eventual goal: increase AR

Volume reqs driven by motor, battery, ESC, autopilot, & servos

→ using airfoiltools to get top $\frac{C_l}{C_d}$

also influences airfoil ± 2

CURRENT C_L req: $L = \frac{1}{2}\rho V^2 C_L S_w = \frac{1}{2}(1.23)(25)^2(C_L)(S_w)$

just put in code for repeatability

Issue: $C_{L_{req}} = 1.398$ (not feasible for good L/D while ALSO wanting good C_m)

could increase S_w or better yet increase cruise speed till $C_{L_{req}}$ is ok!

(~0.2–0.7 C_L in cruise)

making cruise $V = 35 \frac{m}{s}$ → op. @ $7.586 \frac{W}{kg} = \frac{P}{W}$, $54.79 \frac{kg}{m^2}$ wing loading

(double power required but feasible)

$C_{L_{req}} = 0.713$ @ $35 \frac{m}{s}$

$C_{L_{max}} \sim 1.1$

new spec: $S_w = 0.5346\ ft^2$

$b = 2.068\ ft$ $MAC = 0.2585\ ft$

$C_{root} = 0.3693$

$C_{tip} = 0.1477 ft$ $Re \approx 188{,}000$ (laminar)

→ for now select MH45 (review links in code for helpful resources)

C_L/C_D @ 6° aoa ≈ 55 acc airfoiltools

C_m @ 6° aoa ≈ −0.01

$C_d \approx 0.80$ (could decrease speed to match but I'll probably want a different tip airfoil eventually)

$C_d \approx 0.015$

$C_{L_{max}} \approx C_{l_{max}} \cdot 0.9 = 1.15 \cdot 0.9 = 1.035$ (acceptable)

(raymer 12.6)

$$C_{L_\alpha} = \frac{2\pi AR}{2 + \sqrt{4 + \frac{A^2\beta^2}{\eta^2}\left(1 + \frac{\tan^2 \Lambda_{max\,t}}{\beta^2}\right)}} \left(\frac{S_{exposed}}{S_{ref}}\right)(F)$$

$\beta^2 = 1 - M^2$

$\eta = \frac{C_{l_\alpha}}{2\pi/\beta}$

(only for main w/ flaps)

MH 45 @ 200,000 Re

C_{l_α} from airfoil plot (raymer 924 just uses 0.95 for η)
and take $C_{l_\alpha} = \frac{2\pi}{rad}$ from thin airfoil theory
or better yet do a curve fit from airfoil tools ← save in solver file!

$C_{L_\alpha} = 4.520 \frac{1}{rad}$ (useful later) note: based on 0–10°
@ $\alpha_{data} = 8°$, $C_{L_\alpha} = 4.622 \frac{1}{rad}$