Runway Length Calculations
Aircraft with Takeoff Weights less than 60,000 lbs

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Runway Design Assumptions (FAA 150/5325-4b)

- For Aircraft with maximum takeoff weights less than 60,000 consult **Chapters 2 and 3 of the FAA AC 150/5325-4B**
- The procedures in the advisory circular also assume:
- No wind conditions
- Zero runway gradient
- Dry runway conditions
- Data is corrected to account for humidity

U.S. Department of Transportation
Federal Aviation Administration

Advisory Circular

Subject: RUNWAY LENGTH REQUIREMENTS FOR AIRPORT DESIGN
Date: 7/1/2005
Initiated by: AAS-100
AC No: 150/5325-4B
Change:

1. **PURPOSE.** This Advisory Circular (AC) provides guidelines for airport designers and planners to determine recommended runway lengths for new runways or extensions to existing runways.

Critical Design Aircraft

- The individual aircraft that requires the longest runway length
- Federal funding requirements imply the critical aircraft should be used at least for **250 landings and 250 takeoffs** (or 500 itinerant operations)
- Weight categories used in airport runway length design:
  - Small airplane (MTOW < 12,500 lb. or < 5,670 kg)
  - Large airplane - MTOW > 12,500 lb. (5,670 kg) and < 60,000 lb. (27,273 kg)
  - Regional jets (typically > 60,000 lb. (27,273 kg)
  - Commercial Airliners (typically > 110,000 lb.)

Steps in the Runway Length Procedure (5 steps)

1. Identify the list of potential critical airplanes
2. Identify the weights of the critical aircraft and associated weight class
   - If the aircraft MTOW < 60,000 then the method used is based on a “Family Grouping of Airplanes”
   - If the aircraft MTOW >= 60,000 then the method used is based on an ”Individual analysis”
   - Regional Jets use the second method even if their weight is below 60,000 lb.
3. Use Table 1-1 and the critical aircraft in step 2 to decide on the recommended method for runway length required

Steps in the Runway Length Procedure (5 steps)

Table 1-1. Airplane Weight Categorization for Runway Length Requirements

Airplane Weight Category Maximum Certificated Takeoff Weight (MTOW)			Design Approach	Location of Design Guidelines
12,500 pounds (5,670 kg) or less	Approach Speeds less than 30 knots		Family grouping of small airplanes	Chapter 2; Paragraph 203
	Approach Speeds of at least 30 knots but less than 50 knots		Family grouping of small airplanes	Chapter 2; Paragraph 204
	Approach Speeds of 50 knots or more	With Less than 10 Passengers	Family grouping of small airplanes	Chapter 2; Paragraph 205 Figure 2-1
		With 10 or more Passengers	Family grouping of small airplanes	Chapter 2; Paragraph 205 Figure 2-2
Over 12,500 pounds (5,670 kg) but less than 60,000 pounds (27,200 kg)			Family grouping of large airplanes	Chapter 3; Figures 3-1 or 3-2 [1] and Tables 3-1 or 3-2
60,000 pounds (27,200 kg) or more or Regional Jets [2]			Individual large airplane	Chapter 4; Airplane Manufacturer Websites (Appendix 1)

Note[1]: When the design airplane's APM shows a longer runway length than what is shown in figure 3-2, use the airplane manufacturer's APM. However, users of an APM are to adhere to the design guidelines found in Chapter 4.

Note[2]: All regional jets regardless of their MTOW are assigned to the 60,000 pounds (27,200 kg) or more weight category.

Source: FAA 150/5325-4b

Steps in the Runway Length Procedure (5 steps)

4. Select the recommended runway length from various runway lengths generated in step # 3
5. Apply adjustments (if applicable) to the runway length obtained in step # 4 for aircraft with maximum takeoff gross weights between 12,500 lbs and 60,000 lbs
   - Runway gradient
   - Wet pavement conditions

Definition of Primary Runway

- Most airports require only one primary runway
- Primary runways are designed and oriented so that 95% of the time the design crosswind components are not exceeded (more later in the course)
- However, sometimes multiple primary runways are needed for:
  - Capacity reasons
  - To accommodate forecasted growth
  - To mitigate noise impacts
- Design objective for additional primary runways is contained in Table 1-2 of the FAA AC 150/5325-4b

Table 1-2 in FAA AC 150/5325-4b

Table 1-2. Runway Length for Additional Primary Runways

Runway Service Type, User	Runway Length for Additional Primary Runway Equals
Capacity Justification, Noise Mitigation, Regional Jet Service	100 % of the primary runway
Separating Airplane Classes - Commuter, Turboprop, General Aviation, Air Taxis	Recommended runway length for the less demanding airplane design group or individual design airplane

Table 1-3 in FAA AC 150/5325-4b

Table 1-3. Runway Length for Crosswind Runway

Runway Service	Runway Length for Crosswind Runway Equals
Scheduled [1] Such as Commercial Service Airports	100 % of primary runway length when built for the same individual design airplane or airplane design group that uses the primary runway
	100% of the recommended runway length determined for the lower crosswind capable airplanes using the primary runway
Non-Scheduled [2] Such as General Aviation Airports	100% of the recommended runway length determined for the lower crosswind capable airplanes using the primary runway

Note [1]: Transport service operated over routes pursuant to published flight schedules that are openly advertised with dates or times (or both) or otherwise made readily available to the general public or pursuant to mail contracts with the U.S. Postal Service (Bureau of Transportation Statistics, Department of Transportation (DOT)).

Note [2]: Revenue flights, such as charter flights that are not operated in regular scheduled service, and all non-revenue flights incident to such flights (Bureau of Transportation Statistics, DOT). For Federally funded programs, such as AIP, there must be at least 500 annual itinerant operations and 100% of the class.

Runway Length Based on Declared Distance Concept

- New runways are expected to be designed according to the principles of Tables 1-1 and 1-2 in the AC 150/5325-4b
- **Existing runways sometimes** do not meet all new safety criteria
- The **Declared Distance Concept** provides a rational procedure to improve such runways
- We discuss this procedure later in this course

Runway Length for Small Aircraft with MTOW < 12,500 lb (5,670 kg)

- Inputs to the procedure:
- Critical aircraft
- Approach speed (30% above the stalling speed)
- Number of passenger seats
- Airport elevation above mean sea level
- Mean daily maximum temperature of the hottest month of the year
- Use Figures 2-1 and 2-2 in AC 150/5325-4b
- No adjustment for runway gradient or wet pavement (e.g., landing performance)

Small Airplanes with Approach Speeds < 30 knots

- This group includes ultralight aircraft
- **Recommended runway 300 feet (92 meters) at mean sea level conditions**
- Increase runway by 30 feet for every 1000 feet in airfield elevation (0.03 x airfield elevation)
- In the U.S. ultralights are regulated by FAR Part 103
- Web links:
- FAR 103 (https://www.ecfr.gov/current/title-14/chapter-I/subchapter-F/part-103)

Small Airplanes with Approach Speeds > 30 knots and < 50 knots

- This group includes **Light Sport Aircraft (LSA)**
- **FAA recommends an 800-foot (244 meters) runway at mean sea level conditions**
- Increase runway by 80 feet for every 1000 feet in airfield elevation (0.08 x airfield elevation)
- Web links:
- FAA LSA: https://www.faa.gov/aircraft/gen_av/light_sport

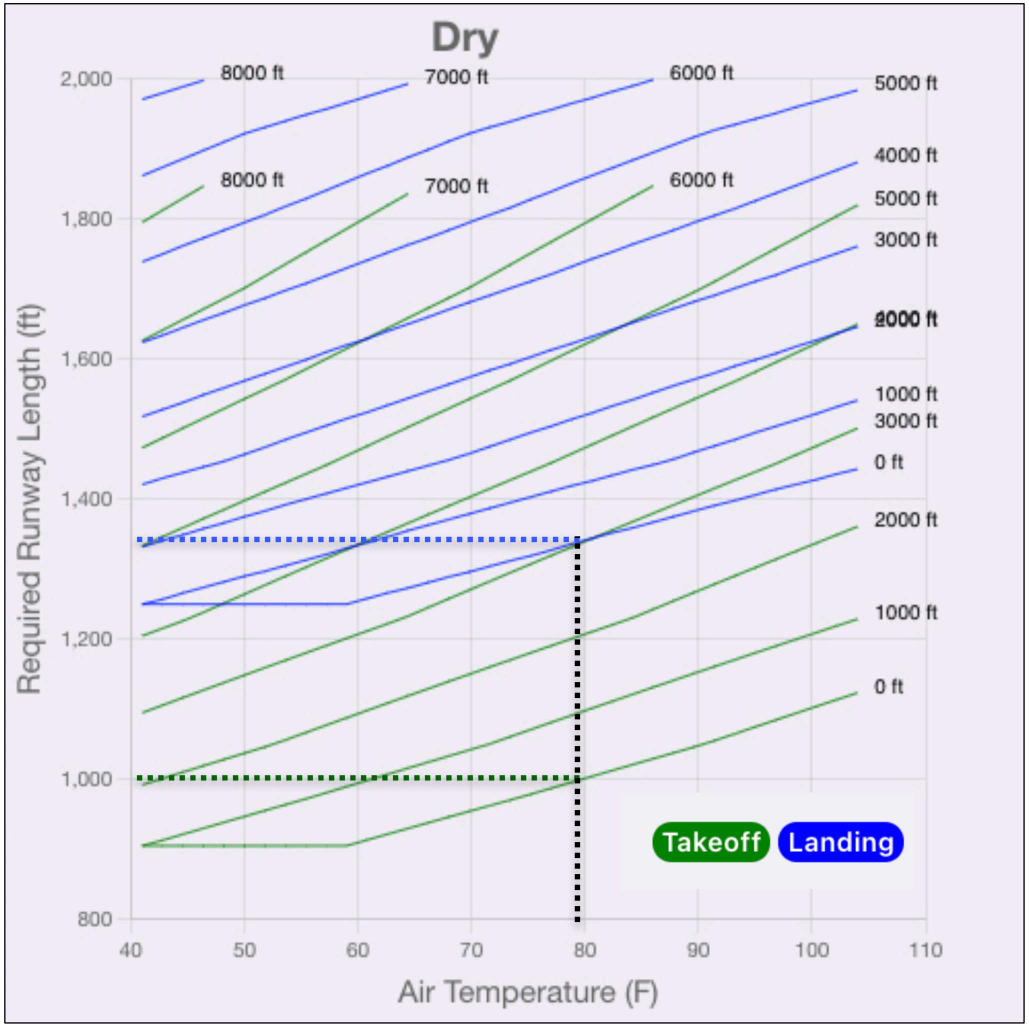
Light Sport Aircraft (LSA)

- Maximum takeoff gross weight : 1,320 lbs (600 kilograms)
- 1,430 lbs if LSA is a seaplane
- Two seats
- 120 knots maximum cruise speed
- Maximum stall speed : 45 knots
- One engine
- Fixed pitch propeller
- Fixed landing gear

Virginia Tech Recommendation for LSA Aircraft

- Based on recent analysis at Virginia Tech for the FAA we recommend:
  - 1,000 ft for takeoff at sea level and 80 deg. F.
  - **1,350 ft** for landing at sea level at 80 deg. F.

Data for the Flight Design CTLS

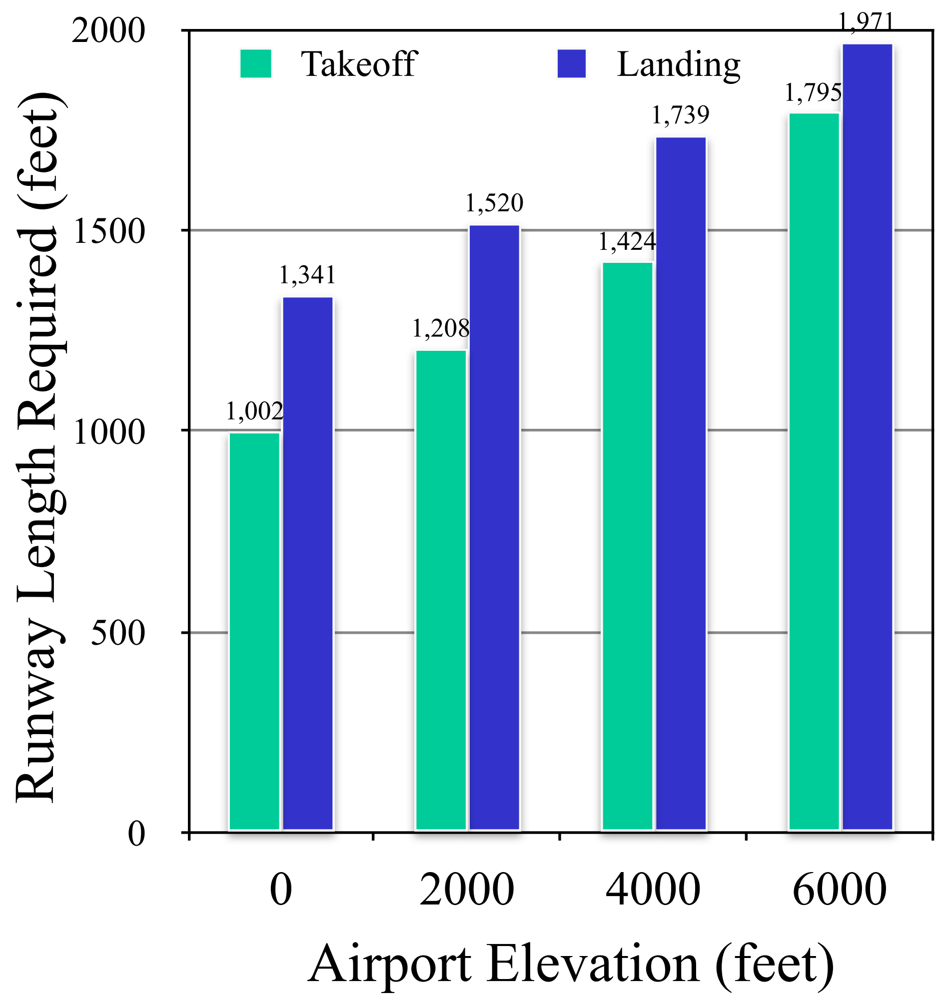


Small Aircraft Runway Length Analysis Tool

Analysis of LSA Aircraft performance Using SARLAT

Airport Elevation (feet)	*Takeoff Runway Length (feet)*	*Landing Runway (feet)*	*Delta from Datum Point (%)*
Sea Level	*1,002*	*1,341*	*0*
2,000	*1,208*	*1,520*	*13.3*
4,000	*1,424*	*1,739*	*29.7*
6,000	*1,795*	*1,971*	*47.0*

