

## Assignment 5: Declared Distances and Runway Separations

### Solution

#### Problem 1

Examine the runway configuration presented in Figure 1. The runway is 7,100 feet long and is located at an elevation of 2,400 feet. The runway has a slope of 0.5%. Use the declared distance concept to answer the following questions.

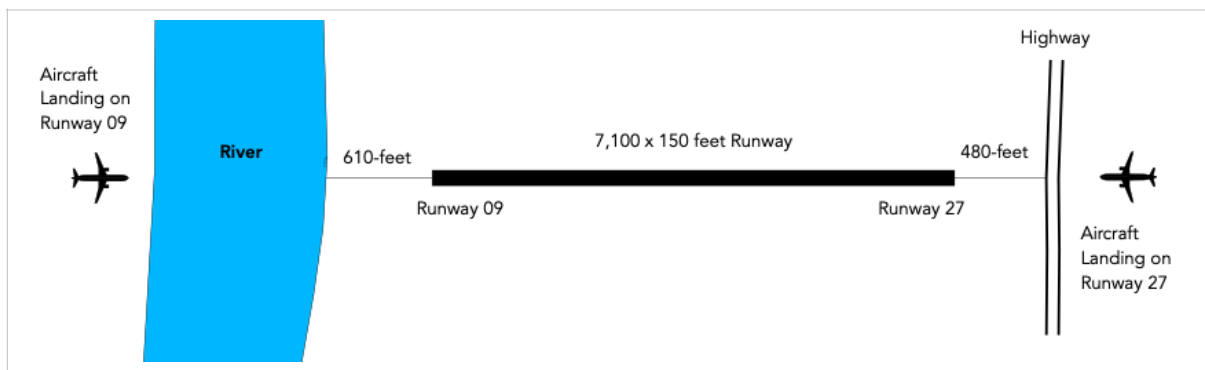


Figure 1. The Geometry of Runway for Problem 1.

- a) For aircraft landing on runway 27, find the landing distance available (LDA) if the runway safety area is to be protected on the landing threshold 27 and the opposite end (runway 09). Clearly state your assumptions.

- Assumption: Gulfstream 450 is the critical aircraft.

AAC: D

ADG: II

- RSA required prior to the threshold of runway 27 = 600 ft
- RSA required beyond the departure end of runway 27 = 1,000 ft

Therefore,

- The runway 27 requires a displaced threshold of 120 feet. Calculation:  $600 \text{ ft} - 480 \text{ ft} = 120 \text{ ft}$ .
- An aircraft landing on runway 27 requires a 1,000-foot RSA protection at runway end 09 (to protect against overruns while landing on runway 27). This implies that 390 feet of the runway are not usable for LDA. Calculation:  $1,000 \text{ ft} - 610 \text{ ft} = 390 \text{ ft}$
- $600 \text{ ft} - 480 \text{ ft} = 120 \text{ ft}$
- $1,000 \text{ ft} - 610 \text{ ft} = 390 \text{ ft}$
- $7,100 \text{ ft} - 120 \text{ ft} - 390 \text{ ft} = 6,590 \text{ ft}$

#### Runway Protection

##### Runway Safety Area (RSA)

Main: C/D/E - II

RSA Dimension	DIM (1)	Visual	Not Lower than 1 Mile	Not Lower than 3/4 Mile	Lower than 3/4 Mile
Length beyond departure end (9,10)	R	1,000 ft	1,000 ft	1,000 ft	1,000 ft
Length prior to threshold (11)	P	600 ft	600 ft	600 ft	600 ft
Width (13)	C	500 ft	500 ft	500 ft	500 ft

Therefore, the LDA such that the RSA requirement is satisfied is **6,590 ft**.

- b) Find the landing distance available for aircraft landing on runway 09. Assume complete protection of the runway safety area on the landing threshold 09 and the opposite end (runway 27). Comment on any difference with part (a).
- 610 ft before runway 09 is enough to cover the RSA (600 ft of length prior to threshold) required for the critical aircraft.

