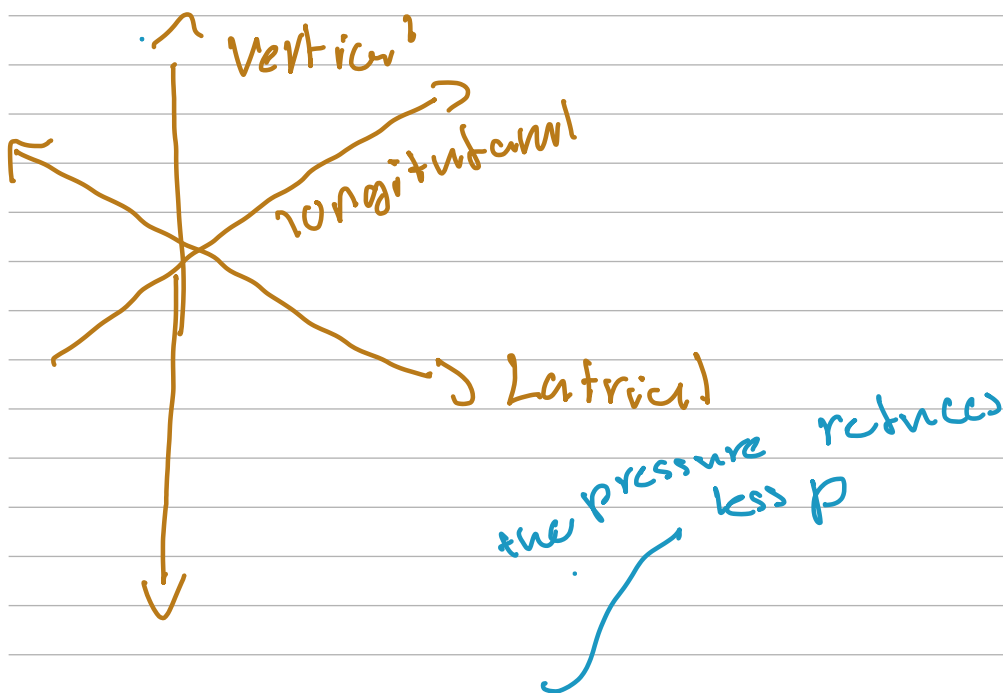
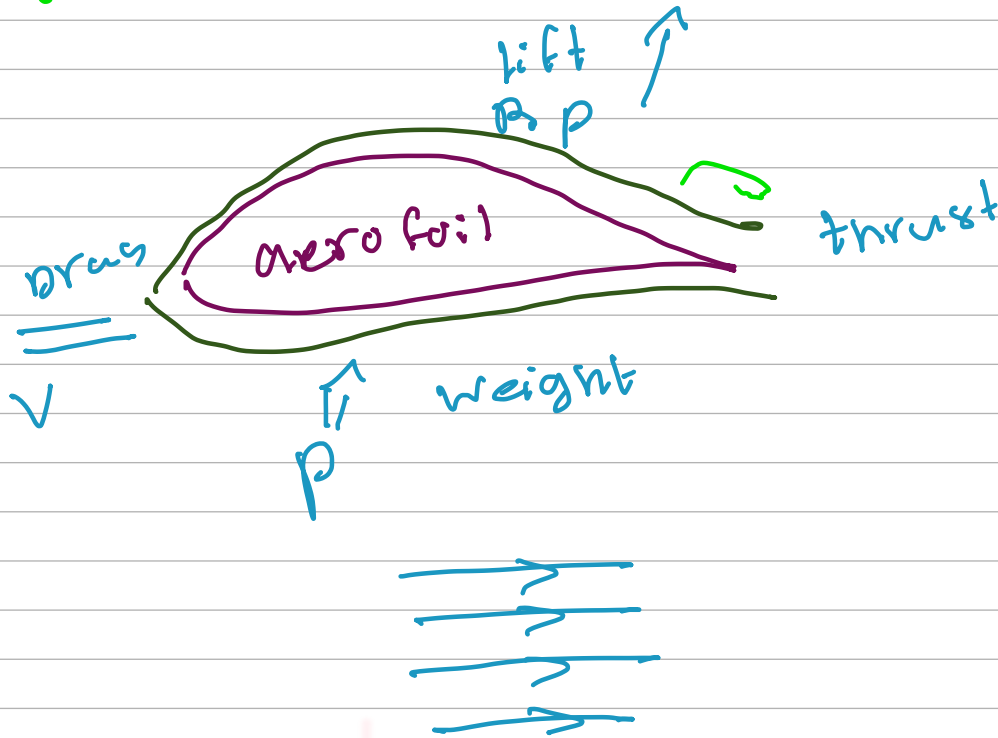