The actual LSA performance indicates an increase of 8% for each 1,000 feet in airport elevation

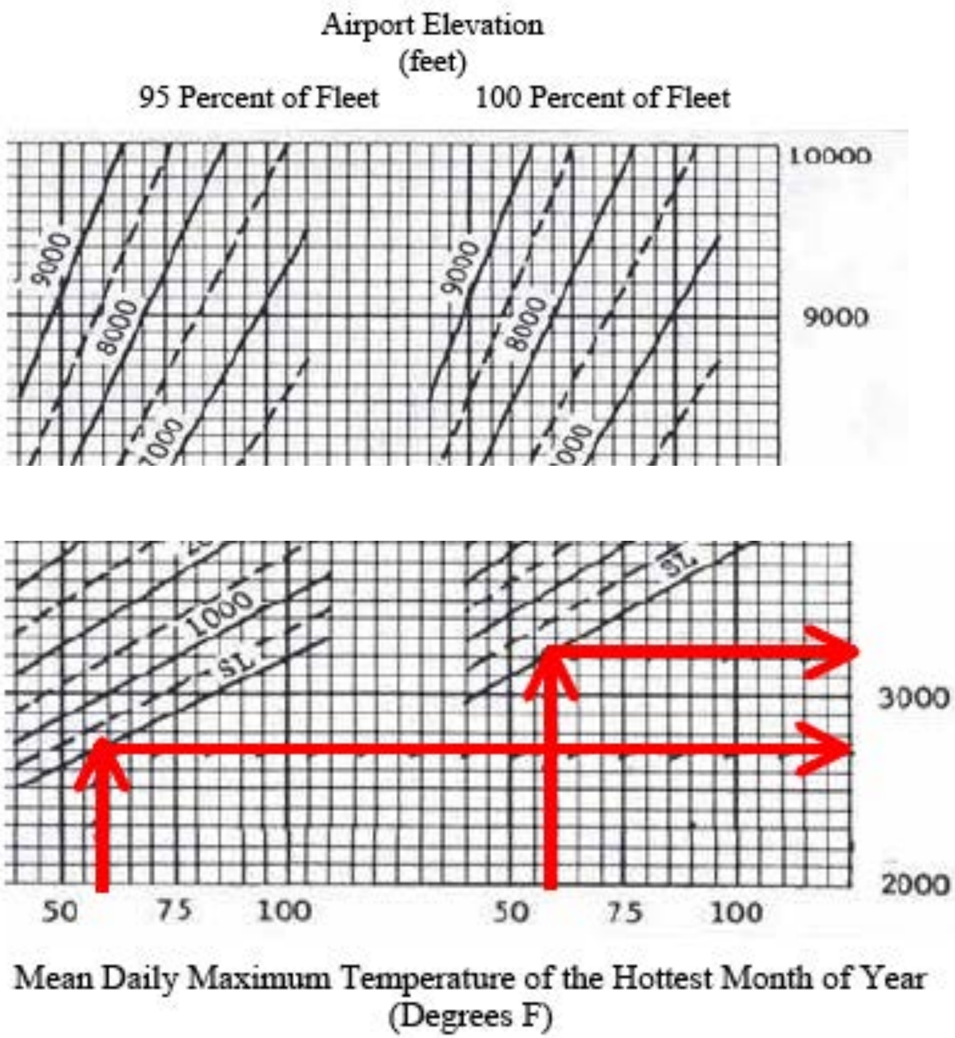


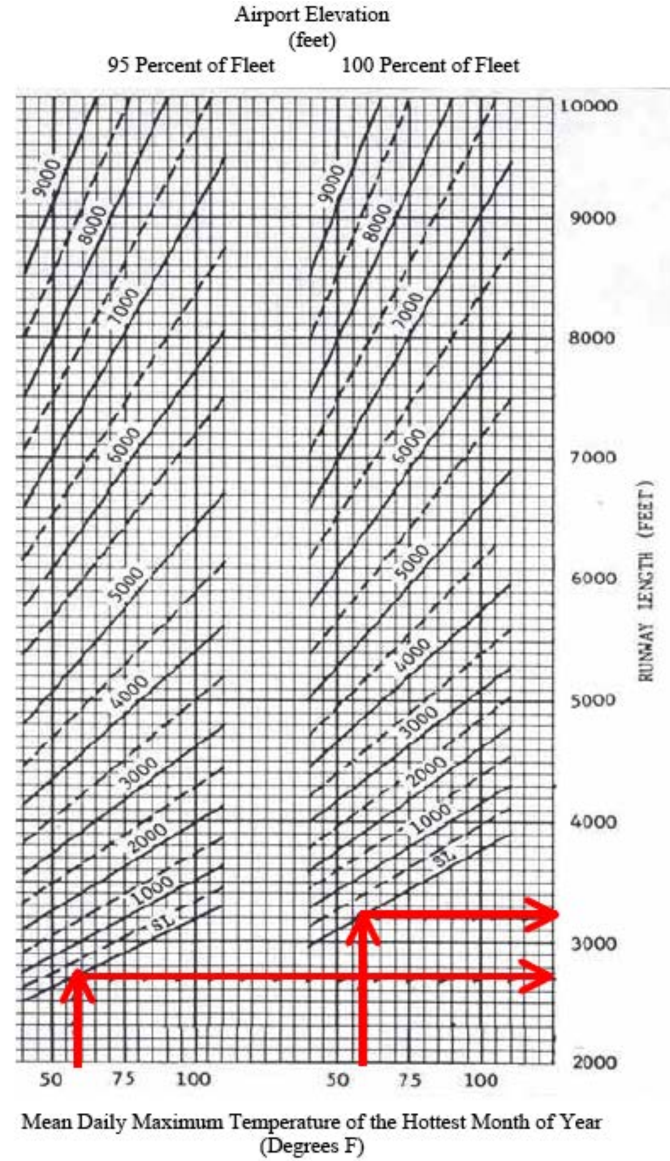
Small Aircraft Runway Length Analysis Tool

Small Airplanes with Approach Speeds > 50 knots or MTOW < 12,500 lb

- This group includes most of the General Aviation (GA) aircraft
- Use Figure 2-1 and 2-2 in the FAA AC 150/5325-4b
- Figure 2-1
  - Aircraft with less than 10 seats (excluding pilot and co-pilot)
  - Two family group designs (95% and 100% of the fleet)
- Figure 2-2
  - Aircraft with more than 10 seats (excluding pilot and co-pilot)

Figure 2-1 in AC 150/5325-4b





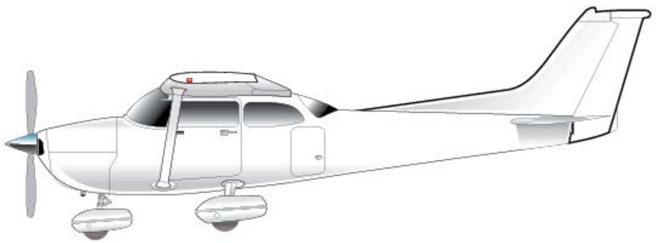
Selection of Percent of the Fleet

- **95 Percent of Fleet**
  - "This category applies to airports that are primarily intended to **serve medium size population communities** with a diversity of usage and a greater potential for increased aviation activities. Also included in this category are those airports that are primarily intended to serve low-activity"
- **100 Percent of Fleet**
  - "This type of airport is primarily intended to serve communities located on the fringe of **a metropolitan area or a relatively large population** remote from a metropolitan area"

Small Aircraft < 10 seats (and <12,500 lbs)

Beech Baron 58

Cessna 421



Cessna 172

Shrike Commander

Cessna 208 Caravan

Figure 2-2 in AC 150/5325-4b

Raytheon Beech King Air A100

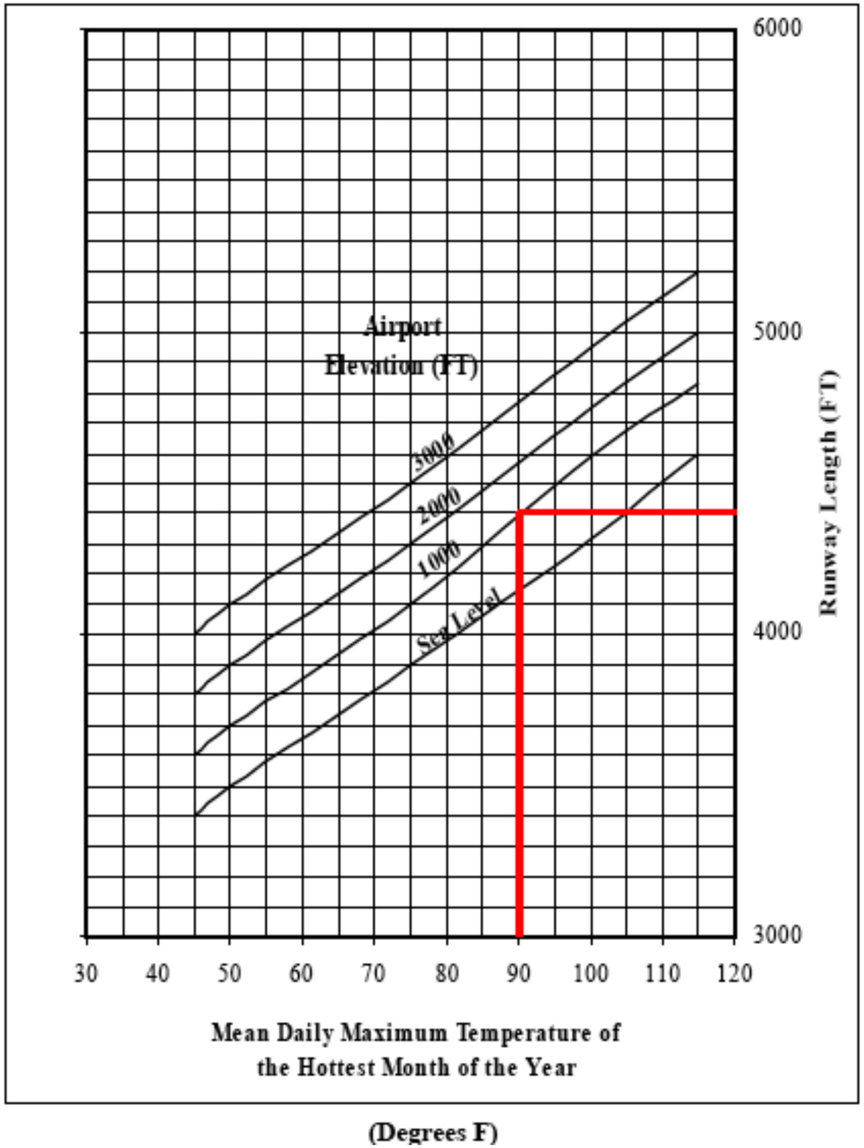
Raytheon B80 Queen Air
Raytheon E90 King Air
Raytheon B99 Airliner
Raytheon A100 King Air
(Raytheon formerly Beech Aircraft)

Britten-Norman
Mark III-I Trilander

Mitsubishi MU-2L

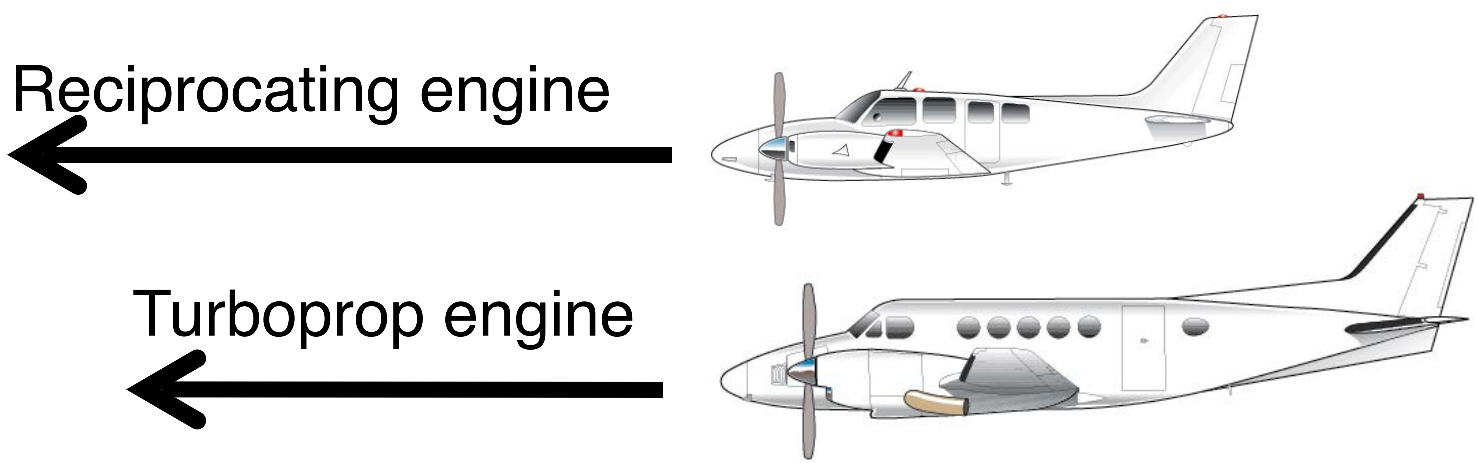
Swearigen Merlin III-A
Swearigen Merlin IV-A
Swearigen Metro II

Representative Aircraft



Important Design Consideration

- For airfield elevations above 3,000 feet (914 meters) use the 100% fleet graph in Figure 2-1 instead of Figure 2-2
- Reason:
- Small aircraft in Figure 2-1 are have reciprocating engine technology that is more prone to "power" degradation with altitude that aircraft included in Figure 2-2



Runway length at high airport elevation

Representative Aircraft with More than 10 Seats

Raytheon Beechcraft King Air 360
ADG II and AAC B

Mitsubishi MU-2B 60 (Long)
ADG I and AAC B

Swearinger Merlin Metro III
ADG II and AAC B

Assumptions in the Development of Curves (applies to curves in Figure 2-1 and 2-2)

- Curves shown in Figures 2-1 and 2-2 comply with Federal Aviation Regulations (FAR) Part 23
- FAR Part 23 applies to the certification of small aircraft
- Assume the following conditions:
  - Zero wind
  - MTOW or MALW
  - Airport elevation and temperature are parameters
- A 10% increase in the runway length values has been accounted for to **compensate for humidity and runway gradient**