Therefore, runway 09 end displacement for arrivals will be  $1,000 \text{ ft} - 480 \text{ ft} = 520 \text{ ft}$

- $1,000 \text{ ft} - 480 \text{ ft} = 520 \text{ ft}$
- $7,100 \text{ ft} - 520 \text{ ft} = 6,580 \text{ ft}$

Therefore, the LDA is **10 feet less than the LDA in part (a)**.

- c) Find the accelerate-stop distance available (ASDA) for aircraft departing runway 27. Assume complete protection of the runway safety areas during the abort maneuver.
- If the aircraft departs from runway 27, it requires at least 1,000 feet of length beyond the departure end. The available length at the end of runway 27 is 610 feet, leaving a need for an additional 390 feet from the 7,100 ft runway.

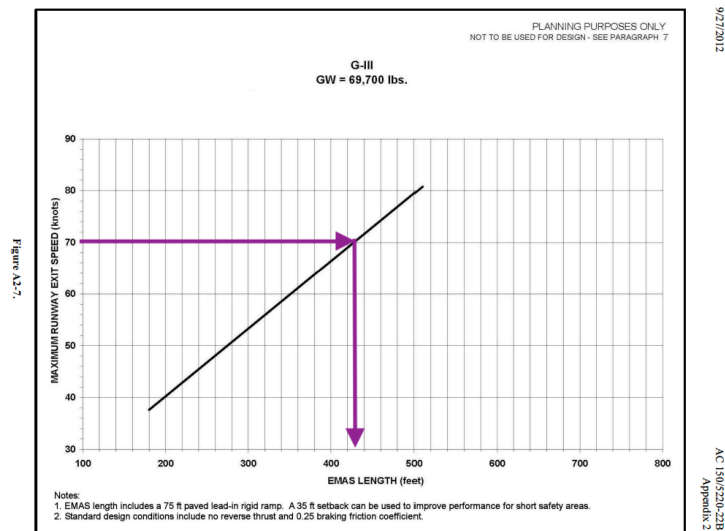
Therefore,

$$1,000 \text{ ft} - 610 \text{ ft} = 390 \text{ ft}$$

$$7,100 \text{ ft} - 390 \text{ ft} = 6,710 \text{ ft}$$

- **6,710 ft is the accelerate-stop distance available (ASDA) for the aircraft departing on runway 27.**
- d) Find the takeoff run available (TORA) for aircraft departing on runway 27. Your solution should protect the runway safety area.
- The same answer as part c.
- e) Would you consider building an EMAS on runway end 27? Explain the safety advantages it would bring to the airport. Describe a scenario (in words) if you want to answer the question.
- Solution 1:
  - Assumptions:
  - Gulfstream G450 is similar to Gulfstream III.
  - Runway 27 end is the area close to the river.
  - An EMAS for the Gulfstream 450 would be approximately 430 feet assuming maximum runway exit speed 70 knots. Since 430 feet is less than the 610 feet available at the end of runway 27, an EMAS could be accommodated. If an EMAS were to be installed, the additional  $1,000 \text{ ft} - 430 \text{ ft} = 570 \text{ ft}$  of length beyond the departure end would no longer be necessary. This would allow for an increase in TORA and ASDA which improves the operational capability of the runway. **Longer declared distances allow longer flights or flights with higher payload.**

- Solution 2:
- Assumptions:
- Gulfstream G450 is similar to Gulfstream III.
- Runway 27 end is the area close to the highway.
- An EMAS for the Gulfstream 450 would be approximately 430 feet assuming maximum runway exit speed 70 knots. Since 430 feet is less than the 480 feet available at the end of runway 27, an EMAS could be accommodated. If an EMAS were to be installed, the additional 1,000 ft - 430 ft = 570 ft of length beyond the departure end would no longer be necessary. This would allow for an increase in TORA and ASDA which might enhance the safety and operational standards of the runway.