# CU 1 . 1.2 to 1.6

physics of atmosphere :-

aerodynamic  $\Rightarrow$  dynamic of gases moving over the surface  
gases + moving



Pressure :-

$\rightarrow$  humidity :  
cloud seeing  $\Rightarrow$  large amount of water

$\rho \uparrow$   $\uparrow$  surface area

→ Atmosphere pressure:

layer of atmosphere

low  
high

height

Barometer used to measure temperature

→ The tube is important

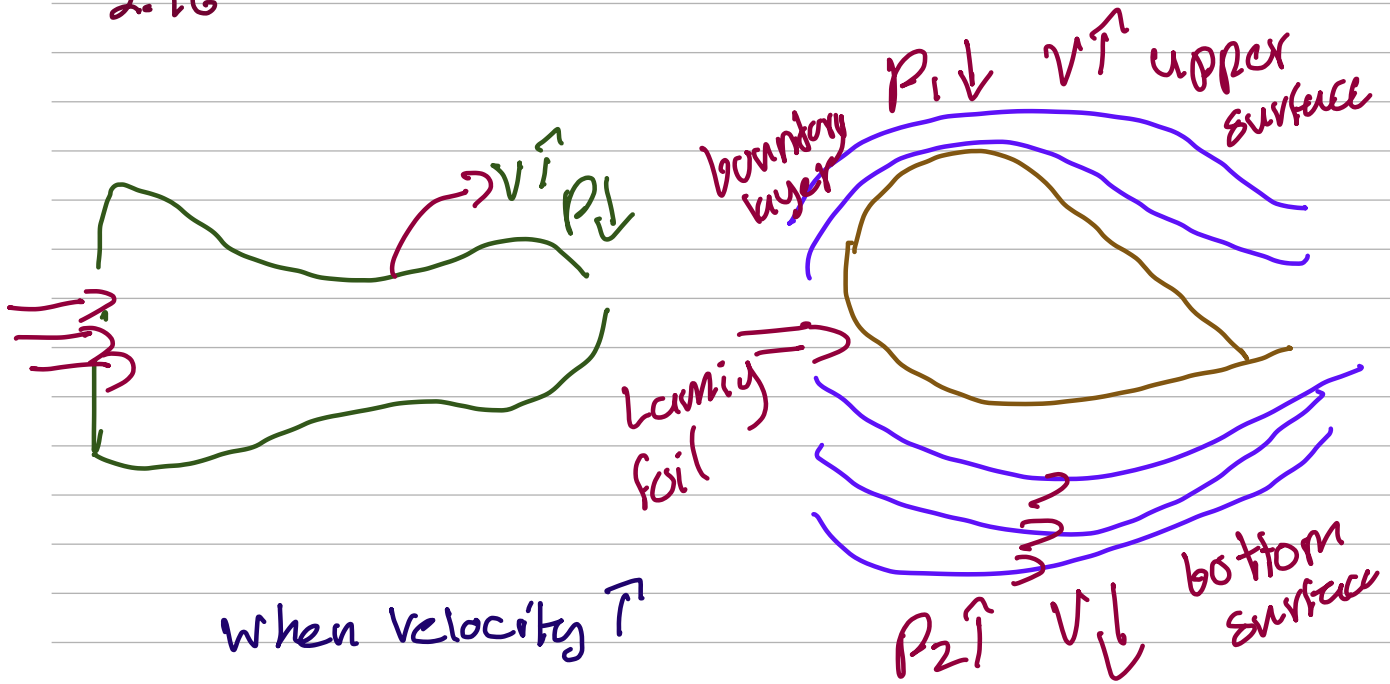
→ Altitude  $\uparrow$  pressure  $\downarrow$

inversely proportional

Density:

