Straight and Level

Straight and Level Flight

Aim

To teach the student how to fly the aeroplane in straight and level flight at varying airspeeds.

Objectives:

At the end of this briefing the student should be able to….

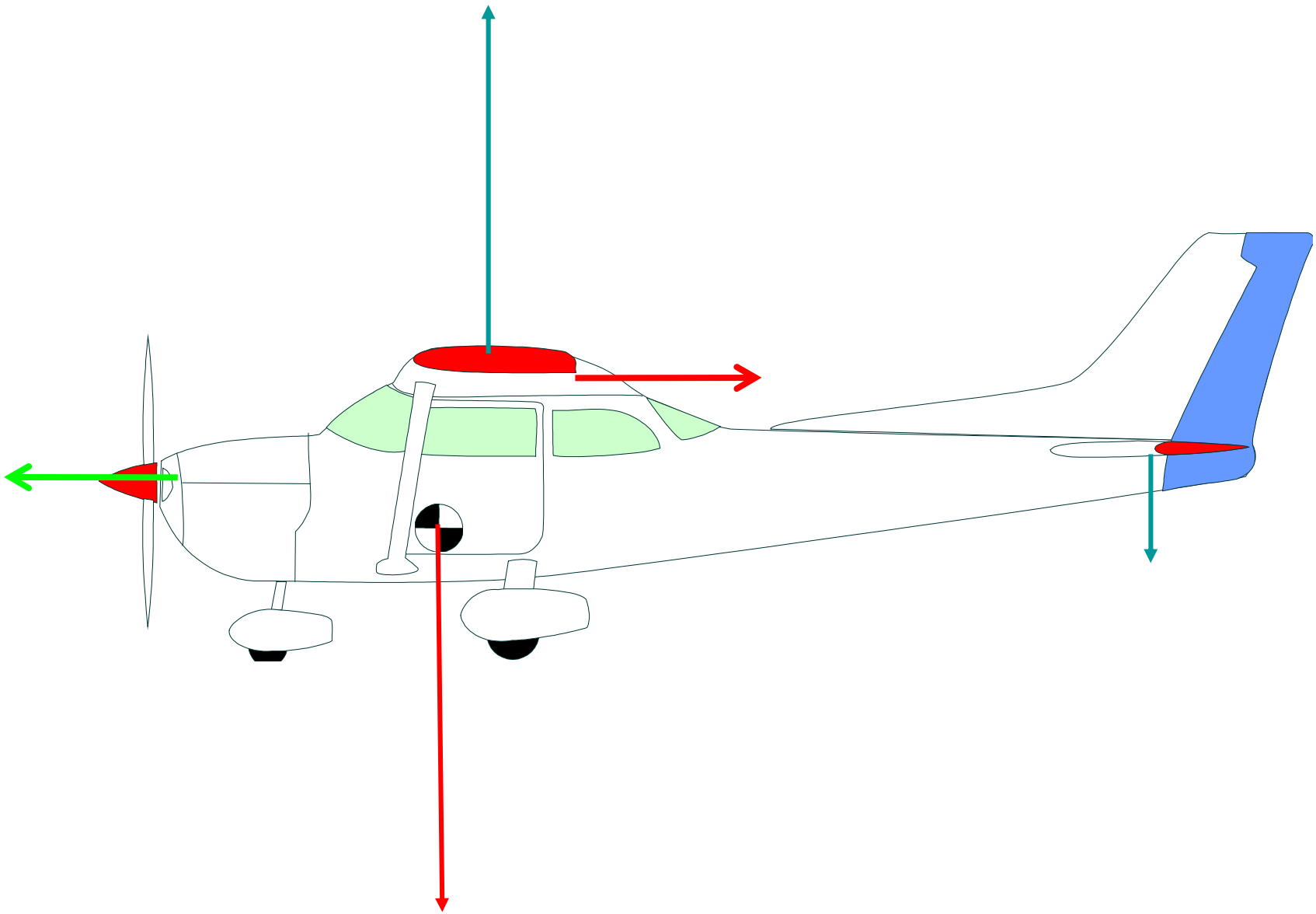
1. State with the aid of a model, the forces acting on an aircraft in steady straight and level flight.