Assumptions in the Development of Curves (applies to Figure 2-2)

- Figure 2-2 includes **accelerate and stop distance** calculations for aircraft with more than 10 seats
- Figure 2-1 does not include accelerate and stop distance criteria
- In general, takeoff is the critical maneuver to determine runway length

Runway Length for Small Aircraft with MTOW > 12,500 lb (5,670 kg) and less than 60,000 lb (27,200 kg)

- Inputs to the procedure:
  - Airport elevation (above mean sea level)
  - Mean daily maximum temperature of the hottest month of the year
  - Use Figures 3-1 and 3-2 in AC 150/5325-4b
  - Requires adjustment for runway gradient or wet pavement (e.g., landing performance)

Runway Length for Small Aircraft with MTOW > 12,500 lb (5,670 kg) and less than 60,000 lb (27,200 kg)

- Use Tables 3-1 and 3-2 to determine the design group to use
- Determine the useful load factor (between 60% and 90%)
- Above 5,000 feet (airport elevations) the runway lengths for these aircraft might be less than those for smaller aircraft < 12,500 lb
- Curves are limited to 8,000 feet (2,439 meters)
- For higher elevations consult the aircraft manufacturers
- This procedure does not include runway length for air carriers

Explanation of Useful Load

- Useful load is the weight an aircraft can carry including:
  - Pilot(s)
  - Passengers
  - Baggage
  - Cargo
  - Usable fuel

Beechcraft King Air B350

Aircraft Name	FAA Type Designator	Engine Type	Aircraft Design Group (ADG)	Aircraft Approach Category (AAC)	Weight Category	Operating Empty Weight (OEW)	Useful Load	Maximum Takeoff Weight (MTOW)	Maximum Allowable Landing Weight (MALW)
Turboprop									
Beechcraft King Air 350ER	B350	Turboprop	II	B	L	10385 lbs	6115 lbs	16500 lbs	15675 lbs

Source: SARLAT Tool

Useful Load and Mission Range

Beechcraft King Air B350

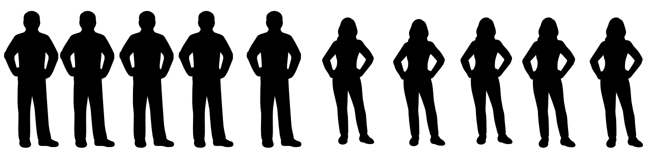
For example: a mission range of 300 nm carrying 10 passengers is equivalent to 61.5% useful load for this aircraft.

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

All values in the table assume two pilots and 30 lbs of luggage for each pilot

Source: SARLAT Tool

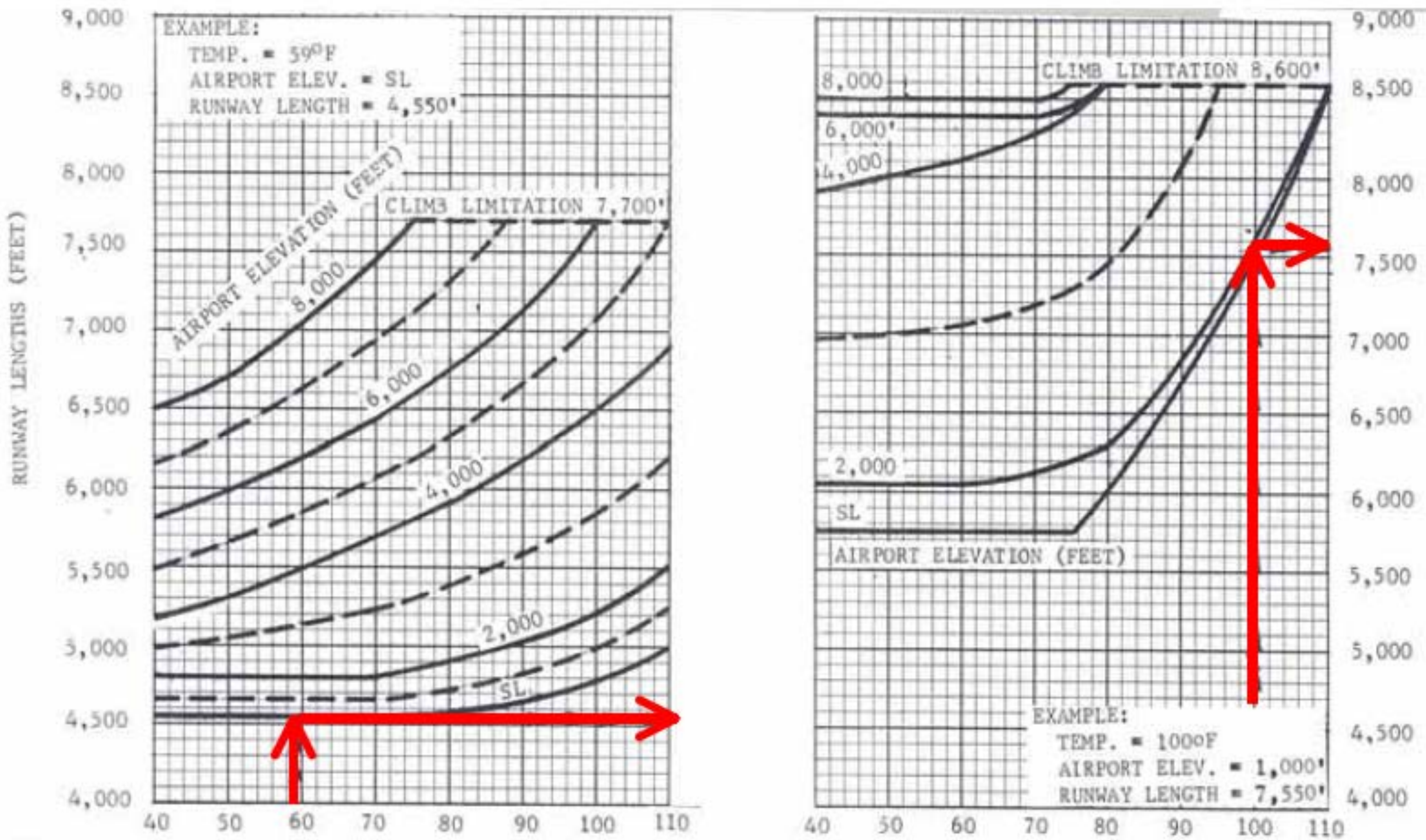
Passengers



Pilots + Baggage + Fuel

The Beechcraft King Air B350ER can fly 300 nm with 10 passengers, two pilots and fuel

Figure 3-1 75% of Fleet (60 and 90% Useful Load)

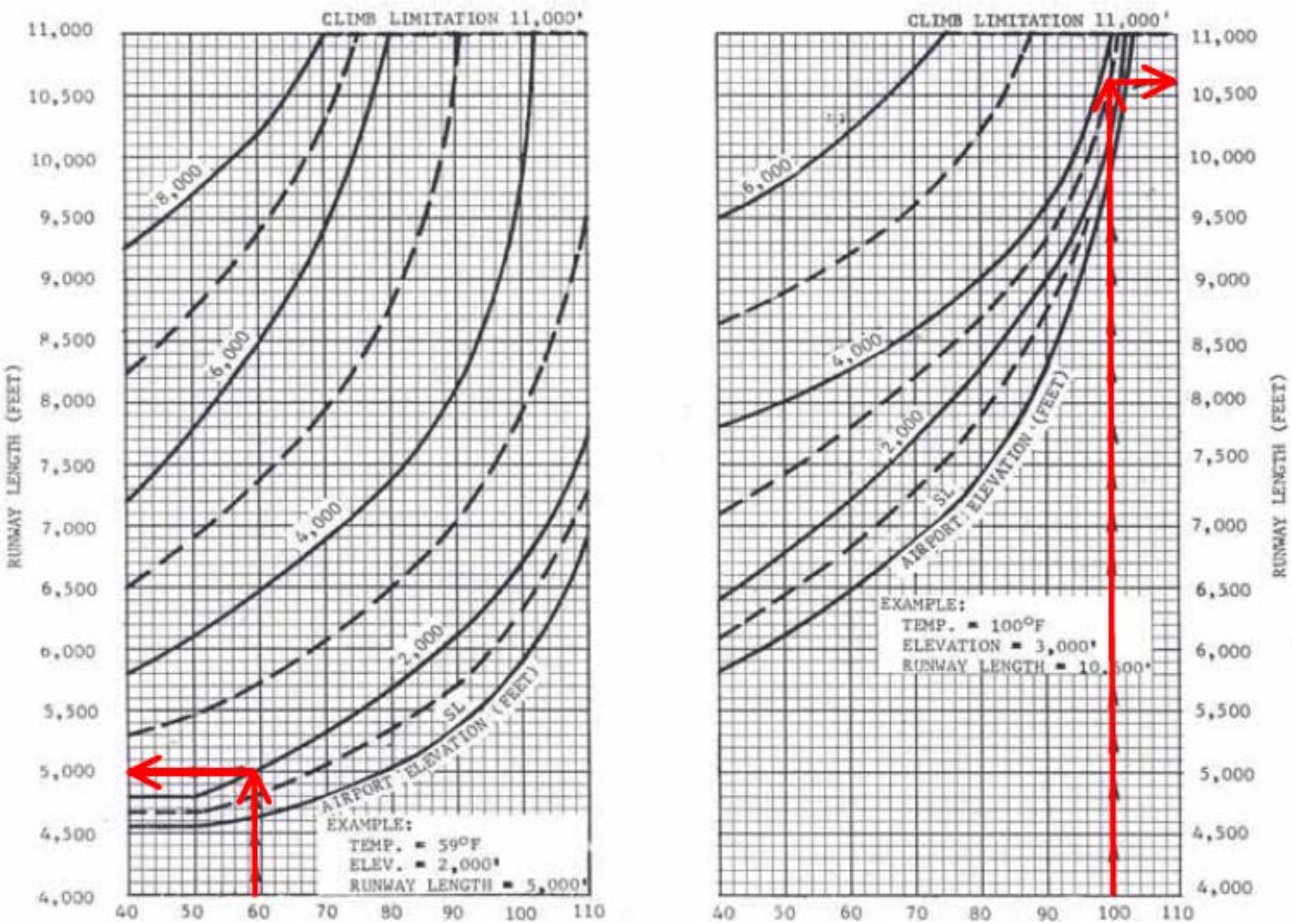


Mean Daily Maximum Temperature of Hottest Month of the Year in Degrees Fahrenheit

75 percent of feet at 60 percent useful load

75 percent of feet at 90 percent useful load

Figure 3-2 100% of Fleet (60 and 90% Useful Load)



Mean Daily Maximum Temperature of Hottest Month of the Year in Degrees Fahrenheit

100 percent of feet at 60 percent useful load

100 percent of feet at 90 percent useful load

Sample Aircraft in 75% of the Fleet

Manufacturer	Model	Manufacturer	Model
Aerospatiale	Sn-601 Corvette	Dassault	Falcon 10
Bae	125-700	Dassault	Falcon 20
Beech Jet	400A	Dassault	Falcon 50/50 EX
Beech Jet	Premier I	Dassault	Falcon 900/900B
Beech Jet	2000 Starship	Israel Aircraft Industries (IAI)	Jet Commander 1121
Bombardier	Challenger 300	IAI	Westwind 1123/1124
Cessna	500 Citation/501Citation Sp	Learjet	20 Series
Cessna	Citation I/II/III	Learjet	31/31A/31A ER
Cessna	525A Citation II (CJ-2)	Learjet	35/35A/36/36A

Aircraft for Figure 3-1

Source: FAA AC 150/5325-4b

Cessna Citation CJ2

Bombardier Learjet 31A

Sample Aircraft in the Remaining 25% of the Fleet

Manufacturer	Model
Bae	Corporate 800/1000
Bombardier	600 Challenger
Bombardier	601/601-3A/3ER Challenger
Bombardier	604 Challenger
Bombardier	BD-100 Continental
Cessna	S550 Citation S/II
Cessna	650 Citation III/IV
Cessna	750 Citation X
Dassault	Falcon 900C/900EX
Dassault	Falcon 2000/2000EX

Source: FAA AC 150/5325-4b

Aircraft for Figure 3-2

Aircraft MTOW > 12,500 lb. (5,670 kg) and less than 60,000 lb. (27,200 kg)

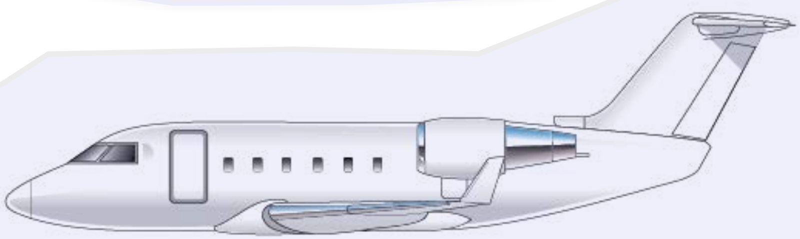
Aircraft for Figure 3-1

Beech King Air 350

Cessna Citation II (550)

Aircraft for Figure 3-2

Dassault Falcon 900c



Bombardier CL 601

Cessna Citation X (750)