$\uparrow$  more pressure  $\uparrow$  more dense

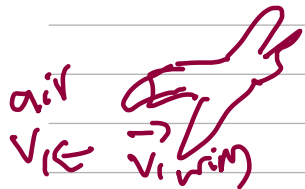
air density  $\downarrow$



When velocity  $\uparrow$   
The resultant  
force  $\uparrow$

$$V_1 > V_2 = \text{lift}$$

$$P_2 > P_1$$



$$V_1 \leftarrow V$$

$$V_2 \Rightarrow \text{Relative velocity}$$

planform  $\Rightarrow$  3 Dimension

2 Dimensional  
cross section

A hand-drawn diagram on lined paper showing a wing platform. The platform is outlined in red and contains three horizontal, wavy lines representing internal structure. A red arrow points from the text "wing platform" to the right side of the diagram. In the top left corner, there is a purple line and some handwritten text that is partially cut off, including "800" and "occh".

Laminar

## Atmospheric pressure

Un Pul

11 Lift

$V_d \downarrow$   $P_d \uparrow$

## Bernoulli's principle

$$r_H > r_D$$
$$P_u < P_d$$
$$P_A > P_U$$
$$P_A < P_D$$

principle  $\nearrow$

$P_n$

$\uparrow$  vortex

$P_0$

chord wig in front and back  
chord line in the middle

Vortices:

Always proportional to lift

vortice  $\propto$  lift

if  $V \uparrow$   $L \uparrow$   
 $\downarrow$   $\downarrow$   
 vertices  $\downarrow$  lift



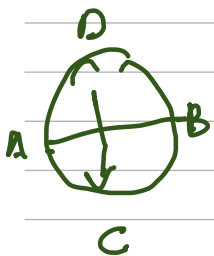
# Aerodynamic terms

1. Aerofoil
2. Leading edge
3. trailing edge
4. chord
5. chord line
6. wing span
7. Average chord  $\Rightarrow \frac{\text{area of the wing}}{\text{wing span} \rightarrow \text{length}}$
8. Mean Aerodynamic Chord (MAC)
9. Angle of incidence  $\Rightarrow$  can be changed  
(angle between wing and chord)
10. wash in
11. washout
12. camber
13. mean camber line
14. finess

AOI  $\uparrow$

AOI  $\downarrow$

angle of incid  
can be vary depen  
on angle pos



Thickness of air  
chord

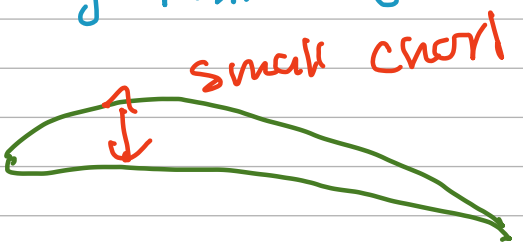
## 15. Aspect Ratio.

- Commercial  $\rightarrow$  High A/R lift high
- Fighter  $\rightarrow$  Low A/R lift less
- General  $\rightarrow$  med A/R

# Aero foils

high finess ratio  $\Rightarrow$  very thin wings

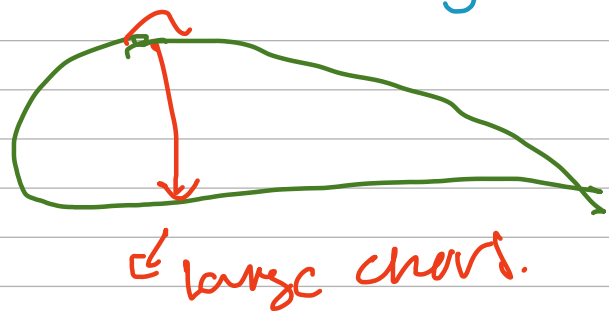
causes unnecessary friction



A hand-drawn diagram of a thin, elongated airfoil. A red double-headed arrow indicates the thickness, with the label "small chord" written above it.

