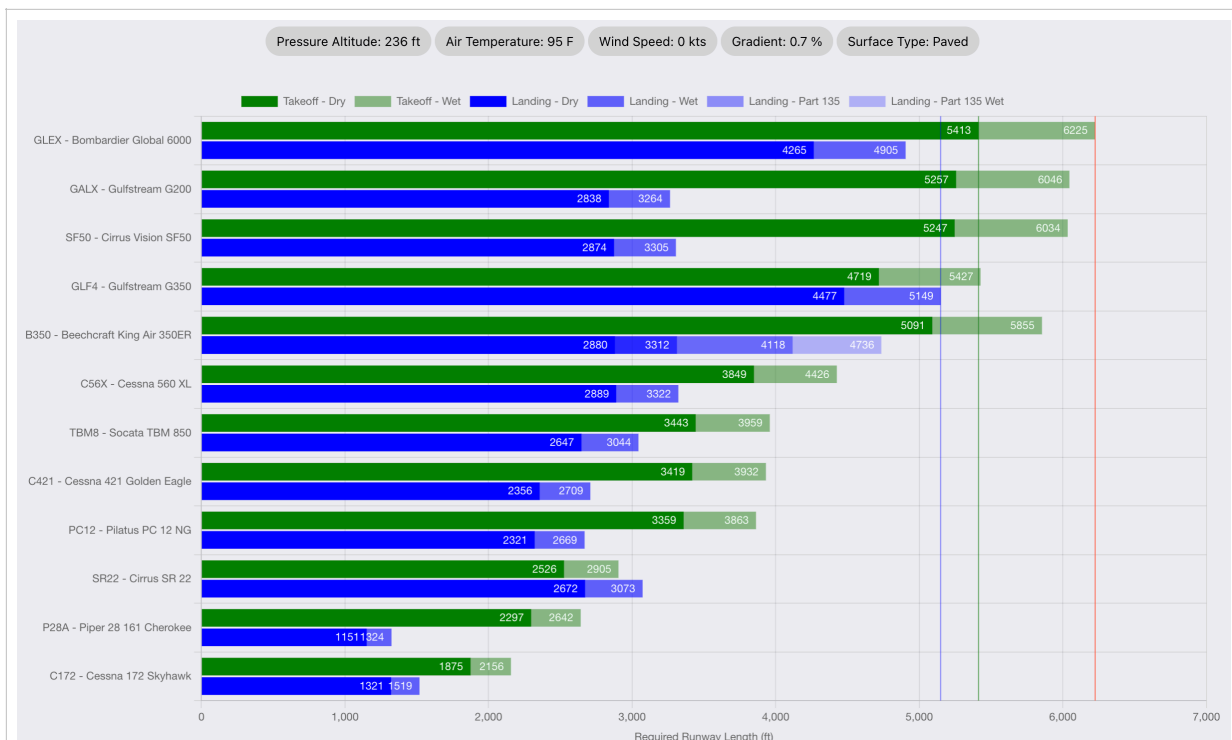
- Find the **runway extension** needed at FCI to allow both all turbofan-powered aircraft to operate at a useful load of 60% in **wet pavement conditions**. In the analysis consider future climate change temperature conditions (2035-2065). Tell me the total runway needed to satisfy the 60% useful load requirement for both aircraft.

Run a new SARLAT Design Evaluation scenario introducing the Gulfstream G200 and the Global Express 6000. Use 95 deg. Fahrenheit in the Design Analysis and use 60% useful load for both aircraft. Other aircraft can stay in the analysis using the default takeoff useful load values. In your analysis make sure you use the 0.7% grade of the existing runway.

Here is a summary table with the values used as input in the Design Scenario.

Table 3. Existing Aircraft Fleet Mix for Problem 3 - Runway Extension Analysis.

