Lecture F08 Mud: Wing Geometry, Wing Design

1. **For what airfoils is $\Gamma(y) = \Gamma_0\sqrt{1-(2y/b)^2}$ valid? What is Γ_0?** (1 student)
   $\Gamma(y)$ is defined for the whole wing, not an airfoil. In a design problem, you can pick $\Gamma(y)$ to be whatever you want.

2. **How did you decide on the elliptic wing shape for Choice 1?** (1 student)
   I didn't pick the wing shape for Choice 1. I picked a constant c_ℓ, and the elliptic wing was a result.

3. **How would you do the design if you wanted $c(y)$ to have a specific shape?** (1 student)
   Just do it. Specify the $c(y)$ you want. If you already picked a load distribution with $\Gamma(y)$, you then have enough info to determine c_ℓ and $\alpha_{\text{geom}}(y)$.

4. **What are α_{geom} and α_{aero}?** (1 student)
   See the figure in the notes. They both describe the wing twist, but α_{aero} also includes the zero-lift angle $\alpha_{L=0}$.

5. **How do α and α_{aero} differ?** (1 student)
   See the figure. α is the angle of the freestream velocity relative to the reference line, and is one number for the whole wing. $\alpha_{\text{aero}}(y)$ is the angle of the local zero-lift line relative to the reference line, and can vary along the span.

6. **How do you change the load distribution for an elliptical wing?** (1 student)
   During design, you can adjust $\alpha_{\text{geom}}(y)$. Once the wing is built and $\alpha_{\text{geom}}(y)$ is fixed, you can do it by deflecting flaps or ailerons.

7. **Is there a reference line to make calculations simpler?** (1 student)
   You can set it to be the chord line of the center airfoil, so that $\alpha_{\text{geom}}(0) = 0$. But that's a very minor simplification.

8. **How much twist will occur in an actual wing?** (1 student)
   A wing which needs a wide speed range (or wide C_L range to be more precise), wants to have minimal twist. A wing which always operates at the same C_L can possibly have a lot of twist with no drawbacks. We'll go over this in class at some point.

9. **Which equations should we know? There are so many!** (1 student)
   You should know and understand concepts. This is not the same as "knowing" (or memorizing) equations.

10. **In PRS 2, if you change $c(y)$, then $c_\ell(y)$ will change, and equation (2) indicates $\alpha_i(y)$ will change. Right?** (1 student)
    Not really. Note that equation (3) completely determines $\alpha_i(y)$ if $\Gamma(y)$ is given. Equation (2) then in effect determines $\alpha_{\text{aero}}(y)$.

11. **No mud** (5 students)