2. Explain why the power requirements change with changes in airspeed.

3. Describe the effect of flap on straight and level flight.

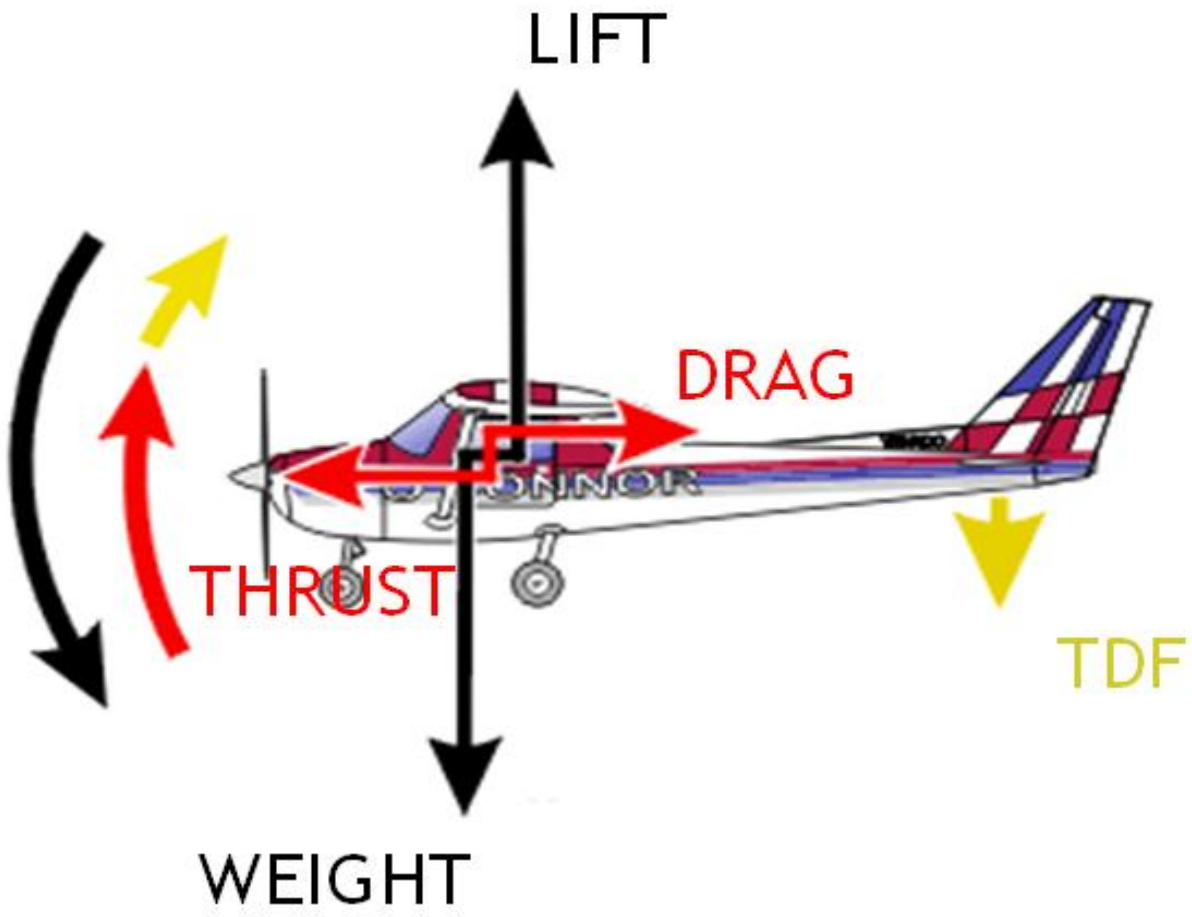
4. State the design features used to affect stability in the rolling, pitching and yawing planes in the aircraft.

FORCES



Couples

Force balance by the elevator and tail plane (moments about C of G)