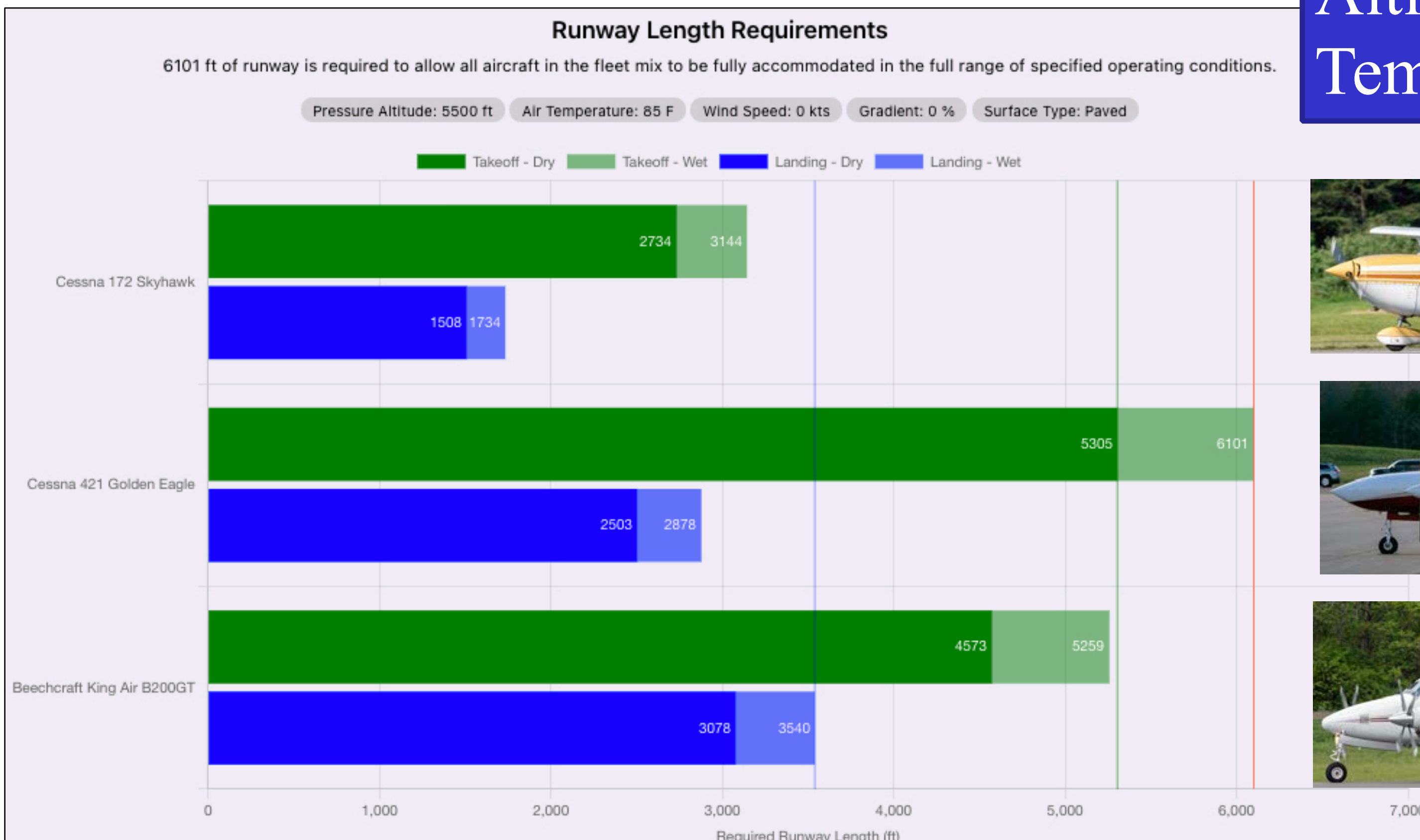
Runway Length Adjustments Small Aircraft MTOW > 12,500 lb (5,670 kg) and less than 60,000 lb (27,200 kg)

- Values shown in Figures 3-1 and 3-2 apply with zero wind conditions and dry runway pavements
- Effective gradient correction (takeoff case)
  - Increase runway length by 10 feet (3.05 meters) for every foot (0.305 meters) of runway elevation difference (low-high)
- Wet and slippery runway correction (landing case)
  - Increase values obtained using the 60% useful load by 15% (for turbojet powered aircraft) up to 5,500 feet whichever is less
  - Increase values obtained using the 90% useful load by 15% (for turbojet powered aircraft) up to 7,000 feet whichever is less

Final Note on Runway Length for Small Aircraft

- For high elevation airports, the performance of smaller aircraft below 12,500 lb may be critical
- Example analysis using the SARLAT tool.
- The Cessna 421C (piston-powered) is the critical aircraft

Altitude = 5,500 ft
Temp. 85 deg. F



Example: BCB Improvements

- Airport: BCB (Blacksburg)
- Issue: **Improve the airport to serve 75% of the aircraft population < 60,000 lbs and 60% of useful load**
  - Airport elevation = 2,132 feet
  - Mean daily maximum temperature of the hottest month of the year = 83 ^{o}F
  - Obtained from average high temperatures on the weather channel (or at NOAA)

Information about BCB Airport (source: www.airnav.com)

KBCB **Virginia Tech/Montgomery Executive Airport**
Blacksburg, Virginia, USA

GOING TO BLACKSBURG?

Reserve a Hotel Room

Rent a Car

FAA INFORMATION EFFECTIVE 15 JANUARY 2009

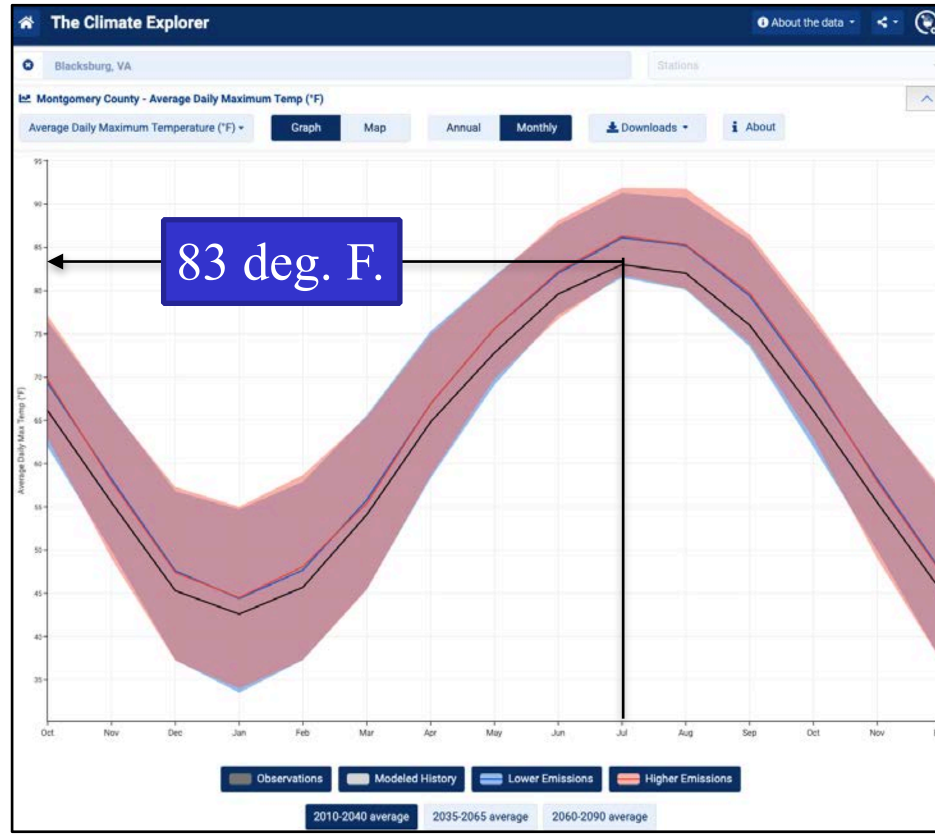
Location

FAA Identifier: BCB
Lat/Long: 37-12-27.5000N / 080-24-28.2000W
37-12.458333N / 080-24.470000W
37.2076389 / -80.4078333
(estimated)
Elevation: 2132 ft. / 649.8 m (surveyed)
Variation: 06W (1985)
From city: 3 miles S of BLACKSBURG, VA
Time zone: UTC -5 (UTC -4 during Daylight Savings Time)
Zip code: 24060

Satellite View of BCB Airport in Spring 2019 (source: Google Maps)

BCB Mean Maximum Daily Temperature Profiles

(source: www.weather.com)



https://crt-climate-explorer.nemac.org/climate_graphs/

BCB Runway Information in Spring 2019 (source: www.airnav.com)

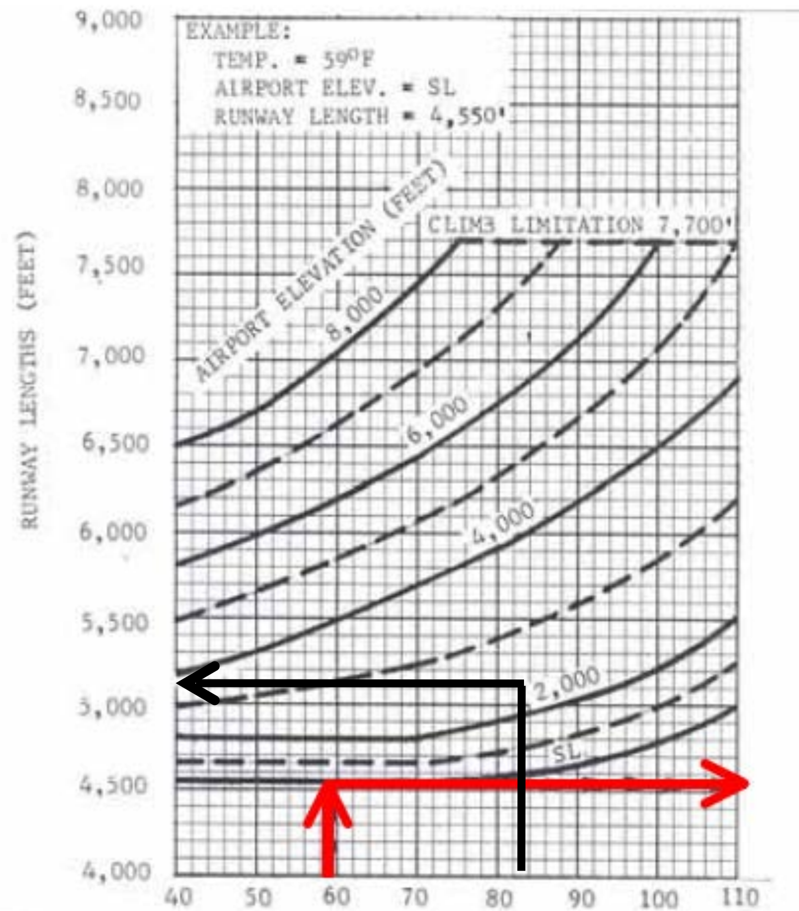
Runway Information

Runway 12/30

	RUNWAY 12	RUNWAY 30
Dimensions:	4539 x 100 ft. / 1383 x 30 m	
Surface:	asphalt, in fair condition	
Runway edge lights:	medium intensity	
Latitude:	37-12.629310N	37-12.287662N
Longitude:	080-24.886423W	080-24.054668W
Elevation:	2112.7 ft.	2131.7 ft.
Gradient:	0.4% UP	0.4% DOWN
Traffic pattern:	left	left
Runway heading:	123 magnetic, 117 true	303 magnetic, 297 true
Markings:	nonprecision, in fair condition	nonprecision, in fair condition
Visual slope indicator:	4-light PAPI on left (3.00 degrees glide path)	2-light PAPI on left (3.75 degrees glide path)
Approach lights:	ODALS: omnidirectional approach lighting system	NSTD
Runway end identifier lights:		yes
Touchdown point:	yes, no lights	yes, no lights
Instrument approach:	LOC/DME	
Obstructions:	24 ft. road, lighted, 600 ft. from runway, 309 ft. right of centerline, 16:1 slope to clear	12 ft. brush, 275 ft. from runway, 154 ft. right of centerline, 6:1 slope to clear

Runway Length Calculation

- Use Figure 3-1 and 60% useful load curve
- Recall: 75% of the GA and corporate jet population is served by this analysis
- **Runway length = 5,200 feet**



Mean daily maximum temperature °F

Runway Length Estimation (BCB) Corrections

- Effective gradient correction (takeoff case)
  - Increase runway length by 10 feet (3.05 meters) for every foot (0.305 meters) of runway elevation difference (low-high)
  - 0.4% grade implies a delta elevation of around 18 feet
  - **Increase Runway Length by 180 feet (or 5380 feet)**
- Wet and slippery runway correction (landing case)
  - Increase values obtained using the 60% useful load by 15% (for turbojet powered aircraft) up to 5,500 feet whichever is less
  - **Min (5980 feet, 5500 feet) = 5,500 feet**

Runway Improvement at BCB

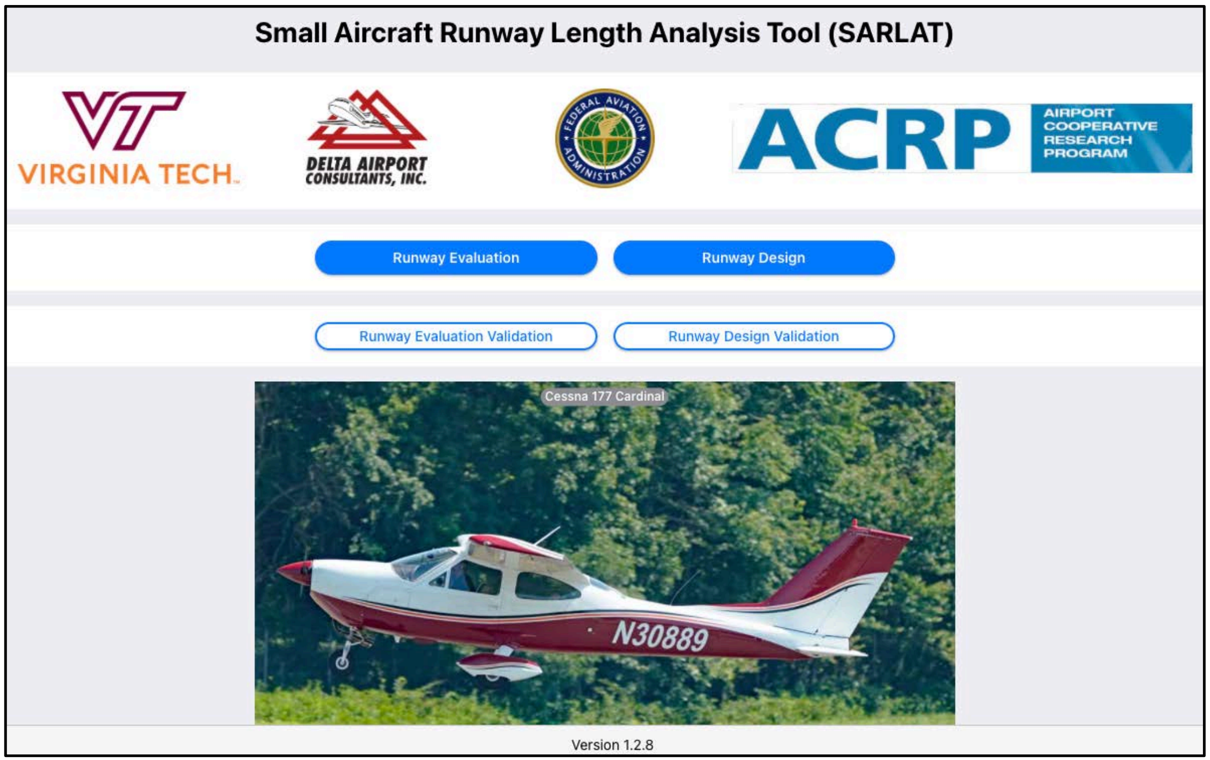
- BCB requires a **5,500 feet runway according to the design procedure**
- Accommodates 75% of the aircraft population below 60,000 lb at 60% useful load factor
- This improvement would better serve a higher population of corporate jets in the U.S.
- During football games many small corporate jets operate in and out of the airport