Aircraft Type	Aircraft	Annual Operations	Takeoff Useful Load (%)
Piston	Cessna 172	5,870	100
Piston	Piper Cherokee 161	4,800	100
Piston	Cirrus SR22	2,400	100
Piston	Cessna 421	460	100
Turboprop	King Air B350ER	1130	70
Turboprop	Pilatus PC12	870	100
Turboprop	Socata TBM 850	320	100
Jet	Cirrus SF50	1020	90
Jet	Cessna Citation 560XLS	960	70
Jet	Gulfstream 350	510	60
Jet	Gulfstream G200	410	60
Jet	Global Express 6000	345	60



SARLAT Design Scenario to Accommodate the GLEX and G200 at 60% Takeoff Useful Load. 95 deg. Fahrenheit.

The analysis shows that both the Global Express 6000 and the Gulfstream 200 could operate from FCI and wet pavement conditions if the runway is extended to a total of 6,225 feet (round down to 6,200 feet).

A 700-foot runway extension would be recommended. Note that since the runway operating conditions are wet pavement for takeoff, the FAA AIP program is unlikely to pay for such extension. The Virginia Dept. of Aviation and the local government could invest funds to make such runway extension possible. Many airport projects (including runway extensions) use multiple source of funding.

- b) With the proposed runway extension, how far can the Global 6000 fly with eight passengers and two pilots?

With a 6,200-foot runway, the Global Express can fly 3,603 nautical miles. This value can be read from the input screen in SARLAT (see below).

Jet						
Aircraft Name	Annual Operations	Trip Distance with Average Passenger Load (nm)	Takeoff Useful Load (%)	Part 135	Landing Weight (% of MALW)	
CL35 - Bombardier Challenger 350	0	1553	60	Yes	82	
CL60 - Bombardier Challenger 605	0	1910	60	Yes	80	
GLEX - Bombardier Global 6000	345	3603	60	No	73	

SARLAT Design Scenario to Accommodate the GLEX and G200 at 60% Takeoff Useful Load. 95 deg. Fahrenheit.

- c) With your proposed runway extension, can the Global 6000 fly from FCI to London Heathrow Airport non-stop considering climate change effects and the future design temperature? In the

analysis consider a typical 6% detour factor applied to the Great Circle Distance for trans-Atlantic flights.

The Great Circle Distance between FCI and LHR is 3,258 nautical miles. Applying a 6% detour factor, the route distance is 3,453 nm. The plane can fly direct to LHR with the average passenger load and two pilots.

Problem 4

Please answer true or false.

Question	True / False
Jet engines produce more thrust as airspeed increases.	FALSE
Piston-engine aircraft performance is very sensitive to airport elevation.	TRUE
The air density in Denver, Colorado is 25% lower than at sea level.	FALSE (see calculation below)*
Runway slope increases the runway length needed.	TRUE. Runways are used in two directions so uphill takeoffs produce a lower deceleration.
Landing speeds remain the same at higher elevation airports for a constant flap setting.	FALSE. Landing speed increases due to lower density at higher elevation airports.
A 30-deg. flap setting produces more drag than a 10-deg. flap setting.	TRUE.
Climb speed increases with higher takeoff weight.	TRUE. Higher takeoff weight increases stall speed and hence climb speed.
Large flap angles are desirable during landing.	TRUE.
Long runways are needed at airports like La Paz, Bolivia (13,325 feet above sea level).	TRUE

* Denver is located at 5,434 feet (see Airnav.com). Consult the International Atmosphere (ISA) tables or Digital Dutch (<https://www.digitaldutch.com/atmoscalc/>). The density of air at Denver is 1.04 kg/cu.meter. The density at sea level is 1.225 kg/cu. Meter. The air density at Denver is ~15% lower than sea level conditions. The sample calculation using Digital Dutch is shown below.



1976 Standard Atmosphere Calculator

Calculator

Table

Graphs

Options

Help

Input

Altitude¹

Temperature offset²

¹ Geopotential altitude

² Temperature deviation from 1976 standard atmosphere (off-standard atmosphere)

[SI Units](#) | [English/US Units](#)

Output

Temperature

Pressure

Density

Speed of sound

Dynamic viscosity

Calculation of Density at Denver, Colorado Airport. Source: Digital Dutch.