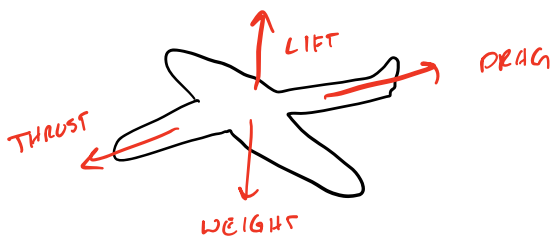
LECTURE 1

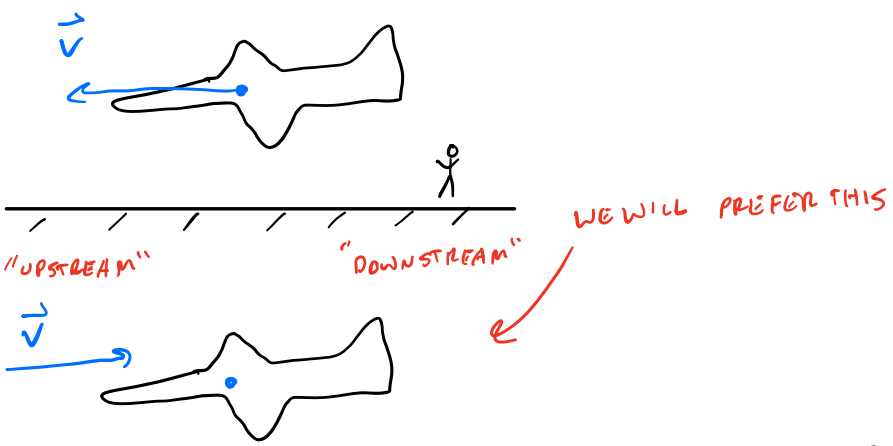
AIRPLANE PARTS

- WING : GENERATES LIFT (AND DRAG)
- FLAPS & SLATS : CONTROL SURFACES, CAN MOVE, HINGED
  ↳ CAN CHANGE LIFT (AND DRAG)

FORCES ON AN AIRPLANE



REFERENCE FRAMES



FREE STREAM: CONDITIONS OF FLOW (VELOCITY, PRESSURE, DENSITY) UPSTREAM OF AIRCRAFT. DENOTED BY ∞

$\vec{V}_\infty$ IS FREE STREAM VELOCITY

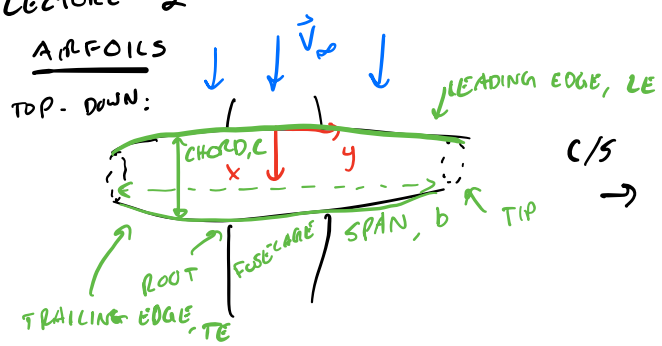
LECTURE 2

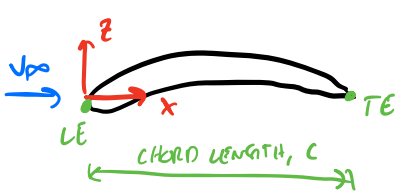
AIRFOILS

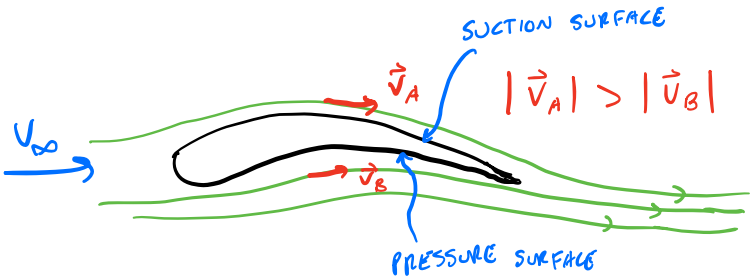
AIRFOIL: 2D CROSS-SECTIONAL SLICE OF A WING, PLANE PERPENDICULAR TO WING.

