# Assignment 2: Simple Runway Length Calculations

Date Due: February 6, 2016   Instructor: A. A. Trani

Problem 1

The Morgantown Municipal Airport-Walter L. Bill Hart Field (MGW) is planning an expansion to serve larger corporate jets in the future. The airport has 78 general aviation aircraft based at the airport. The airport would like to expand the facility to attract larger aircraft like the (shown in Figure 1).
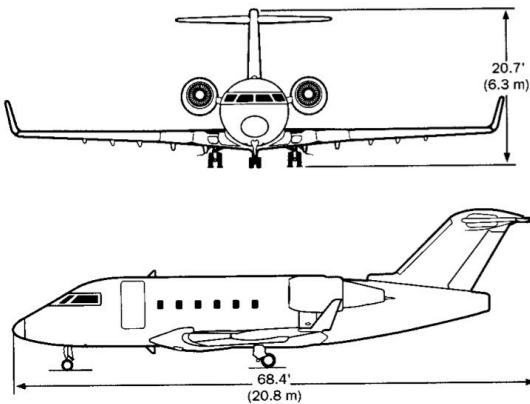
a) For the master plan, estimate a suitable runway length to operate all aircraft safely at the airport. If a runway extension is needed, make a recommendation.

b) Verify if the smaller GA aircraft require more runway than the the corporate jets.

Figure 1. Bombardier Challenger 604.

Problem 2

a) Use the fundamental equation of motion explained in class and explain the effect of airport elevation on runway length requirements. Explain which terms contribute to the increase or decrease of runway length.

b) Use the Boeing 787-8 (Dreamliner) document for airport planning (http://www.boeing.com/commercial/airports/plan_manuals.page) to contrast the runway length requirement as a function of temperature. For this analysis consider the Boeing 787-8 departing from Doha (Qatar) at a desired takeoff weight of 490,000 lb. Plot and compare the runway lengths needed at three temperatures provided in the Boeing manual (ISA, ISA+15 deg. C and ISA+25 deg.C.).

Figure 2. Boeing 787-8 Dreamliner at Narita Airport (A. A. Trani).

Problem 3

You are evaluating the runways at National Reagan Airport (DCA) in Washington, DC. A new low-cost carrier wants to operate Boeing 757-200 aircraft (Figure 3) from this airport to several destinations the Caribbean (Punta Cana in Dominican Republic and Bridgetown in Barbados). The airline and the airport authority want to know if the longest runway at DCA would be able to accommodate a Boeing 757-200 with PW 2040 engines for these routes. The Boeing 757-200 in question has a maximum takeoff weight of 250,000 lbs. (MTOW). Assume the airline operates the Boeing 757-200 in a single class cabin configuration with 224 seats.

a) Calculate the stage lengths for each service using the great-circle calculator (http://gc.kls2.com/). In your analysis add a 5% route detour factor to account for normal detours due to air traffic control and to avoid weather enroute. Use these corrected distances in your calculations.

b) Find the runway length needed to operate both routes. Comment on the feasibility to offer such service. If the runway is short, state a desired runway extension.

c) How much payload can the aircraft carry on the critical route with a full complement of passengers?

Figure 3. Boeing 757-200 at Charlotte (NC) Airport (A. A. Trani).

Problem 4

A new airport is being designed for Mexico City (assume the pressure altitude is ~7000 ft. above sea level). The runway should be enough to satisfy a Boeing 777-200LR. The Boeing 777-200LR (with GE90-115B1 engines) in question has a maximum takeoff weight of 766,000 lbs. (MTOW). See the specifications of the Boeing 777-200LR in the appropriate Boeing document. The mean maximum temperature of the hottest month of the year in Mexico is 23 deg. C. The critical stage length is a non-stop flight to Shanghai, China. In your calculations use a Boeing 777-200LR in a two-class cabin configuration with 279 seats. In your analysis factor a 5% detour factor in your distance calculations.

a) Recommend the runway length needed to operate this service with full passenger payload. Comment on your results.

b) Find the runway length needed with full passenger load plus 12 metric tons of belly cargo.

Figure 4. Boeing 777-200LR at Atlanta Airport (A. A. Trani).