- f) The largest and most critical aircraft operating at the airport is the Gulfstream 450 (see Figure 1). Using SARLAT 2, verify if the aircraft can operate at 85% useful load using the ASDA distance calculated in part (C). Comment on the solutions for both a dry and wet runway.

- Assumptions:
- Design temperature = 80 F
- Wind = zero
- Runway grade (slope) = 0.5%
- Based on the solution provided by SARLAT 2, the required runway length for takeoff operations on dry pavement is 6,472 feet, given the specified assumptions. Therefore, the available ASDA of 6,710 feet meets this requirement.



Note, that the FAA considers the dry pavement for takeoff standards and wet pavement for landing standards.



*Figure 1. Gulfstream 450 Departs Virginia Tech Montgomery Executive Airport(BCB).  
Source: A. Trani.*

## Problem 2

Use Google Earth to verify the runway separations and answer the following questions.

### Cincinnati/Northern Kentucky International Airport (CVG)

- a) Can the airport conduct simultaneous approaches to runways 36L and 36C in Instrument meteorological conditions?

- The distance between runways 36L and 36C centerlines is 4,290 ft.
- Airport elevation from the sea level is 875 ft.
- **Simultaneous operations are allowed.**



- b) Briefly explain the FAA runway separation rule that applies and the distance between the runways in question.

- FAA rules for airports below 2,000 ft pressure altitude: straight-in simultaneous approaches are authorized if a distance of 3,200 feet between parallel runways (centerlines) is available. Note that the radar system must be active in the airport.
- Therefore, simultaneous approaches can be conducted on runways 36L and 36C, as they are parallel and have a separation of more than 3,200 feet between them (centerlines).

- c) Can CVG air traffic controllers allow simultaneous departures from runways 36C and 36R? State the rule used.

- FAA rules for simultaneous departures: simultaneous departures are authorized if a distance of 2,500 feet between parallel runways (centerlines) is available. Note that the radar system must be active in the airport.
- Therefore, simultaneous departures can be conducted on runways 36L and 36C, as they are parallel and have a separation of more than 2,500 feet between them (centerlines).

## San Francisco International Airport (SFO)

- d) Can the airport conduct simultaneous approaches to runways 28R and 128L in Instrument meteorological conditions?



- The distance between runway 28R and 28L centerlines is just 750 ft. Therefore, under the FAA standards, simultaneous approaches cannot be conducted on these two runways. However, as mentioned in FAA JO 7110.65W, under specific (light wind, good visual meteorological conditions) conditions, the SFO airport can accommodate simultaneous arrivals on runways 28L and 28R. This operation is called Simultaneous Offset Instrument Approach (SOIA).
- e) Under what meteorological conditions can SFO conduct simultaneous approaches to runways 28R and 28L? Name the procedure used.
- Simultaneous approaches/simultaneous Offset Instrument Approach (SOIA) may be operated under the ceiling of 2,100 ft (clouds) with four nautical miles of visibility conditions. (Reference: [chrome-extension://efaidnbmninnibpcjpcglcfeindmkaj/https://www.flysfo.com/sites/default/files/PRM\\_SOIA\\_version\\_1\\_0.pdf](chrome-extension://efaidnbmninnibpcjpcglcfeindmkaj/https://www.flysfo.com/sites/default/files/PRM_SOIA_version_1_0.pdf))
- f) Load the Webtrak data for San Francisco International Airport (SFO) on September 2, 2024 (see Figure 2). Specifically, the focus should be on the airport operations starting at 11:00-11:20 AM (morning), which is a busy period. The WebTrack 6 site is located at: <https://webtrak.emsbk.com/>. Are simultaneous operations from runways 1R and 1L possible based on your observations?
- Yes, simultaneous departure operations from runways 1R and 1L are possible, as observed between 11:00 AM and 11:20 AM on 09/02/2024.
- g) Explain some of the challenges you see for Air Traffic Control based on your observations using Webtrak.
- SFO's closely spaced parallel runways (28L/28R and 1L/1R) present challenges for simultaneous operations (takeoffs and landings), particularly in low visibility or poor weather conditions. In such situations, controllers may need to switch to single-runway operations, which reduces airport capacity and leads to delays both in the air and on the ground. Besides conducting departure and arrival operations on crossing runways might be challenging during the rush hours.