Low finess ratio  $\Rightarrow$  very thick wing

causes high turbulent



friction and turbulent is inversely

hypersonic  
supersonic  
transonic  
speed of sound 1.2  
speed subsonic 0.75

$$\text{mach} = \frac{\text{speed of aircraft}}{\text{speed of sound}}$$

Thrust, lift, weight, Drag

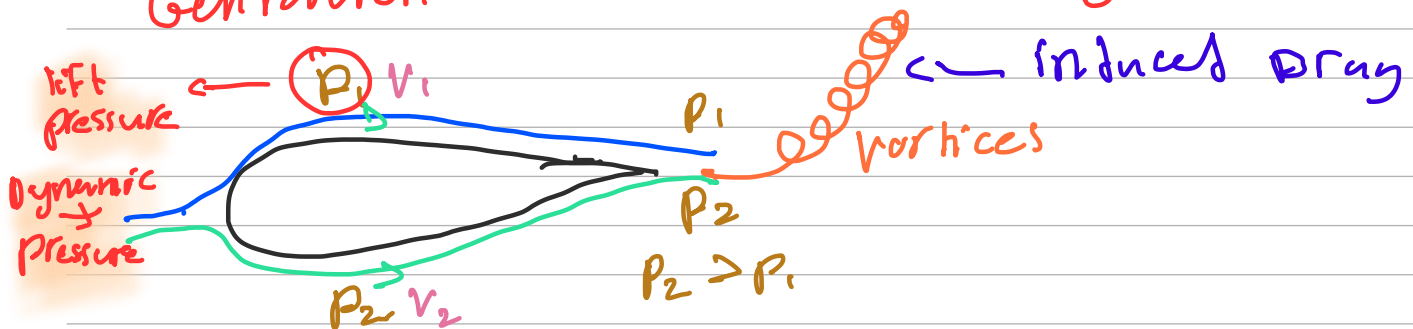
if aircraft to move upward  $L > W$

thrust is created either by propeller or turbine engine

Drag: Resistance to fly

if aircraft tend to move forward  $Th > Drag$

Generation of lift and Drag



$$I/D \propto \frac{\text{lift}}{AoA}$$
  
induced drag

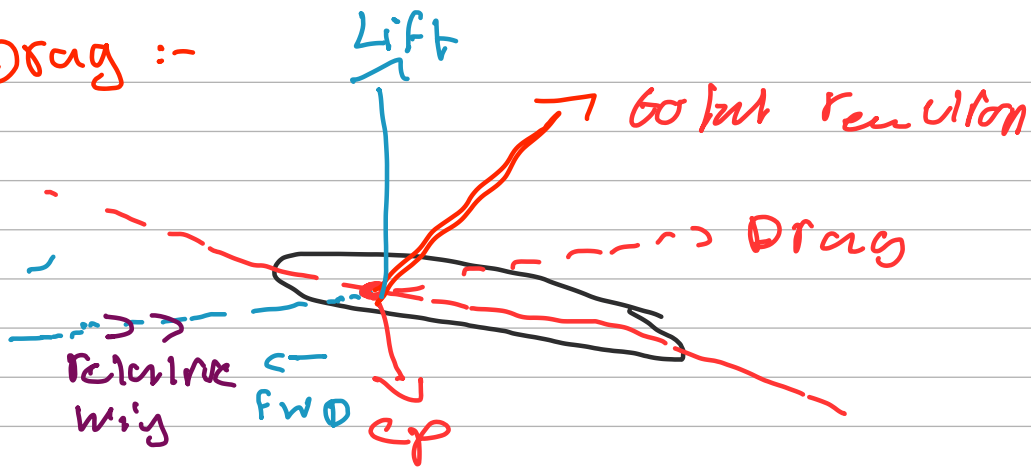
if aircraft move up  $L > W$   
 $Th > D$

if aircraft move down  $L < W$

$AoA \Rightarrow$  can increase, varies

$AoI \Rightarrow$  fixed angle cannot increase

Drag :-



• When total reaction  $\uparrow$ , Lift and Drag  $\uparrow$ .

