Section 7, Homework (8) … Due Monday November 29, 2021

Part 1

Solution Hints: Assume supersonic flow at probe and Wedge has a 10 deg. half angle, work backwards from probe...

\[ P_\infty = 26.436 \text{ kPa} \]

\[ \alpha = 12^\circ \]

\[ P_4 = 30.454 \text{ kPa} \]

\[ P_{04 \text{ sensed}} = 143.062 \text{ kPa} \]

- Calculate Freestream Mach Number
- Assume \( \gamma = 1.4 \)

Static pressure Measurement is ahead of shock

“Rayleigh Pitot Equation”
\( \gamma = 1.4 \)
\( \gamma = 1.4 \)

M2-Theta-Mach Plot
During the late 1920s and into the 1930s, the National Advisory Committee for Aeronautics (NACA) developed a series of thoroughly tested airfoils and devised a numerical designation for each airfoil — a four digit number that represented the airfoil section's critical geometric properties.*

- First digit describing maximum camber as percentage of the chord.
- Second digit describing the distance of maximum camber from the airfoil leading edge in tenths of the chord.
- Last two digits describing maximum thickness of the airfoil as percent of the chord.

Section 7, Homework, Part 2

- Consider NACA 0012 Airfoil at 1.5°α.
- Calculate the critical drag rise (subsonic) Mach number for zero wing sweep
- Re-Calculate the $M_{cr}$ assuming 30° wing sweep, $\Delta$
- \textbf{Compare the effective fineness ratios (t/c), for the unswept and swept wing sections}
- \textbf{What do you conclude?}

\[ \alpha = 1.5^\circ \]

\[ M_\infty = 0.6 \]
NACA 0012 at $1.5^\circ \alpha$

$C_p_{\text{min}} \sim -0.94$

$M_\infty = 0.6$

$\alpha = 1.5^\circ$

@ zero sweep

$C_{p,crit} = \frac{C_{p,0_{\min}}}{\sqrt{1 - M_\infty^2}}$

@ zero wing weep

.. Calculate $M_\infty$ cr
NACA 0012 at 1.5°α with 30 deg. Wing sweep (Λ)

What is $M_{\text{crit}}$ @ 30° wing sweep (Λ)

What is Fineness Ratio @ 30° wing sweep (Λ)

$C_p_{\text{min}} \sim -0.94$

$M_{\infty} = 0.6$

$\alpha = 1.5^\circ$

$\frac{t}{c_{\text{equiv}} = \frac{t}{c / \cos \Lambda}}$
Homework 8, Part 3

- Consider NACA 006 airfoil at 6 different Angles of Attack, at $M_\infty=0$.

- Plot $M_{crit}$ as function of Angle of Attack

- Perform Calculations using the following compressibility corrections
  - Prandtl-Glauret
  - Karman-Tsien
  - Laitone’s Rule

- Compare the resulting curves