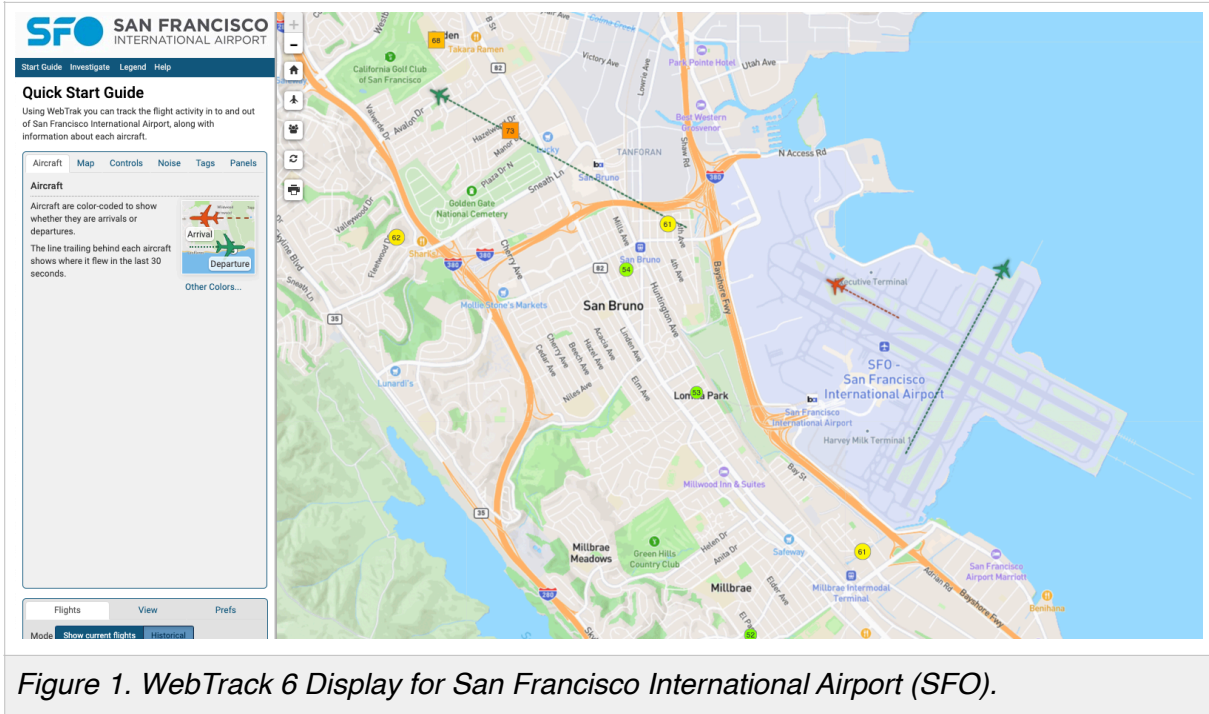
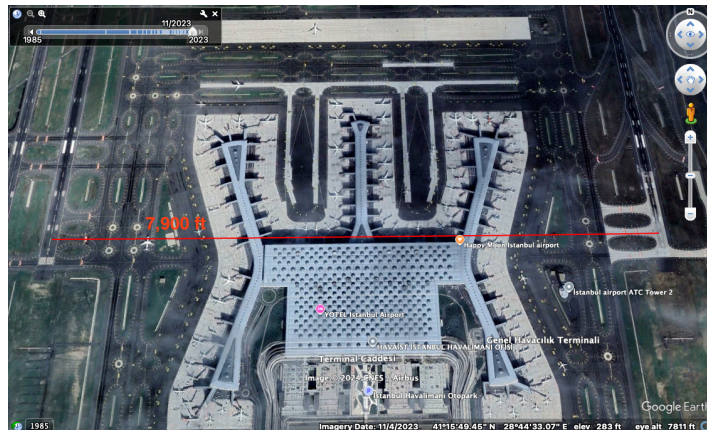


Figure 1. WebTrack 6 Display for San Francisco International Airport (SFO).