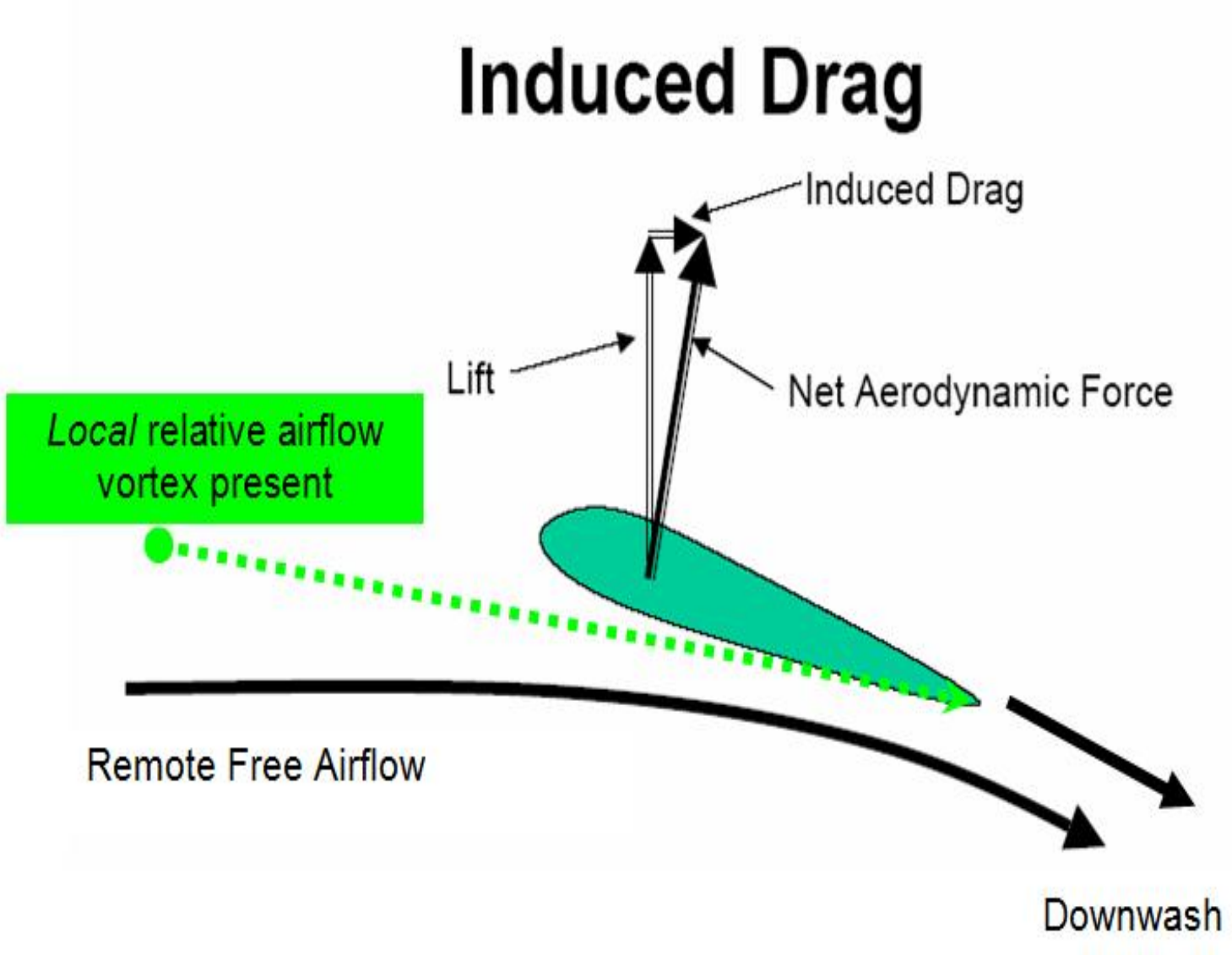
Drag

Types of Drag

- **Induced drag** is a by-product of lift and is directly related to AoA. Induced drag is greatest at Low speed flight with high AoA

- **Parasite drag** comprises ***form drag*** *(streamline)*, ***skin friction*** *(roughness) &* ***interference*** *(landing gear, antennas etc) drag*. Greater at high airspeeds.