Blacksburg Montgomery Executive Airport (BCB) ramp during a football game

Satellite View of BCB Airport in Spring 2022 (source: Google Maps)

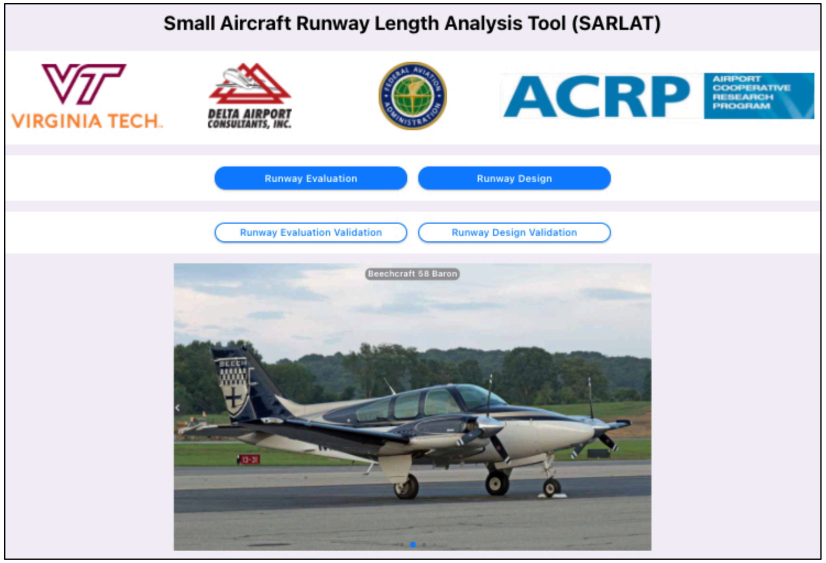
Small Aircraft Runway Analysis Tool (SARLAT)

Computer Software Tool to Estimate Runway length for Small Aircraft



New FAA Guidance for Airport Projects Requires Using the Small Aircraft Runway Length Analysis Tool (SARLAT)

- A computer program developed at the Virginia Tech Air Transportation Systems Laboratory
- SARLAT includes detailed runway performance data for forty two representative small aircraft
  - Includes business jets weighing up to 20,200 lbs
  - Includes dozens of single engine and multi-engine piston aircraft
  - Includes representative turboprop aircraft

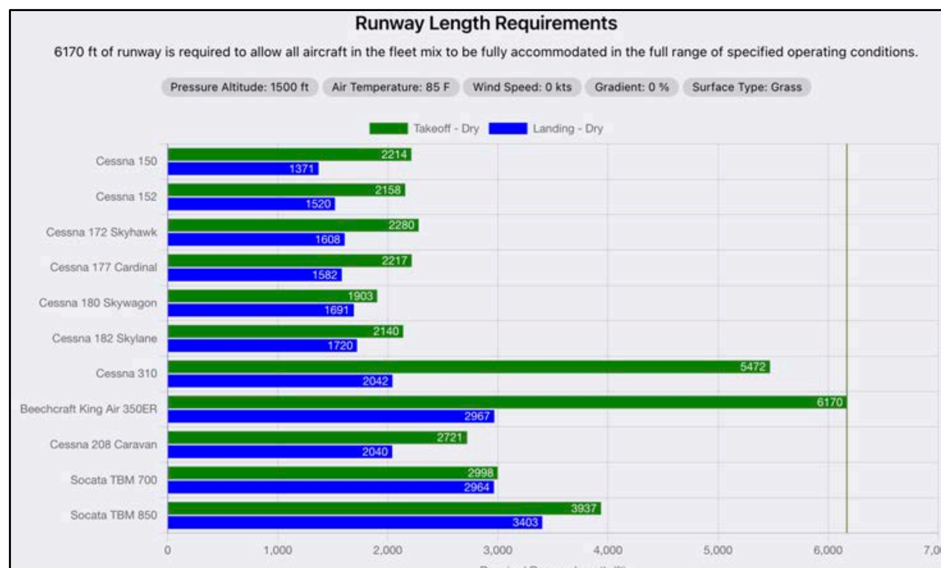


http://128.173.204.63/cee4674/cee4674_pub/SARLAT_Tool_UserGuide_128.pdf

Get the SARLAT User Guide at the link above

SARLAT Tool

- Stand-alone tool
- Consider individual aircraft performance
- Consider all airport design factors
  - Temperature
  - Wind conditions
  - Airport elevation
  - Aircraft climb limits (if applicable)
  - Aircraft useful load
- Produce runway length requirements for both takeoff and landing conditions



SARLAT uses Javascript and Matlab
Runs on Windows and Mac OS systems

Small Aircraft Runway Length Analysis Tool (SARLAT) for Windows Operating System

Step 1: Download the Small Aircraft Runway Length Analysis Tool (SARLAT) setup file from:

Windows: https://atsl-software-downloads.s3.amazonaws.com/sarlat/V1.2.8/SARLAT-1.2.8+Setup.exe

Step 2: Locate the downloaded file on your hard drive folder

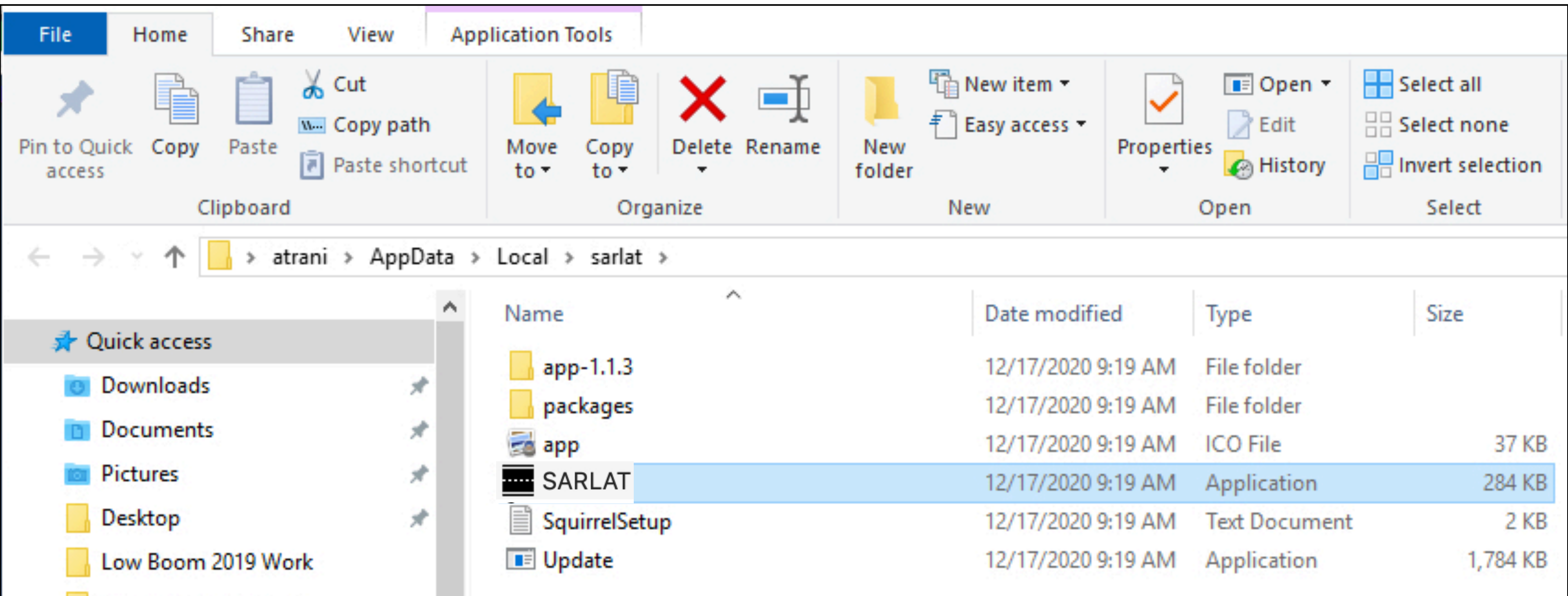
SARLAT-1.2.8+Setup.exe

Step 3: Install the application

Double click on the **SARLAT-1.2.8+Setup.exe** file

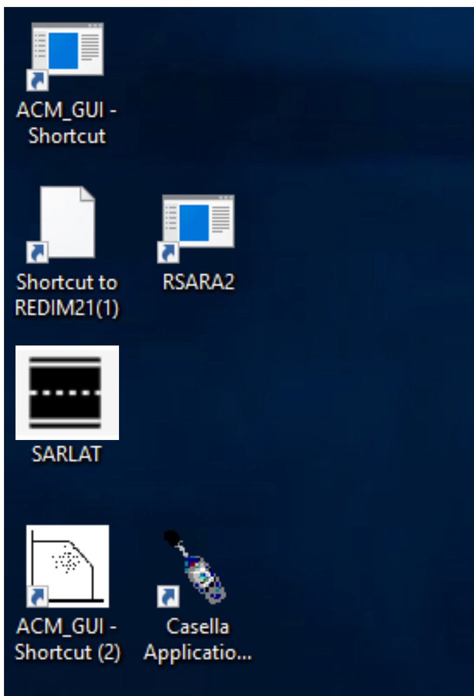
Small Aircraft Runway Length Analysis Tool (SARLAT) for Windows Operating System (2)

- SARLAT is usually installed in your local drive under the name SARLAT
- The example shows SARLAT installed in the **user/AppData/local folder**



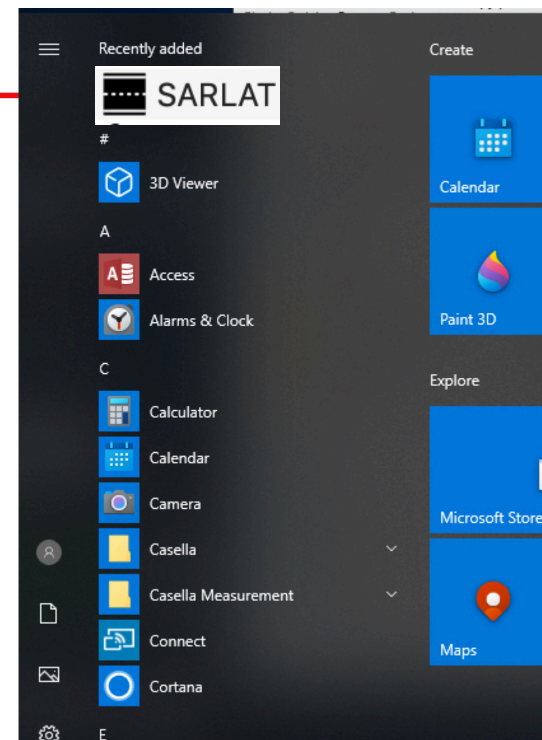
Small Aircraft Runway Length Analysis Tool (SARLAT) for Windows Operating System (3)

- After installation, SARLAT creates an icon on the desktop automatically
- To run the application again, use the icon on the desktop



Small Aircraft Runway Length Analysis Tool Application icon installed on the Desktop

SARLAT can be executed from the **Applications Panel** in Windows



Small Aircraft Runway Length Analysis Tool (SARLAT) for Mac Operating System

Step 1: Download the Small Aircraft Runway Length Analysis Tool (SARLAT) setup file from:

Mac: https://atsl-software-downloads.s3.amazonaws.com/sarlat/V1.2.8/SARLAT-1.2.8-x64.dmg

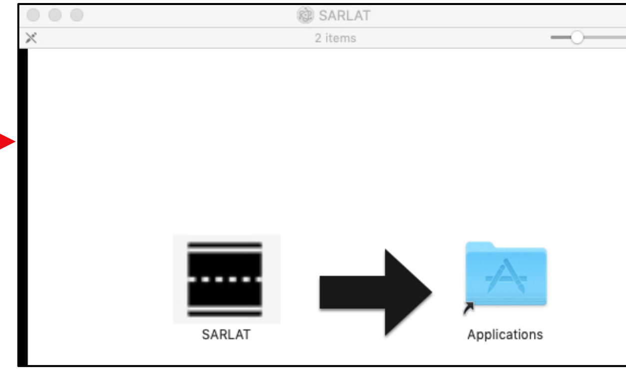
Step 2: Locate the downloaded file on your hard drive folder. The file is an Apple Disk Image file called **SARLAT-1.2.8.dmg**

Step 3: Install the application

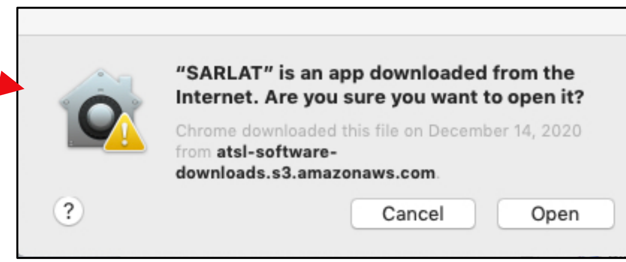
Double click on the **SARLAT-1.2.8.dmg** file on the Mac OS

Small Aircraft Runway Length Analysis Tool (SARLAT) for Mac Operating System (2)

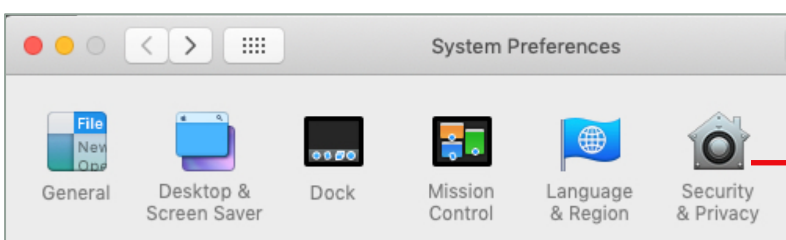
Step 4: Drag the SARLAT application icon to your Applications Folder

