Problem 1

A Boeing B727-200 jet with Pratt and Whitney JTD8-5 engines has an Operating Empty Weight (OEW) equal to 54,325 kg. It can carry up to 150 passengers (pax.). The range (stage length) that this aircraft can fly is 1,000 miles. The aircraft has an average route speed equal to 870km/hr and an average fuel burn equal to 6.2 kg/km. The maximum structural take-off weight (MSTOW) of this aircraft equals to 83,900 kg.

The aircraft will take off from a runway with an airfield elevation equal to 1000m above mean sea level (AMSL) and the aerodrome temperature (mean daily maximum temperature of the hottest month of the year) is equal to 20 degrees C. The regulations governing the use of this aircraft require only 0.75 h reserve in route service.

Estimate the desired take-off weight.

Solution

Desired Take-off Weight = OEW + Payload+ Trip Fuel + Reserve Fuel.

- OEW = 54,325 lb
- Payload = Revenue generating load = weight of passengers, their luggage, cargo, mail.
  Assuming average weight of a passenger = 80 kg
  Assuming average weight of his bag = 20 kg
  Assume the aircraft is not carrying any cargo or mail.
  Payload = 80 kg x 150 + 20 kg x 150 = 15,000 kg
- Trip Fuel = Fuel burn x range
  Trip Fuel = 6.2 kg/km x (1000 miles x 1.609 km/mile) = 9,976 kg
- Reserve Fuel = Time to fly with reserve fuel x Aircraft Speed x Fuel burn
  Reserve Fuel = 0.75 hr x 870 km/hr x 6.2 kg/km = 4046 kg
- Desired Take-off Weight = 54,325 + 15,000 + 9,976 + 4046= 83,347 kg
- Desired Take-off Weight = 83,347 kg < MSTOW = 83,900 kg

Problem 2

The following problem illustrates the application of the runway length corrections method.

The runway length required for landing at sea level in standard atmospheric conditions is equal to 2,100 m. The runway length required for take-off at a level site at sea level in standard atmospheric conditions is equal to 2,500 m. The aerodrome elevation is 150 m above mean sea level. The aerodrome reference temperature is 24 degrees C and the runway slope is 0.5%.

Estimate the actual runway length at the existing aerodrome conditions.

Solution

A- Correction to runway take-off length:

1- Runway Take-off length corrected for elevation = Increase the basic runway length at the rate of 7% per 300 m elevation from mean sea level = L_0 x (0.07 x E/300) + L_0
   L_1 = 2,500 x 0.07 x 150/300 + 2,500 = 2,588 m
2- Runway Take-off length corrected for elevation and temperature = Further increase the length corrected for elevation at a rate of 1% for every 1 degree C by which the aerodrome reference temperature exceeds the temperature in the standard atmosphere ISA for the aerodrome elevation = 0.01 x L_1 x (T – T_1) + L_1
   - Calculate T1 = adjusted temperature in standard atmosphere for E from ICAO Table 3-1 (table is presented in lecture 2 slide No. 26)
   By interpolation, at aerodrome elevation E = 150 m, T1 = 14.025 degree C
   L_2 = 0.01 x 2,588 x (24 – 14.025) + 2,588 = 2,846 m
3- Check that the total correction for elevation and temperature does not exceed 35% of basic runway length = 846 m < 875 m (0.35 x 2500)
4- Runway take-off length corrected for elevation, temperature and slope = Further increase the length corrected for elevation and temperature at the rate of 10% for each 1% of runway slope = 0.1 x G x L_2 + L_2
   L_3 = 0.1 x 0.5 x 2,846 + 2,846 = 2,988m

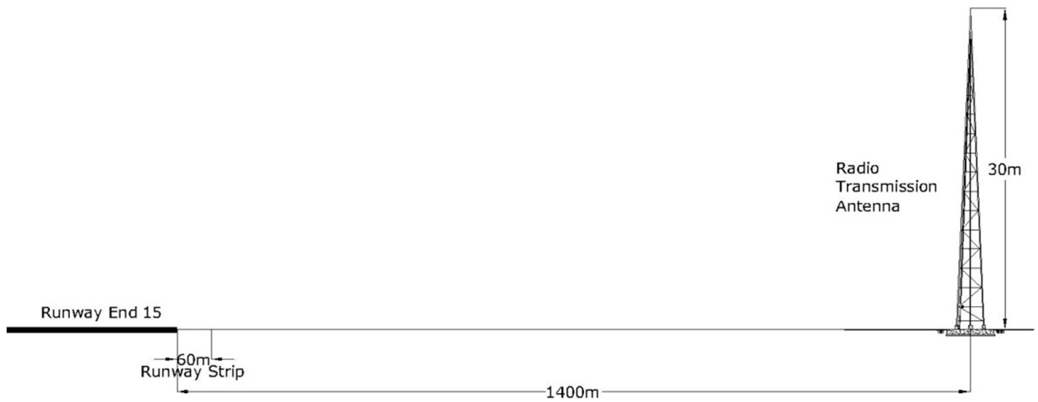
B- Correction to runway landing length:

1- Runway landing length corrected for elevation = Increase the basic runway length at the rate of 7% per 300 m elevation from mean sea level = L_0 x (0.07 x E/300) + L_0
   L_1 = 2,100 x 0.07 x 150/300 + 2,100 = 2,174 m

C- Take-off and landing runway length reconciliation: Choose the largest = 2,988 m

Problem 3

The end of a precision approach runway whose length is 2150m is located 1400m from a newly constructed radio transmission antenna whose height is equal to 30m as shown in the Figure. The antenna falls under the approach path of threshold 15 whose elevation is equal to 52.5m Mean Sea Level (MSL). The ground elevation at the antenna site is also equal to 52.5m MSL.



Knowing that the approach surface starts at end of the runway end strip, is the Antenna an obstruction to navigation in the final approach path to threshold 15? Suggest one alternative to use Runway 15 if this antenna cannot be relocated.

Assuming that the take-off direction is from Runway 15 end and the runway length is equal to 2150m. The runway has a Clearway equals to 200m and no Stopway. Calculate the Takeoff Run Available (TORA), the Takeoff Distance Available (TODA) and the Accelerate Stop Distance Available (ASDA) knowing that the whole runway length is available for takeoff.

Solution

- The runway is Precision Approach Code 4. The antenna is an obstruction.
  Refer to ICAO Table 4.1, presented in Lecture 4, slide No. 25
  The antenna is located 1,400m from threshold < 3,000m i.e. it falls in the approach surface first section whose slope is equal to 2%
  The approach surface starts 60m after threshold.
  The height of the approach surface at the location of the antenna = 2% x (1400 – 60) = 26.8m Therefore the antenna penetrates the approach surface by 30 – 26.8 = 3.2m
- Displace the threshold.
  The distance between the start pint of the approach surface and the antenna so that the antenna does not penetrate the surface = antenna height/slope of the first section of the approach surface

X = 30/2% = 1,500m

Therefore the threshold is to be displaced by 1,500 + 60 -1,400 = 160m

- TORA = 2150,

  TODA = TORA + CWY = 2150 + 200 = 2350,

  ASDA = TORA + SWY = 2150 + 0 + 2150