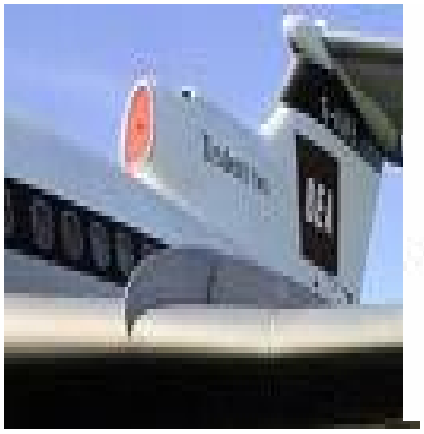
Induced Drag

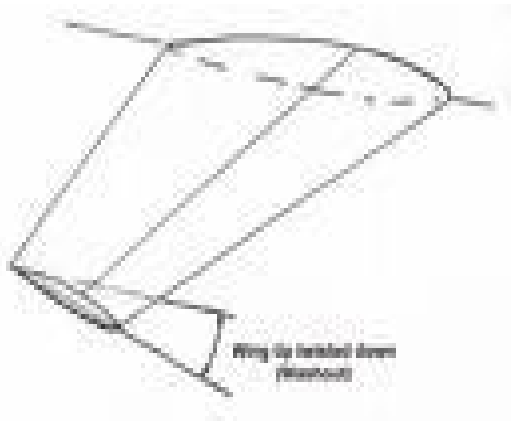


Induced drag

Can be reduced by….

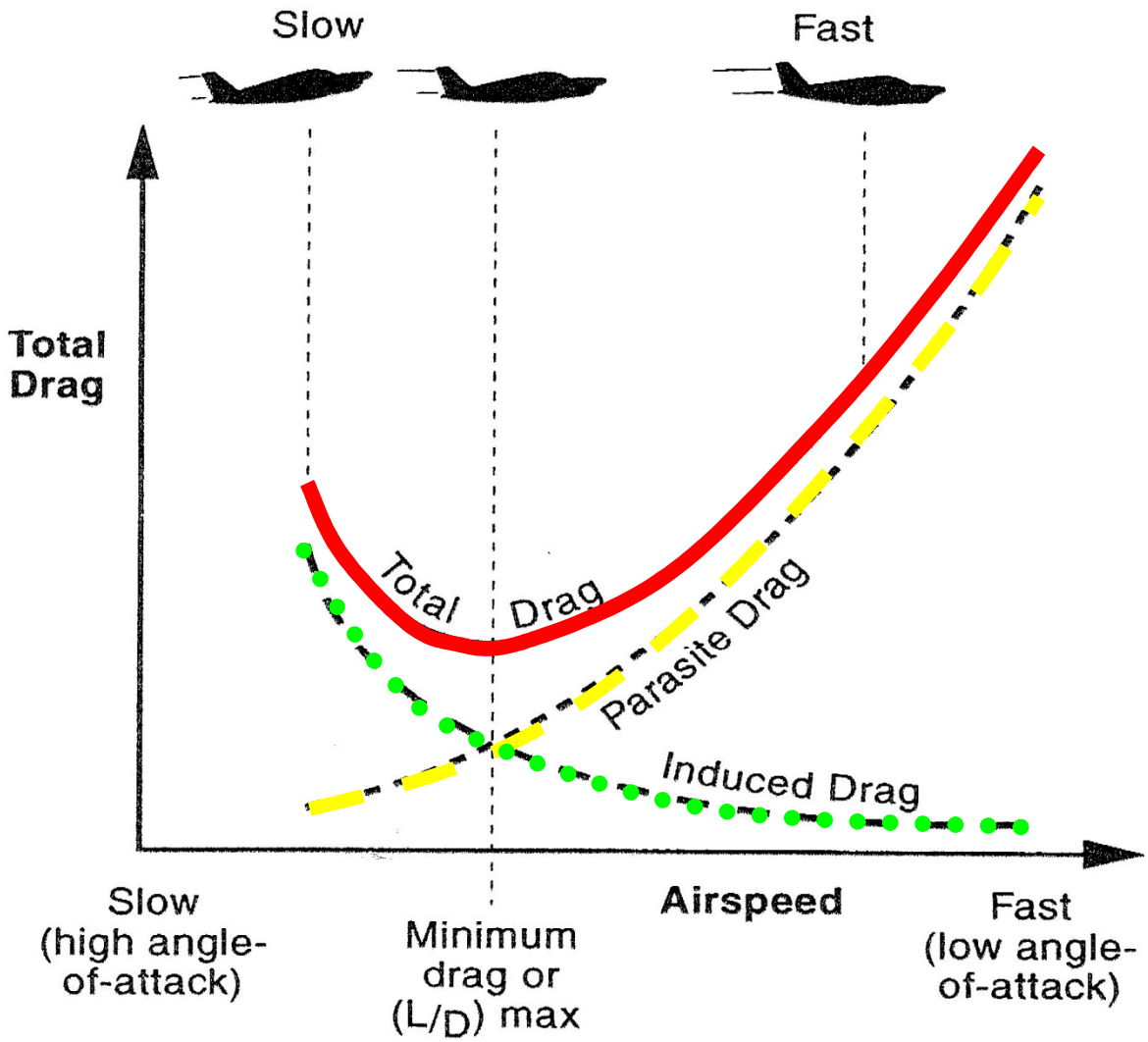
- High aspect ratio wing (longer narrow wing)
- Elliptical wing
- Wing fences straighten (span wise flow)
- Washout (wing root AoA higher than wing tip)