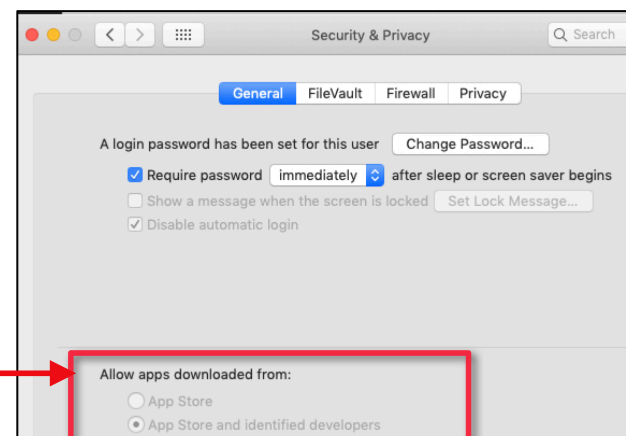


Step 5: Click **Open** in the security warning allowing the SARLAT application to run in your computer



Step 6: If necessary, allow the SARLAT application dialog in the **Security & Privacy** inside the **Systems Preferences**





Small Aircraft Runway Length Analysis Tool (SARLAT) for Mac Operating System (3)

- After installation, the SARLAT Application resides in the Applications Folder in your computer

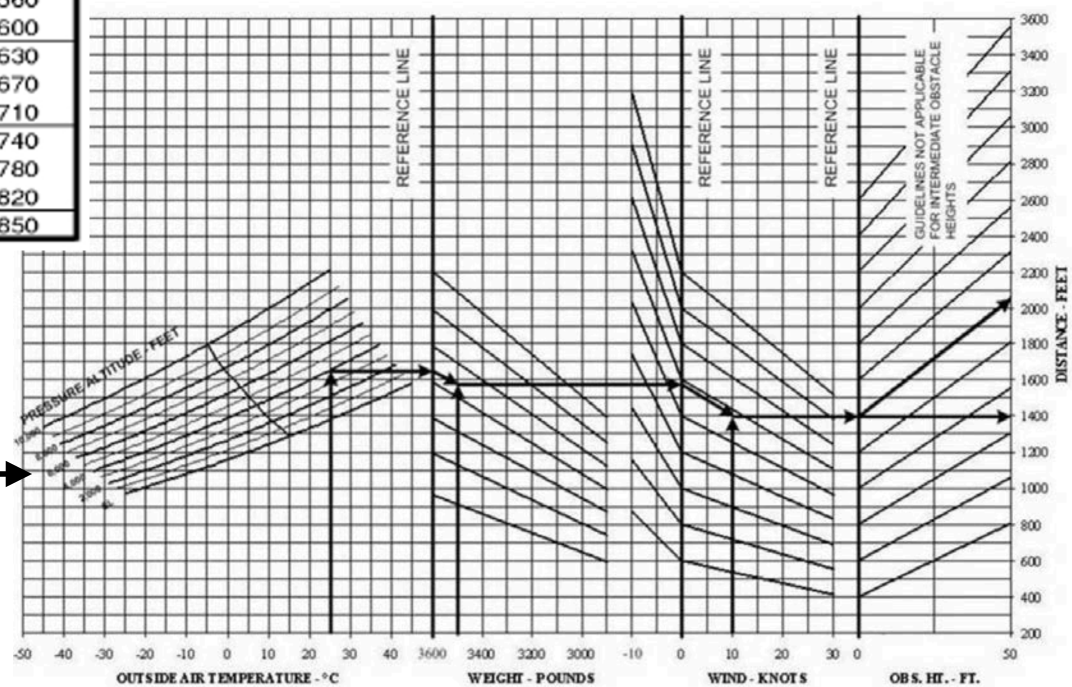
- Double click in there SARLAT icon to run the application
- You can create a shortcut by dragging the SARLAT Application icon to the computer task bar

SARLAT Application Icon

SARLAT : Data Gathering and Analysis

TEMP DEG C	WEIGHT = 16500 POUNDS VREF = 111 KIAS		VAPP = 117 KIAS		
	TAILWIND 10 KTS	ZERO WIND	HEADWINDS 10 KTS	HEADWINDS 20 KTS	HEADWINDS 30 KTS
–25	3290	2760	2600	2450	2300
–20	3330	2790	2640	2490	2340
–15	3370	2830	2680	2520	2370
–10	3410	2870	2710	2560	2410
–5	3450	2910	2750	2600	2450
0	3490	2950	2790	2640	2490
5	3540	2990	2830	2670	2520
10	3580	3030	2870	2710	2560
15	3620	3070	2910	2750	2600
20	3660	3110	2950	2790	2630
25	3710	3150	2990	2830	2670
30	3750	3190	3020	2860	2710
35	3790	3230	3060	2900	2740
40	3830	3270	3100	2940	2780
45	3870	3310	3140	2980	2820
50	3910	3340	3180	3010	2850

Cessna Citation 560XL



Columbia 400

SARLAT : Translate Data Into a Common Graphical Format

Cessna Citation Jet 3 Data

Climb Limits Considered

Elevation = Sea Level								
Ambient Temp °C / °F	Takeoff Weight (lb)							
	13,870	13,400	13,000	12,500	12,000	11,500	11,000	10,000
10 / 50	3,130	2,940	2,820	2,700	2,580	2,570	2,580	2,640
15 / 59	3,180	2,990	2,870	2,740	2,620	2,600	2,610	2,670
20 / 68	3,230	3,040	2,910	2,780	2,660	2,630	2,650	2,710
25 / 77	3,290	3,090	2,960	2,820	2,700	2,660	2,680	2,740
30 / 86	3,440	3,230	3,070	2,900	2,770	2,640	2,630	2,680
35 / 95	3,690	3,460	3,280	3,060	2,860	2,720	2,600	2,570
40 / 104	4,030	3,740	3,530	3,290	3,070	2,850	2,680	2,450
45 / 113	4,480	4,130	3,850	3,540	3,290	3,060	2,840	2,510
50 / 122	5,050	4,610	4,280	3,900	3,550	3,280	3,040	2,600
55 / 131	—	5,180	4,770	4,310	3,910	3,550	3,240	2,760
Climb Wght Temp Limits °C/°F	54/129	55/131	55/131	55/131	55/131	55/131	55/131	55/131
Field Length at Temp Limits (ft)	5,580	5,180	4,770	4,310	3,910	3,550	3,240	2,760

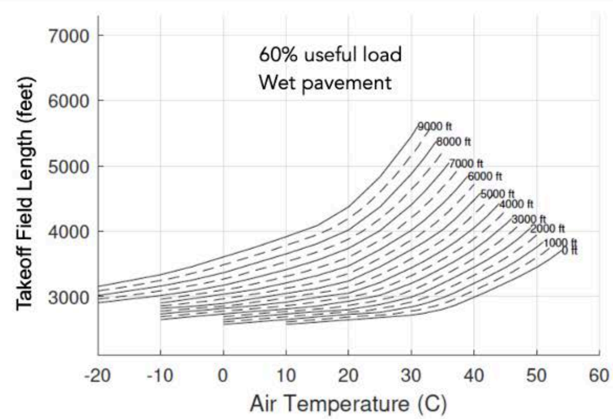
Elevation = 3,000 Feet								
Ambient Temp °C / °F	Takeoff Weight (lb)							
	13,870	13,400	13,000	12,500	12,000	11,500	11,000	10,000
-10 / 14	3,220	3,030	2,910	2,780	2,660	2,640	2,660	2,720
0 / 32	3,330	3,130	3,010	2,870	2,750	2,720	2,740	2,800
10 / 50	3,470	3,260	3,110	2,980	2,840	2,780	2,790	2,850
15 / 59	3,610	3,390	3,220	3,040	2,910	2,780	2,770	2,810
20 / 68	3,760	3,530	3,340	3,120	2,980	2,840	2,740	2,780
25 / 77	4,000	3,740	3,540	3,300	3,080	2,920	2,780	2,700
30 / 86	4,330	4,010	3,790	3,530	3,290	3,050	2,870	2,600
35 / 95	4,800	4,420	4,110	3,800	3,530	3,280	3,040	2,680
40 / 104	5,450	4,970	4,610	4,200	3,830	3,540	3,270	2,800
45 / 113	—	5,650	5,190	4,690	4,250	3,850	3,510	2,990
Climb Wght Temp Limits °C/°F	44/111	47/117	47/117	47/117	47/117	47/117	47/117	47/117
Field Length at Temp Limits (ft)	6,080	5,980	5,470	4,920	4,440	4,010	3,640	3,070

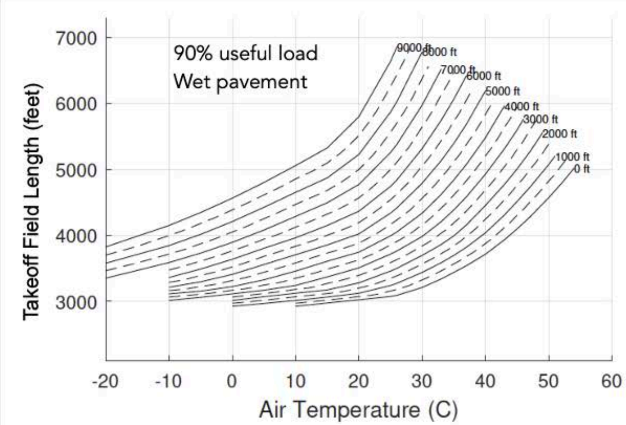
Intermediate Step

	A	B	C	D	E	F	G	H	I	J	K	L
1		-20	-10	-5	0	5	10	15	20	24	25	27
2	0						3130	3180	3230	3274	3290	3337
3	1000				3120	3176	3230	3280	3340	3429	3460	3539
4	2000				3230	3274	3330	3400	3520	3666	3710	3803
5	3000		3220	3271	3330	3391	3470	3610	3760	3945	4000	4118
6	4000		3330	3369	3440	3557	3710	3870	4050	4282	4350	4491
7	5000		3440	3529	3650	3810	3990	4180	4380	4664	4750	4937
8	6000		3600	3751	3920	4110	4320	4530	4780	5099	5200	5439
9	7000	3580	3860	4038	4240	4460	4690	4920	5240	5659	5790	6100
10	8000	3840	4180	4380	4600	4840	5100	5360	5760	6343	6520	6930
11	9000	4150	4530	4750	5010	5280	5570	5880	6450	7560		

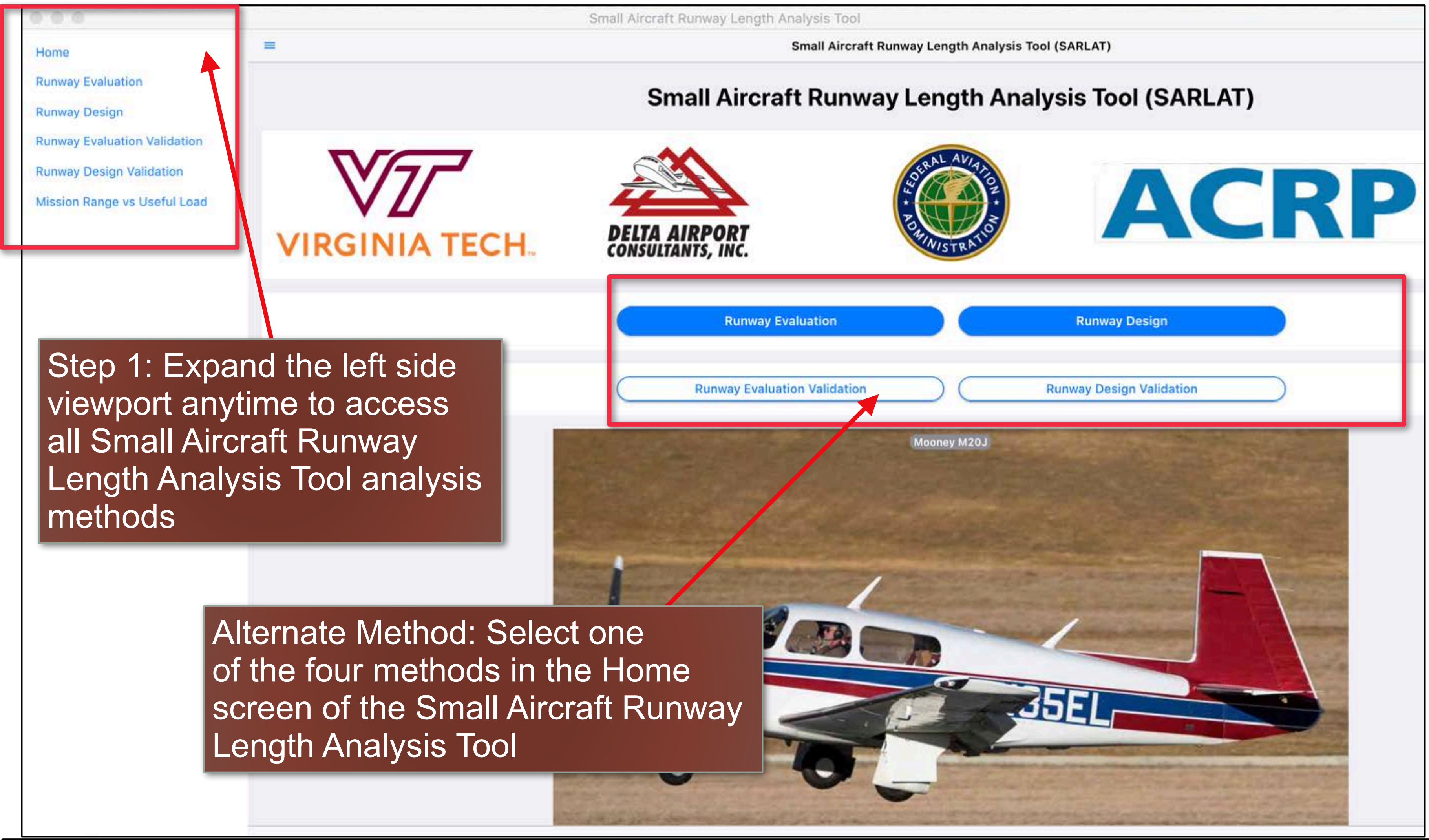
	M	N	O	P	Q	R	S	T	U	V	W
1	30	31	34	35	37	40	41	44	45	48	50
2	3440	3480	3633	3690	3813	4030	4110	4381	4480	4809	5050
3	3690	3740	3904	3970	4130	4420	4521	4850	4970	5365	5650
4	3970	4034	4263	4350	4547	4890	5011	5407	5550	6030	
5	4330	4411	4693	4800	5038	5450	5597	6080			
6	4740	4839	5197	5330	5617	6110	6300				
7	5270	5394	5822	5980	6340						
8	5880	6041	6590								
9	6670	6890									
10											
11											

