Exam 1 - Take Home

Open Notes and Internet

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Instructions

Create a solution file using the word processor of your choice. Convert to PDF and submit to Canvas. Include all screen captures of all your work including aircraft manufacturer's tables and figures, FAA nomographs and others.

Honor Code Pledge

The information provided in this exam is my own work. I have not received information from another person while doing this exam.

_____ (your signature/name)

Problem #1 (40 points)

An airline is evaluating flying from Sacramento (SMF) to several Asian destinations including Seoul Incheon Airport (South Korea) and Tokyo Narita Airport (in Japan). The airline is exploring using Boeing 787-10 aircraft with characteristics provided in Table 1.

In your analysis use the latest version of the Boeing documents for airport design. Add 6% to the distance calculated to account for real Air Traffic route conditions and to account for possible weather deviations from the shortest flight path.

Table 1. Critical Aircraft Used in the Re-design of LAX Runway 24R.

Airport Design Aircraft
Boeing 787-10 with Rolls-Royce engines.
Rolls-Royce engines with **typical thrust rating**.
Aircraft maximum design takeoff weight is 560,000 lb.
Aircraft has a **mixed class seating configuration**.

a) Estimate the Operating Empty Weight (OEW) from the Payload-Range diagram for this aircraft. Consult homework 2 solution if needed.

b) Find if a runway extension is needed at Sacramento to allow the airline to fly the longest of the two proposed routes. The airline would like to carry 100% of passengers and an additional 30,000 kilograms of cargo in the form of belly cargo (State the airport design temperature, airport elevation and other environmental conditions and assumptions used in your calculations. State the figure(s) used in the aircraft manufacturer documents (a screen capture would be useful).

c) Estimate the fuel per passenger to fly a full load of passengers in the critical route.

d) Find the unconstrained (i.e., maximum takeoff weight) runway length needed to operate the Boeing 787-10 from Sacramento using the design temperature conditions of the airfield. Compare the constrain design (Part a) with the unconstrained solution. Comment.

Problem # 2 (30 points)

Several years ago, the Charleston (WV) Yeager Airport (CRW) experienced a geotechnical collapse of a retention wall on runway 5 end (see Figure 1). The collapse took down the EMAS system. Your job is to define the characteristics of the new EMAS system using the most recent fleet mix at Yeager Airport.

a) Aircraft operating at Yeager today include the Bombardier CRJ-200, CRJ-700 and the CRJ-900 aircraft. Design the dimensions of an EMAS system that is capable of stopping such aircraft at the recommended runway exit speed. If some aircraft in the fleet at CRW are not included in the EMAS data provided by the FAA, provide a rational design method using similar aircraft in weight to those included in the FAA EMAS document. Explain your rationale. State the runway exit speed used and the EMAS length.

Figure 1. Charleston (West Virginia) Airport Runway 5 end after geotechnical collapse of retention wall.

b) If the largest commercial aircraft operating at CRW is the Bombardier CRJ-900, find the FAA Runway Design Code (RDC) of the airport.

c) For CRW, estimate the dimensions of the RSA, OFZ, OFA and RPZ. The airport has approaches down to 3/4 mile (see Figure 2).

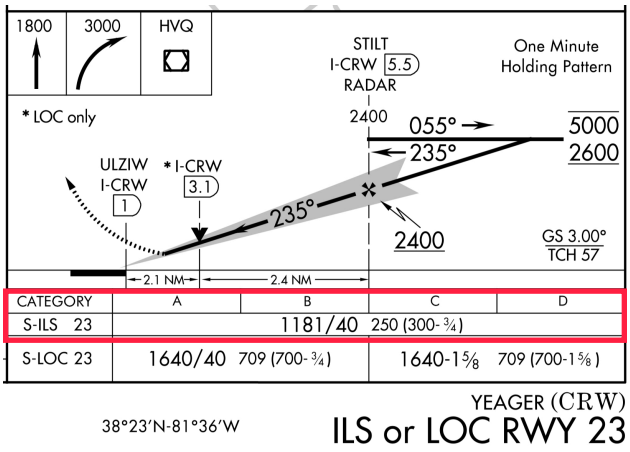

Figure 2. Instrument Landing System (ILS) approach for runway 23 at CRW. Source: Flightaware. Note the red rectangle with 300 feet RVR and 3/4 mile visibility minima for ILS approach to runway 23.

d) Inspect the runway end for runway 23. Explain the reason for a displaced threshold. Explain if the dimension of the displaced threshold is consistent with current design criteria.

e) Inspect the runway end for runway 5. Explain the reason for a displaced threshold. Explain if the dimension of the displaced threshold is consistent with current design criteria.

Problem # 3 (30 points)

Use the experimental Small Aircraft Runway Length Analysis Tool (SARLAT) demonstrated in class to design the runway length for a new General Aviation airport to be constructed at a site located 3,500 feet above sea level. Data from a temperature survey yields a mean daily maximum temperature of the hottest month of 90 degree F. Table 2 shows the aircraft fleet mix expected to operate at the airport. Use the default load factors in the SARLAT tool.

Table 2. Expected Aircraft Fleet at Proposed General Aviation Airport. Aircraft in Boldface Text are shown in the Picture.

Aircraft Type	Representative Aircraft	Sample Picture
Single Engine Piston	**Cirrus SR-22** Cessna 182	
Multi-engine Piston	**Cessna 421**	
Turboprop Aircraft	**Pilatus PC-12**	

Aircraft Type	Representative Aircraft	Sample Picture
Turbofan Aircraft	**Cessna 560XL**	

a) Report the critical aircraft **dry pavement takeoff and landing** conditions.

b) Report the **wet pavement takeoff and landing** for the critical aircraft.

c) Find the runway length needed to operate the fleet mix of aircraft if the airport client wants to provide enough runway for both dry and wet conditions.

d) The Federal Government (through FAA) helps public airports to pay for the runway infrastructure. Based on economic analyses, the Federal Government will fund a **wet landing runway and dry takeoff runway** as part of the Airport Improvement Program funds. Find the runway length that FAA will pay for the airport. Compare to the airport client solution (part c).

e) Compare the solution obtained in part (d) using SARLAT with the current FAA Advisory Circular 150/5325-4b design curves for the same class of aircraft. Explain any differences observed.