CHORD: STRAIGHT-LINE DISTANCE BETWEEN LE & TE, VARIES AS F'N OF SPAN

TOP-DOWN:





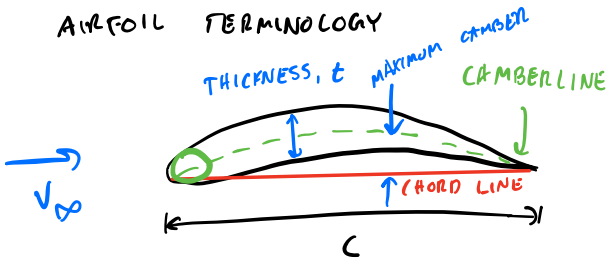


INCOMP & INVISCID ALONG STREAMLINE:

AS $V \uparrow$, $P \downarrow$

$\therefore P_A < P_B$

AIRFOIL TERMINOLOGY



CAMBER LINE: LOCUS OF POINTS HALFWAY BETWEEN UPPER (SUCTION) SURFACE AND LOWER (PRESSURE) SURFACE

THICKNESS: MEASURED AS A % OF c.

E.G. 10% THICK AIRFOIL, $t/c = 0.1$ AT MAX. THICKNESS

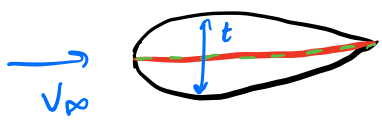
CAMBER: MEASURED AS A % OF c

E.G. 2% CAMBER, 0.02 c

LEADING EDGE: DEFINED BY CIRCULAR ARC

SYMMETRIC AIRFOIL: NO CAMBER

CAMBERLINE = CHORD LINE



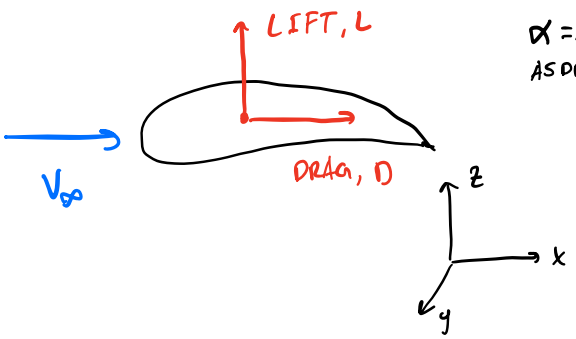
CAMBERED AIRFOIL: NON-SYMMETRIC

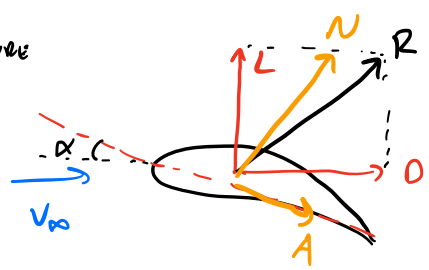
HAS CAMBER & CURVATURE

EXAMPLE ABOVE.

LECTURE 3

AERODYNAMIC FORCES

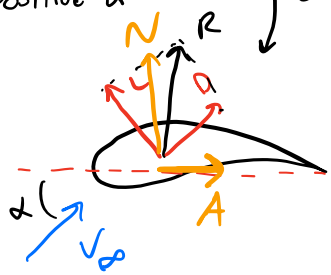




α = ANGLE OF ATTACK

AS DRAWN, POSITIVE α

EQUIVALENT



L & D ALWAYS TAKEN WITH RESPECT TO V_∞

R: RESULTANT FORCE
→ CAN DECOMPOSE INTO:

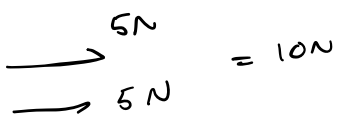
A: AXIAL FORCE (ALONG CHORD)
N: NORMAL FORCE (⊥ CHORD)

$$\begin{bmatrix} L \\ D \end{bmatrix} = \begin{bmatrix} \cos\alpha & -\sin\alpha \\ \sin\alpha & \cos\alpha \end{bmatrix} \begin{bmatrix} N \\ A \end{bmatrix}$$

$$L = N\cos\alpha - A\sin\alpha \quad , \quad D = N\sin\alpha + A\cos\alpha$$

QUIZ

5 N/M · 1M



= 10N