# Revision Test 1

1. Atmospheric pressure is measured by instrument called **Barometer**

2. An aircraft can fly **faster** at high altitude where air density is low than at low altitude where air density is greater.

3. in which type of layer of atmosphere does most civilian aviation take place?? **Troposphere**

4. **Velocity** is the rate of motion in a practical direction in relation on time

5. When fluid flowing through a tube reaches a constriction the speed of fluid **increase** and the pressure **decrease**

6. The boundary layer is the part of the airflow that is **closest** to the surface of the aircraft

7. The **chord** of a wing is the width of the wing from leading edge to trailing edge

8. A comparison between the wingspan and the chord of wing is known as **aspect ratio**

9. **AOA** is defined as the angle between the chord line and the direction of relative wind.

10. **interference** drag is generated by the mixing of airflow streamline between airframe components such as wing and fuselage.

11. What type of drag continuously increase as airspeed

increase?

parasitic drag

Calculation :-

mass

$$m = A \cdot \rho \cdot V \rightarrow \text{velocity}$$

cross section      density

section 1

$$A_1 = 1 \text{ m}^2$$

$$\rho_1 = 1.2 \text{ kg/m}^3$$

$$V_1 = 120 \text{ m/s}$$

$$m = ?? \quad V_2 = ??$$

section 2

$$A_2 = 0.5 \text{ m}^2$$

$$\rho_2 = 1.2 \text{ kg/m}^3$$

or 1

you must follow these steps.



Ex1.

$$\dot{m} = \rho \cdot A \cdot V \quad \checkmark 2$$

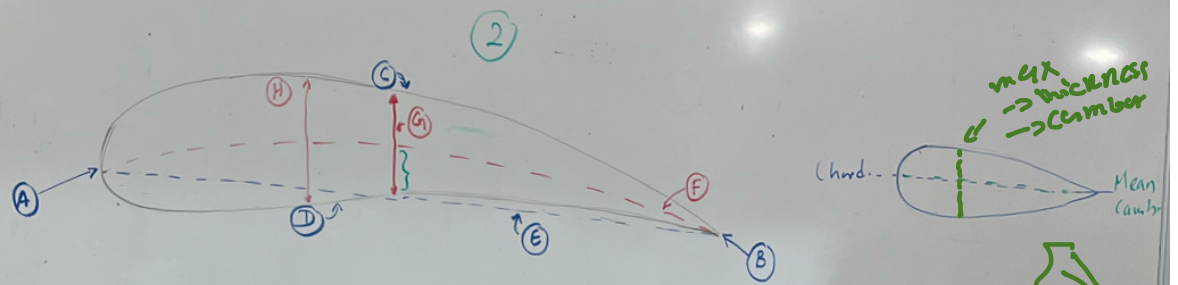
$$= \left( 1.2 \frac{\text{kg}}{\text{m}^3} \right) \left( 1.0 \text{ m}^2 \right) \left( 120 \frac{\text{m}}{\text{s}} \right) \quad \checkmark 4$$

$$= \frac{144 \text{ kg}}{\text{s}} \quad \checkmark 2 \quad \checkmark 4 \quad \text{mass flowrate}$$

$$\rho_1 A_1 V_1 = \rho_2 A_2 V_2 \quad - 2$$

$$V_2 = \frac{\rho_1 A_1 V_1}{\rho_2 A_2} = \frac{1.2 \times 1 \times 120}{1.2 \times 0.5} = \frac{288 \text{ m/s}}{240 \text{ m/s}}$$
$$= \frac{1.2 \text{ kg/m}^3 \times 1 \text{ m}^2 \times 120 \text{ m/s}}{1 \text{ kg/m}^3 \times 0.5 \text{ m}^2}$$





A - Leading Edge ✓

B - Trailing Edge ✓

C - Upper <sup>Aerofoil</sup> surface ✓

D - Lower surface ✓

E - Chord line ✓

F - Mean camber line. ✓

G - Maximum camber ✓

H - Maximum Thickness. ✓

max  
→ thickness  
→ camber

Chord - Mean camber

in symmetrical aerofoil:

- mean camber and chord line are in the same line
- Max thickness and Max camber are in the same line as well.

Nouf Albedwawi