MAE 136 Study Guide (Equations Manual)

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1 Aerodynamic Forces

Lif Coefficient: $c_L = \frac{L}{(q_\infty * S)} = \frac{2L}{\rho_\infty V_\infty^2 * S}$

Drag Coefficient: $c_D = \frac{D}{(q_\infty * S)} = \frac{2D}{\rho_\infty V_\infty^2 * S}$

Moment Coefficient: $c_M = \frac{M}{(q_\infty * S)} = \frac{2M}{\rho_\infty V_\infty^2 * S}$

*if the above coefficients are per unit span, the S gets replaced with c. In addition to the above, there are two force coefficients:

Pressure Coefficient: $C_p = \frac{p - p_\infty}{q_\infty}$

Skin Friction Coefficient: $C_p = \frac{\tau}{q_\infty}$

2 Pathlines and Streamlines

A pathline is the path a particular fluid elemtn traces in space. A streamline is a curve whose tangent is the same direction as the velocity vector at that point.

For 2D flow:

$vdx - vdy = 0$

More generally:

$\vec{ds} x \vec{V}$

Recall that vorticity is defined as:

$\vec{\zeta} = 2\vec{\omega} = \nabla x \vec{V}$

& if $\nabla x \vec{V} = 0$ the flow is said to be irrotational. In 2D this means: $\frac{\delta v}{\delta x} - \frac{\delta u}{\delta y} = 0$