Final Presentation In SARLAT





SARLAT : Model Integration and Graphic User Interface



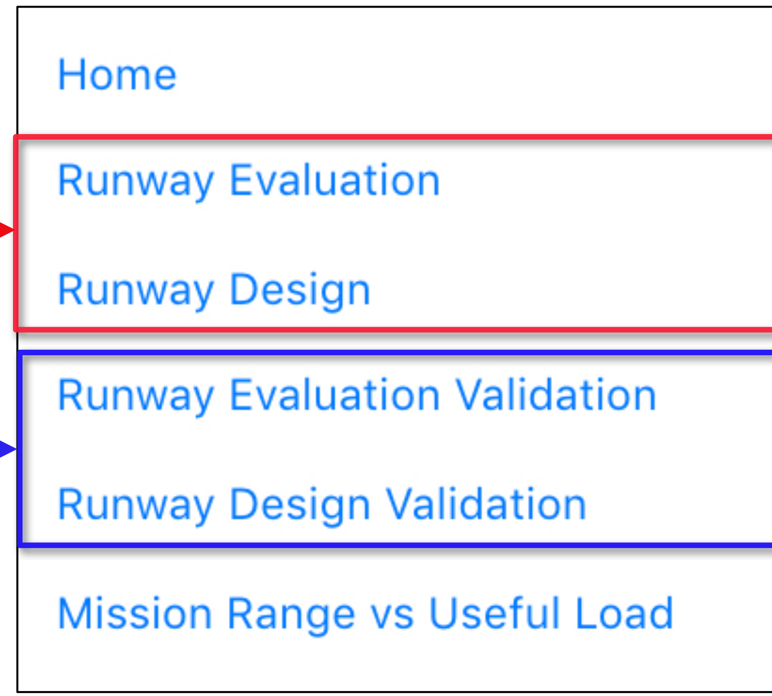
Step 1: Expand the left side viewport anytime to access all Small Aircraft Runway Length Analysis Tool analysis methods

Alternate Method: Select one of the four methods in the Home screen of the Small Aircraft Runway Length Analysis Tool

General Information About the Model

The Small Aircraft Runway Length Analysis Tool has **four modes of operation described below:**

- **Analysis modes:**
  a) Evaluation of an existing runway
  b) Design of a new runway
- **Validation modes:**
  a) Evaluation of an existing runway
  b) Design of a new runway



- Use the **Analysis Modes** to evaluate or design a new runway
- Use the **Validation Modes** to validate and visualize the runway performance of individual aircraft for a set of airport conditions

Runway Evaluation Mode

- **Objective:**
  - To evaluate if a given **aircraft fleet can operate at the existing airport**
- **Output Produced**
  - Suitability of each aircraft to operate at the airport
    - Takeoff distances (dry and wet)
    - Landing distances (dry, wet, Part 135 dry, and Part 135 wet)
  - Aircraft useful load for the given runway length available and airport conditions

Runway Evaluation Mode

Step 1: Select Runway Evaluation mode

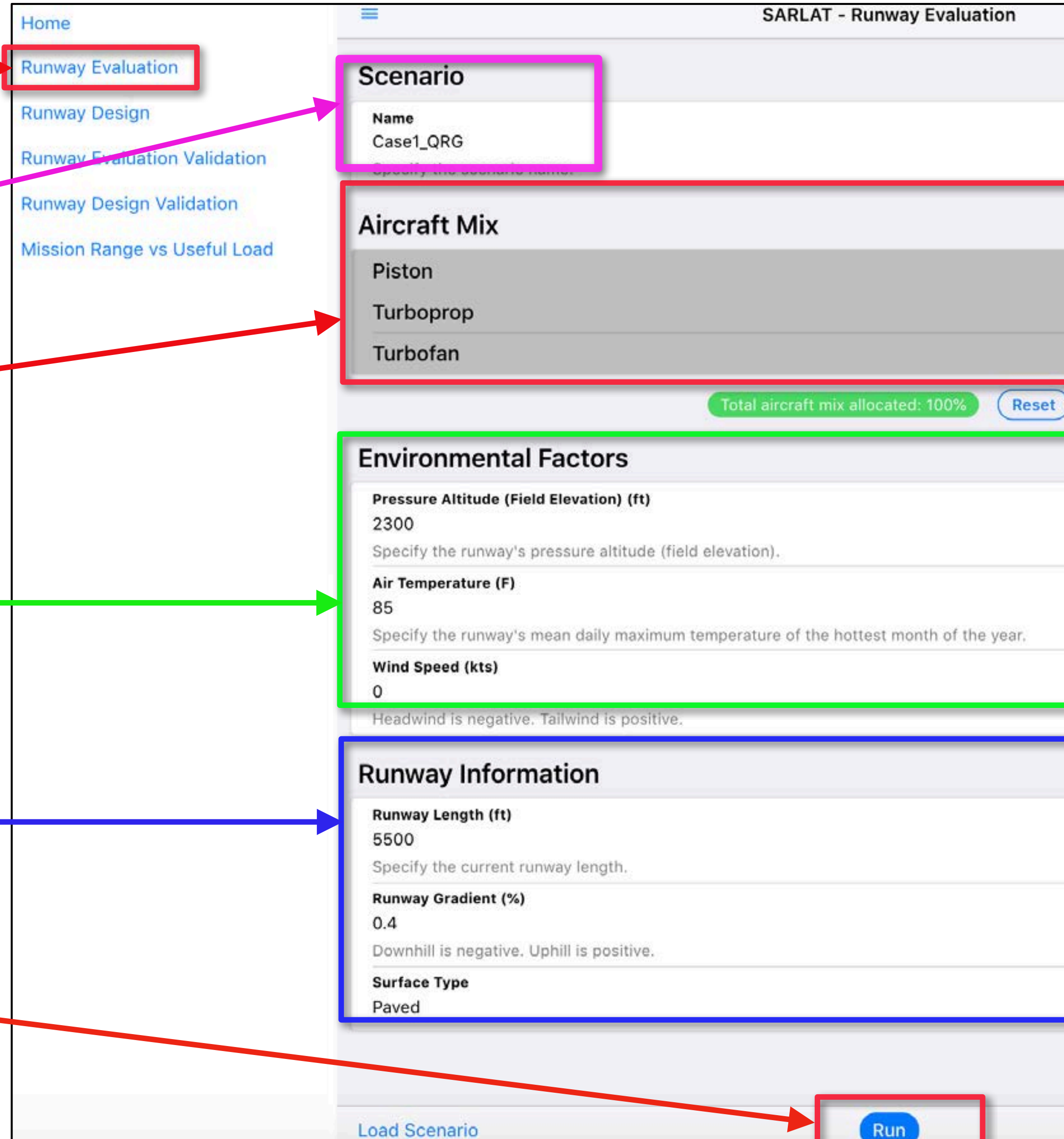
Step 2: Select a scenario name

Step 3: Select the aircraft using the airport and enter the fleet mix (expandable list)

Step 4: Enter the airport environmental conditions

Step 5: Enter the runway information

Step 6: Run the case



Runway Evaluation Mode

Evaluation Conditions

- Pressure altitude = 2,300 feet
- Runway length = 5,500 feet
- Design temperature = 85 deg. F.
- Runway gradient = 0.4%
- Surface = paved

Runway Evaluation Conditions

Landing Suitability Table Includes 14 CFR Part 135 Landing Checks

Takeoff Weights and Useful Load Constraints

Case1_QRG

Runway Takeoff and Landing Restrictions

Pressure Altitude: 2300 ft | Air Temperature: 85 F | Wind Speed: 0 kts | Runway Length: 5500 ft | Gradient: 0.4 % | Surface Type: Paved

Aircraft Name	Aircraft Mix	Takeoff Weight (Useful Load)		Landing at Maximum Landing Weight					
				No Correction		Part 135 Eligible		Part 135	
		Dry	Wet	Dry	Wet	Dry	Wet	Dry	Wet
Piston									
Beechcraft 58 Baron	40%	5400 lbs 100 %	5400 lbs 100 %	✓	✓				
Cessna 172 Skyhawk	30%	2300 lbs 100 %	2300 lbs 100 %	✓	✓				
Turboprop									
Beechcraft King Air 350ER	10%	14932 lbs 74 %	12872 lbs 41 %	✓	✓			✓	✓
Jet									
Cessna 560 XL	20%	20200 lbs 100 %	19841 lbs 95 %	✓	✓	✓	✓	✗	✗

Export table to Excel

Copy table to Clipboard

Mission Range vs. Useful Load Tradeoff (Case 1)

Evaluation Conditions

Pressure altitude = 2,300 feet
Runway length = 5,500 feet
Design temperature = 85 deg. F.
Runway gradient = 0.4%
Surface = paved

Provides information to translate useful load to mission range

Output for Case 1 (King Air 350ER)

		Takeoff Weight (Useful Load)	
		Dry	Wet
Turboprop			
Beechcraft King Air 350ER	10%	14932 lbs 74 %	12872 lbs 41 %

- Home
- Runway Evaluation
- Runway Design
- Runway Evaluation Validation
- Runway Design Validation
- Mission Range vs Useful Load

Select the Mission Range Document Link

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

All values in the table assume two pilots and 30 lbs of luggage for each pilot

The Beechcraft King Air 350ER can takeoff at 74% useful load in dry runway conditions.
The King Air B350ER can fly 10 passengers 600 nm with useful load of 74%.
The King Air B350ER is limited to 41% useful load (can take 10 passengers for less than 100 nm).

Runway Evaluation Output (Case 1)

Evaluation Conditions

Pressure altitude = 2,300 feet
Runway length = 5,500 feet
Design temperature = 85 deg. F.
Runway gradient = 0.4%
Surface = paved

Export table to Excel | Copy table to Clipboard

Aircraft Name	FAA Type Designator	Engine Type	Aircraft Design Group (ADG)	Aircraft Approach Category (AAC)	Weight Category	Operating Empty Weight (OEW)
Piston						
Beechcraft 58 Baron	BE58	Piston	I	B	T	4000 lbs
Cessna 172 Skyhawk	C172	Piston	I	A	S	1419 lbs
Turboprop						
Beechcraft King Air 350ER	B350	Turboprop	II	B	L	10385 lbs
Pilatus PC 12 NG	PC12	Turboprop	II	B	S	6173 lbs
Socata TBM 700	TBM7	Turboprop	I	A	S	4050 lbs

Export results to Excel or to the clipboard

Aircraft table with general information about each aircraft

Aircraft grouped in three engine categories

Runway Design Mode

Step 1: Select Runway Design mode

Step 2: Name your scenario

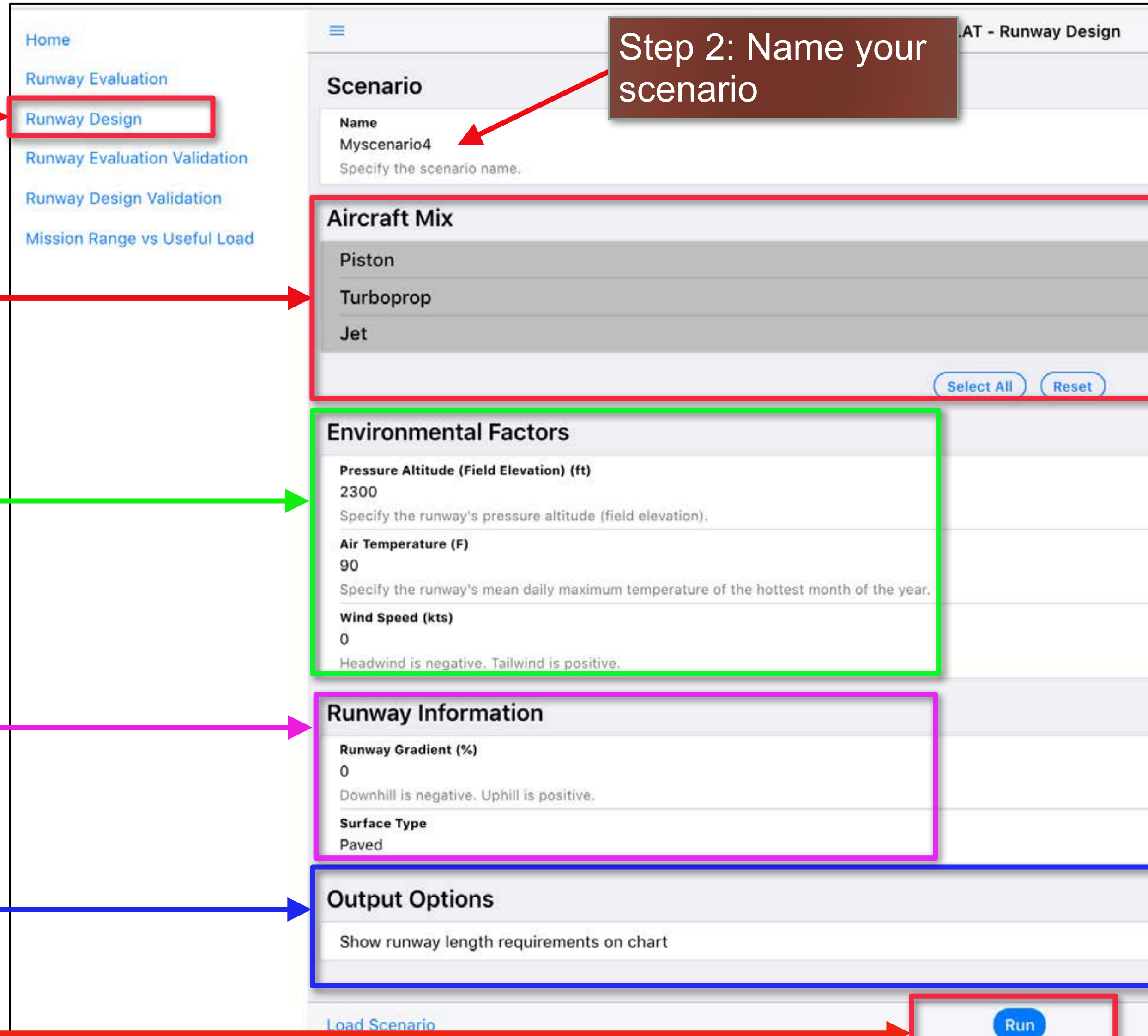
Step 3: Select the aircraft to be considered in the runway design