### Istanbul Havalimani International Airport (IST)

- h) Can the airport conduct simultaneous approaches to the parallel runways in Instrument meteorological conditions? Name the ICAO rule used and the estimated distance between runways.



- The airport can conduct simultaneous approaches on runways 35R and 36. The distance between these runway centerlines is about 7,900 ft which makes them eligible for simultaneous approach operations based on the ICAO Document 9643.
- i) Name the runways selected in your assessment.
- 35R and 36

## Problem 3

Briefly answer the following questions with three short sentences.

- a) What are converging runway operations (CRO)? Give an example airport impacted by CRO operations.
- Converging Runway Operations (CRO) involve the use of two or more runways that converge at an angle, with less than 1 nautical mile of separation between their runway ends. In these operations, aircraft approach or depart in non-parallel directions, requiring precise coordination to ensure safety. Harry Reid International Airport (LAS) in Las Vegas is an example of an airport impacted by CRO. LAS has multiple runways, including converging ones such as runways 1L and 8R, with a separation of about 2,670 feet, which is less than 1 nautical mile. When departures occur on runways 26L and 19R, air traffic controllers must carefully manage operations on these converging runways to maintain safety.



- b) Explain the differences in ICAO and FAA runway separation standards for visual runways.
- FAA:
    - Independent simultaneous arrivals/departures can be conducted with at least 700 ft between runway centerlines if VFR conditions and visibility of more than 3 nm are satisfied. (with or without a control tower)
    - Dependent arrivals/departures can be conducted with at least 300 ft between runway centerlines if VFR conditions are satisfied. (with control tower)
  - ICAO:
    - Runway separations according to ICAO standards under visual conditions for parallel non-instrument runways intended for simultaneous use are as follows: (reference: Air Traffic Control and Runway Separations CEE 4674 handout)
      - 120 meters (394 feet) for Aerodrome Runway Code 1
      - 150 meters (492 feet) for Aerodrome Runway Code 2
      - 210 meters (689 feet) for Aerodrome Runway Codes 3 and 4
- c) State the minimum runway separation for simultaneous departures from parallel runways in the US (assume instrument meteorological conditions).
- The minimum runway separation required for simultaneous departures from parallel runways is 2,500 ft under IMC and IFR rules.



- d) Briefly explain the purpose of the Terminal Radar Approach and Departure Control Facility at an airport.
- TRACON at an airport is responsible for managing aircraft movements during the critical phases of flight in the terminal airspace, which typically extends from the airport up to about 50 nautical miles and up to 10,000 feet in altitude. TRACON facilities control both arrivals and departures.
- e) State two benefits of using the Automatic Dependent Surveillance-Broadcast (ADS-B) technology compared to radar technology.
- ADS-B provides more frequent updates compared to traditional radar technology. ADS-B broadcasts aircraft position data approximately once per second while traditional radar systems have update rates ranging from 4 to 12 seconds.
  - ADS-B enables aircraft to receive information about other nearby airplanes directly in the cockpit. This enhances situational awareness for pilots and consequently, safety while traditional radar technology does not provide this level of information directly to pilots.
- f) Explain the reason for the assignment of cruise altitudes based on headings.
- Different cruise altitudes such as FL 340, FL 360, FL 380, and FL 410 are assigned based on aircraft headings to maintain vertical separation between aircraft and prevent collisions.