HW #5 Drag Prediction Project

Globe Swift Aircraft


Using the pictures above and the (almost) scale drawings below, estimate the C_{D0} of the aircraft for the following configurations:

a) Clean (no gear or flaps deployed)
b) with just gear down for takeoff, and
c) with gear and flaps (at 30°) for landing

Assume the cruise altitude is 7,500 feet and the cruise velocity is 140 mph (121.6 kts)
Neglect antenna wires in the 3-view
Neglect the cooling drag increment for the engine.
Neglect propeller drag or swirl drag increment of prop wash.
Assume the canopy drag is part of the overall fuselage drag, so include the wetted area of the canopy in the overall fuselage wetted area.
For protuberance drag (rivets, gaps etc) use a 5% multiplier factor on the overall drag of the airplane.

Use the posted example of the P-63 as a "go by". You will need to research the aircraft to obtain dimensions to determine the scale of the drawing and estimate component sizes, etc.

Show all your work!!!!

(This project is worth 20 points.)

Ref: Hoerner 'Fluid Dynamic Drag' and Abbott and von Doenhoff 'Theory of Wing Sections'

For wing/body interference drag increment, use Fig 23 page 8-10 with the t/c of the wing root airfoil. This drag coefficient is referenced to the thickness squared, so re-ref the delta CD to wing area using the wing maximum thickness for the wing root airfoil. Remember that this drag has to be applied to both port and starboard sides.

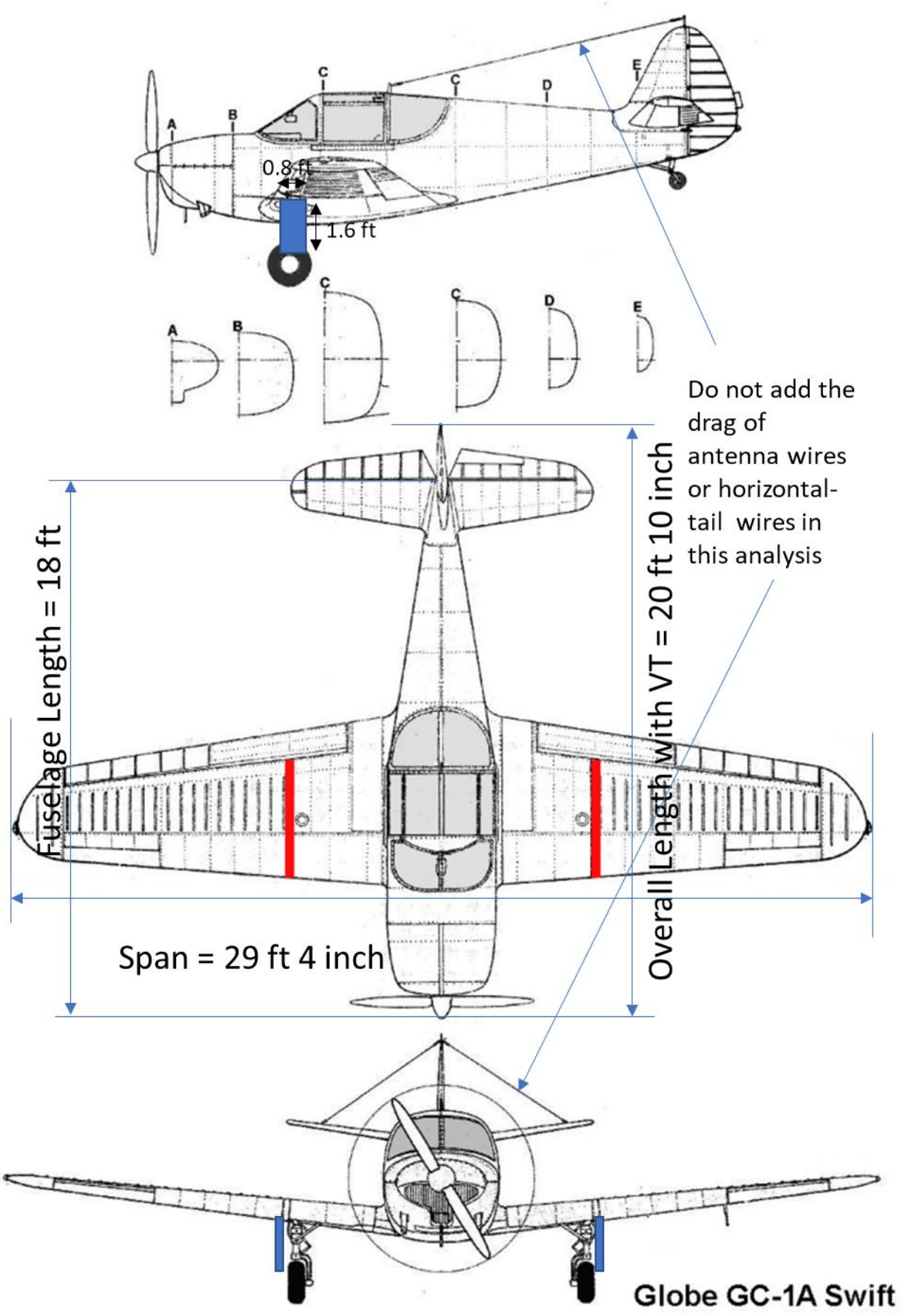
For landing-gear drag use figure 38 p. 13-15 and assume total length/diam=2. Use 'round strut with

fork' drag curve.

For landing-gear door when the gear is down, use the geometry shown in the sketch to compute the skin friction drag on both doors (total wetted area of each door and port/starboard sides). To estimate the form drag, apply a 0.1 multiplier on the skin friction drag increment you obtain for the doors.

For the cavity drag when the gear is down, use Figure 19 page 5-10, using the middle diagram in the figure, where the cavity height is 0.5 x cavity diameter.

for flap sectional DCL and DCD use figure 113 page 209 in Abbott and von Doenhoff for 30-deg flap deflection. Use slotted flap curve for 23012 and a CL value of 2.0. this close to a 30-deg flap deflection for the slotted flap. Use the 2D CD as the flap increment but apply a ratio on the increment using the percent span of the flap as measured from the drawing.


A
B
C
C
D
E
0.8 ft
1.6 ft
A
B
C
C
D
E
Do not add the drag of antenna wires or horizontal-tail wires in this analysis
Fuselage Length = 18 ft
Overall Length with VT = 20 ft 10 inch
Span = 29 ft 4 inch
Globe GC-1A Swift

Landing gear well cavity when gear down:
Diameter 1.6 ft
length and width of cavity covered by gear door=1.6 ft x 0.8 ft
Length of gear door 1.6 ft
Chord of gear door 0.8 ft