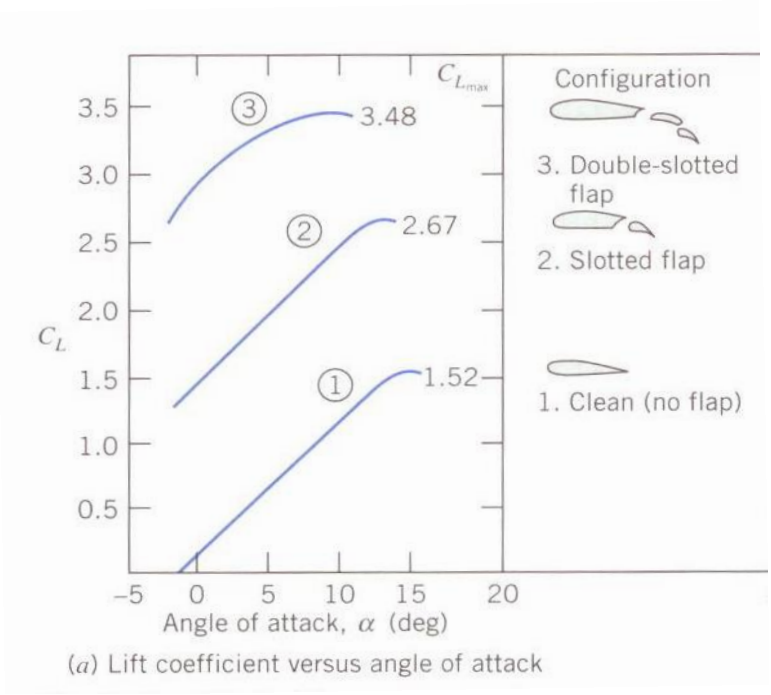
LIFT

LIFT & DRAG SELF ASSESSMENT SHEET 3

1. The Aero Boero 115 uses the NACA 23012 [1] airfoil for its wings. At take-off its weight is 802kg [2] and the wing area 17.4m^2. Assuming the wing C_L is the same as the aircraft C_L by how much is the minimum landing speed reduced if a single-slotted flap is deployed? (Assume wing area increases by 33%). Take air density at ground level to be 1.2 kg/m^3.



(a) Lift coefficient versus angle of attack

Ans: 9.3 m/s or 35%

2. The drag coefficient for a wing of finite span is given by:

$$C_D = C_{D,infinite} + \frac{C_L^2}{\pi A_{Ratio}}$$

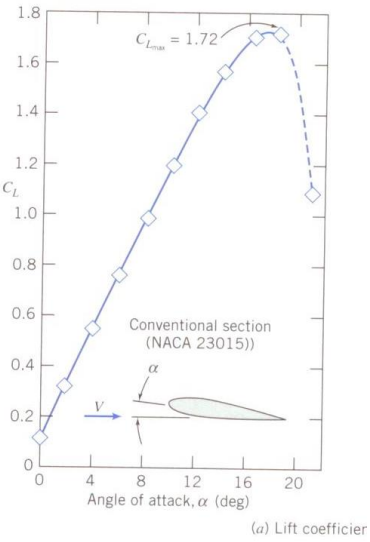
a) Using the data for NACA 23015, what is the drag coefficient for a wing of aspect ratio (b/c) of 6.5 at an angle of attack of 8°?

b) If the planform area is 150m^2, what is the drag force on the aerofoil when flying at an altitude of 5,000m and a speed of 500 mph?

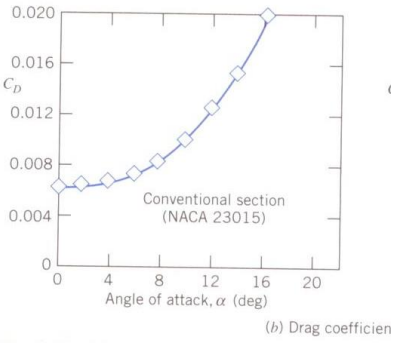
c) How much thrust is required to overcome this drag?

d) Remembering that:

$$C_D = \frac{D/A_p}{\frac{1}{2}\rho V^2}, \qquad C_L = \frac{L/A_p}{\frac{1}{2}\rho V^2}$$



(a) Lift coefficier



(b) Drag coefficien

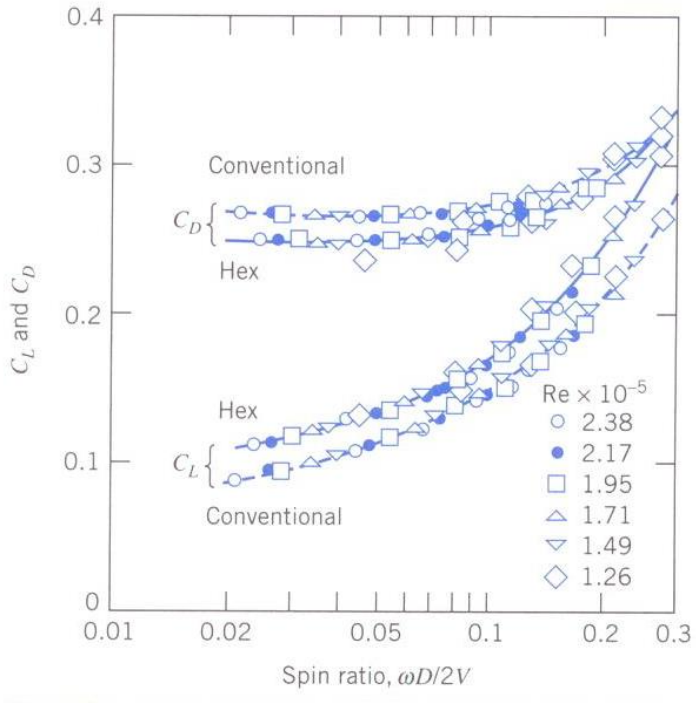
[1] http://www.ae.illinois.edu/m-selig/ads/aircraft.html
[2] http://www.airliners.net/aircraft-data/stats.main?id=4

What mass can this aerofoil support?

Ans: 0.057, 154 kN, 34 MW, 275T

3. **(Optional question, to do after self-study slides of spinning sports balls)** Under the Rules of Golf, a golf ball weighs no more than 1.620 oz (45.93 grams), has a diameter not less than 1.680 in (42.67 mm)[3]. When a conventional golf ball is travelling at 100 mph what spin speed corresponds to a lift coefficient of 0.1? By how much does the spin rate need to increase if the lift is to be doubled?

Ans: 73 rad/s, 323 rad/s



[3] http://en.wikipedia.org/wiki/Golf_ball