Step 4: Enter the airport environmental conditions

Step 5: Enter the runway grade and surface

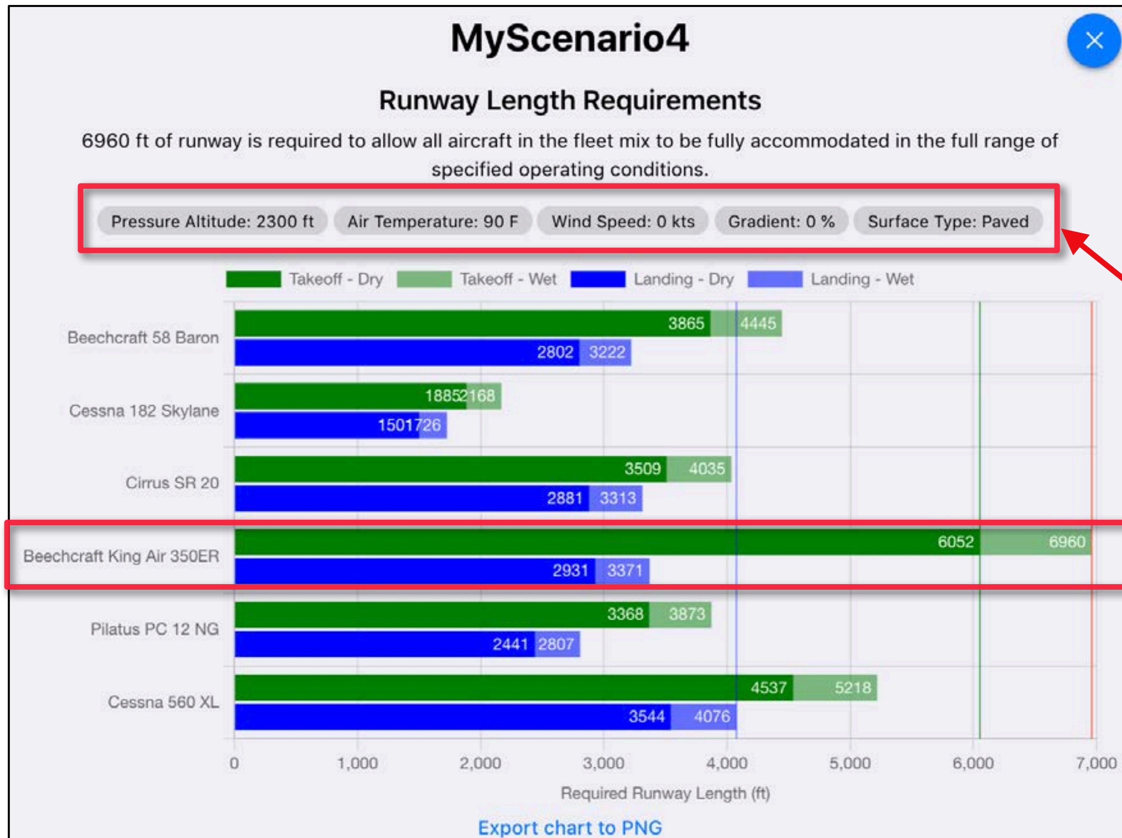
Step 6: Select the output options

Step 7: Run the case



Runway Design Mode Output

Design Conditions	Pressure altitude = 2,300 feet Design temperature = 90 deg. F. Useful load = 90% turbofan and turboprop, 100% for piston Wind speed = 0 knots Runway gradient = 0%



- The Beechcraft King Air B350ER is the critical aircraft

Runway Design Conditions

6,960-foot runway needed (wet pavement)
6,052-foot runway needed (dry pavement)

Runway Design Output (1)

Design Conditions	
	Pressure altitude = 2,300 feet Design temperature = 90 deg. F. Useful load = 90% jets, 100% others Wind speed = 0 knots Runway gradient = 0%

Aircraft Name	Useful Load (%)	Takeoff (ft)		Landing (ft)					
				No Correction		Part 135 Eligible		Part 135	
		Dry	Wet	Dry	Wet	Dry	Wet	Dry	Wet
Piston									
Beechcraft 58 Baron	100	3865	4445	2802	3222				
Cessna 182 Skylane	100	1885	2168	1501	1726				
Turboprop									
Beechcraft King Air 350ER	60	5120	5888	2931	3371			4191	4820
Pilatus PC 12 NG	90	3368	3873	2441	2807				
Jet									
Cessna 560 XL	90	4537	5218	3544	4076				

Takeoff distance output

Landing distance output

Runway Evaluation Validation Mode

- **Objective:**
  - Provides a graphical representation of aircraft takeoff weight and runway length required for various design parameters (temperature, runway grade, and wind speed)
- **Output Produced**
  - Plot of runway length versus takeoff weight

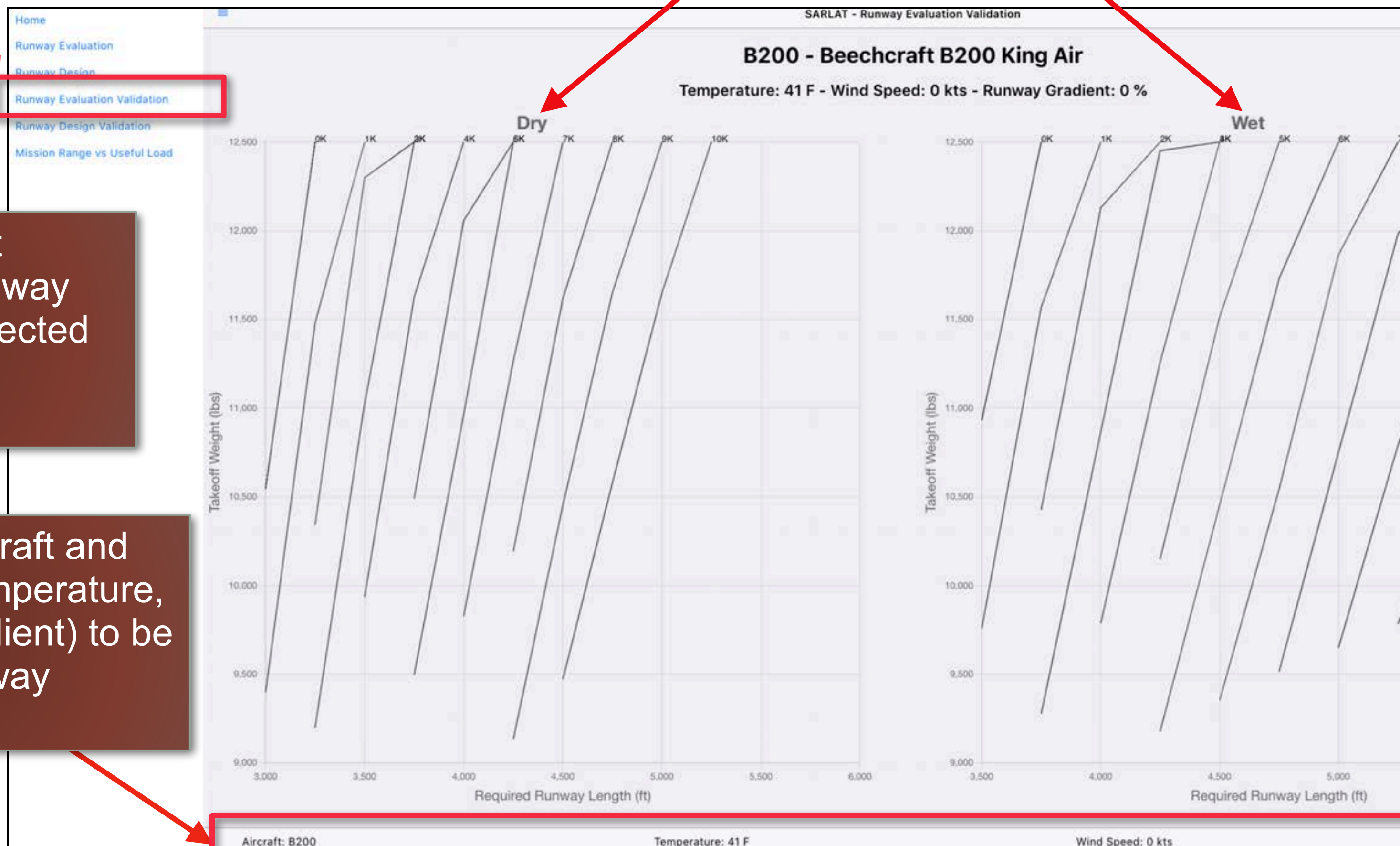
Runway Evaluation Validation Mode

Step 1: Select Runway Evaluation Validation mode

Dry and Wet pavement conditions are reported

Plot shows the aircraft takeoff weight and runway length required for selected airport environmental conditions

Step 2: Select the aircraft and airport conditions (Temperature, Wind Speed and Gradient) to be considered in the runway evaluation.



Runway Design Validation Mode

- **Objective:**
  - Provides a graphical representation of aircraft takeoff weight and runway length required for various design parameters (temperature, runway grade, and useful load
- **Output Produced**
  - Plot of runway length versus takeoff weight

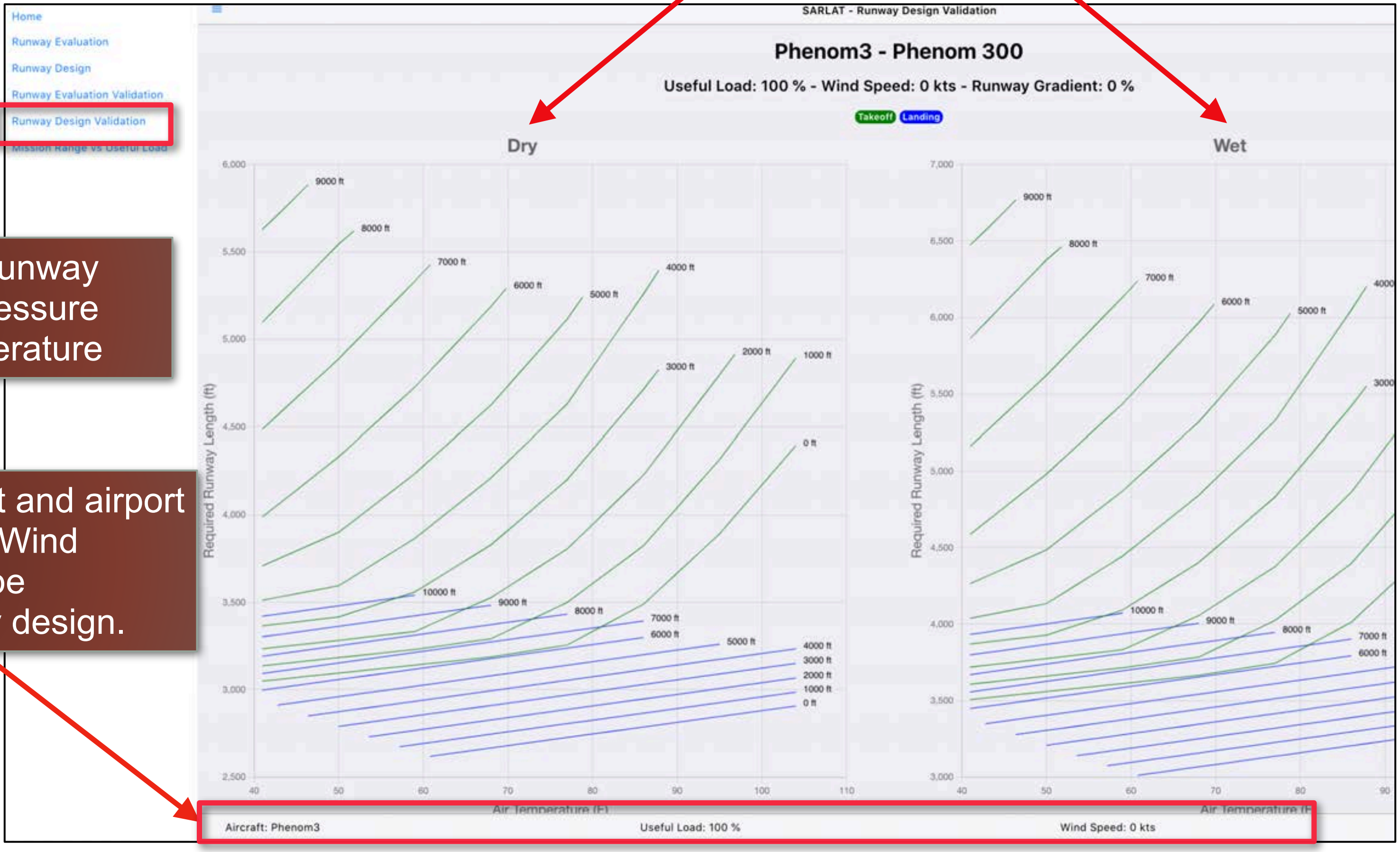
Runway Design Validation Mode

Dry and Wet pavement conditions are reported

Step 1: Select Runway Design Validation mode

Plot shows the required runway length as a function of pressure altitude and airfield temperature

Step 2: Select the aircraft and airport conditions (Useful Load, Wind Speed and Gradient) to be considered in the runway design.



SARLAT Design Limits

Parameter	Lower Limit	Upper Limit	Remarks
Temperature (deg. Fahrenheit)	41	104	
Pressure Altitude (feet)	0	None	Most aircraft performance data is reported to 8,000 feet altitude
Wind (knots)	-10	5	Headwind is negative
Runway Gradient (%)	0	2	Assumes both runway ends of the runway are used (uphill is positive)
Runway Surface Conditions	Dry, Wet, Grass*, and Gravel*		

* Only for selected aircraft with such data in the Pilot Operating Handbook

SARLAT Reports the Following Data

- For turbofan and turboprop aircraft weighing 12,500 lbs or more, we report **Accelerate and Stop Distance (ASD)**
- For turboprop aircraft weighing less than 12,500 lbs, we report **Takeoff Distance to Clear a 50-foot Obstacle**
- For multi-engine, piston-powered aircraft, we report **Accelerate and Stop Distance (ASD*)**
- For single engine piston-powered aircraft, we report **Takeoff Distance to Clear a 50-foot Obstacle**

* For AIP projects, use the takeoff charts included in Appendix D comparing takeoff and accelerate-stop-distance for twin-engine piston aircraft.

* Twin engine, piston-powered aircraft are 5-15 times more prone to engine failures compared to twi-engine turboprops.

Providing Feedback to Improve the SARLAT Tool

- We welcome your feedback
- Please contact:

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Air Transportation Systems Lab

or

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Director
Air Transportation Systems Lab