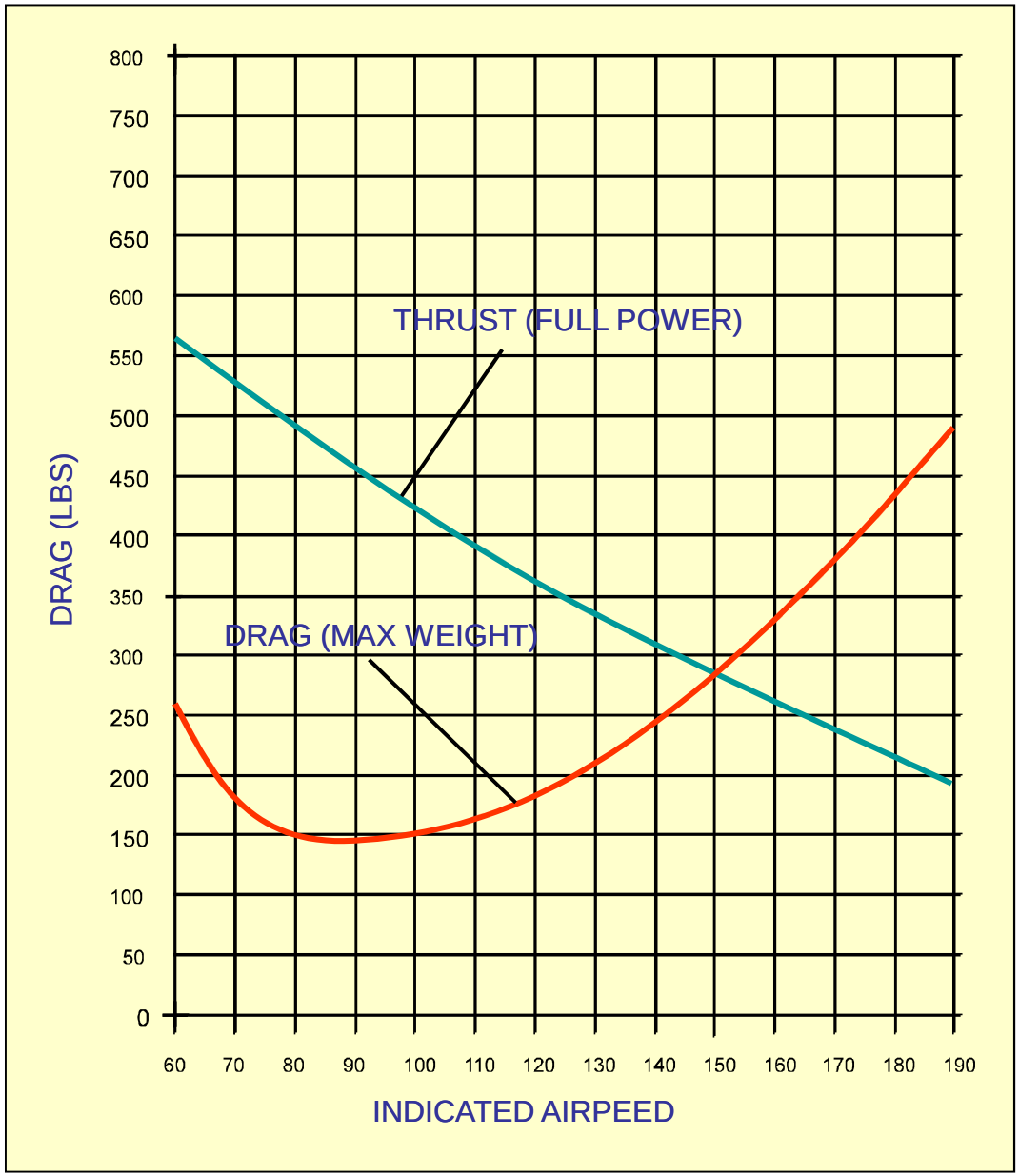


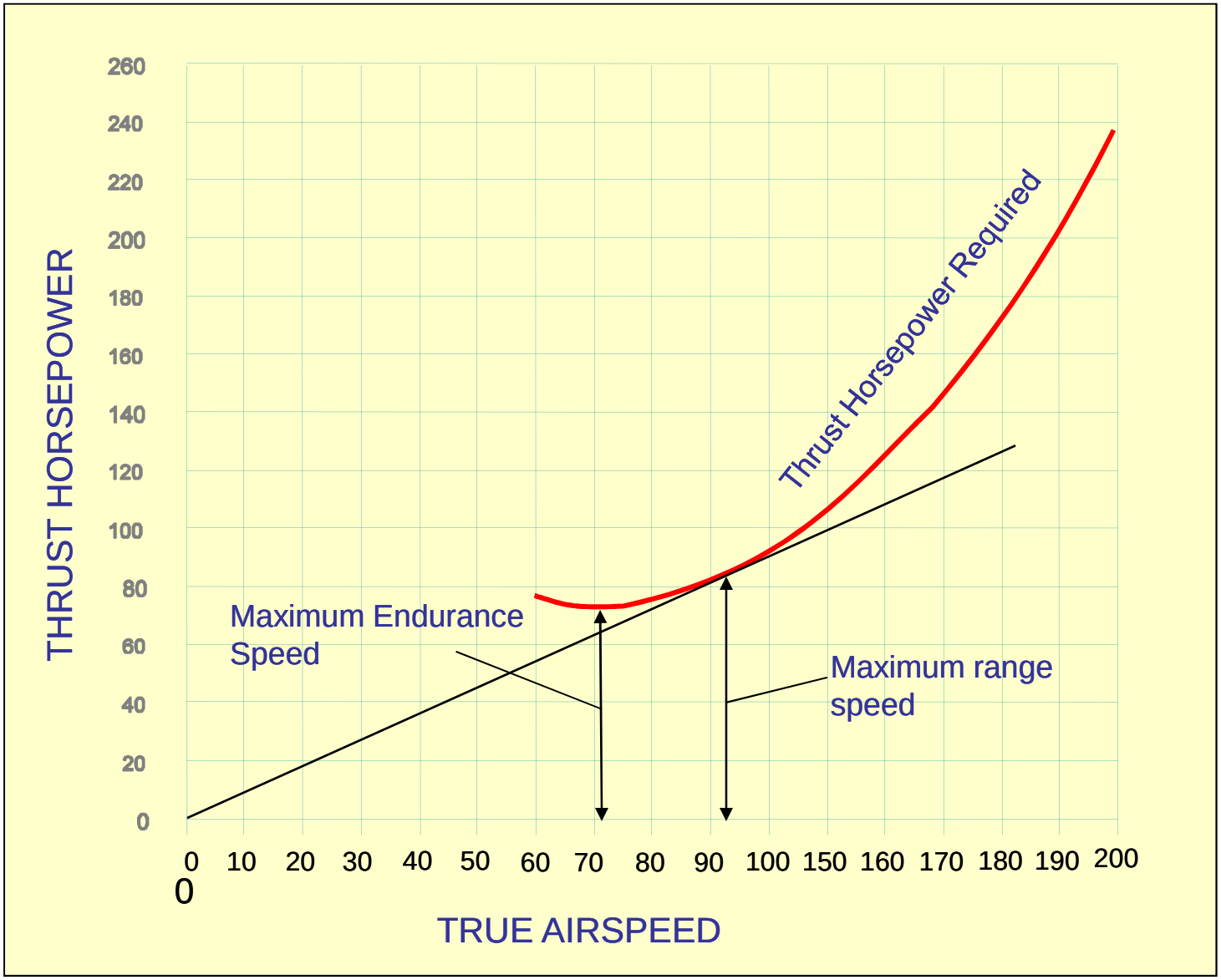


DRAG Vs AIRSPEED

Drag vs Air Speed




800
750
700
650
600
550
500
450
400
350
300
250
200
150
100
50
0
DRAG (LBS)
THRUST (FULL POWER)
DRAG (MAX WEIGHT)
60
70
80
90
100
110
120
130
140
150
160
170
180
190
INDICATED AIRPEED


THRUST HORSEPOWER
260
240
220
200
180
160
140
120
100
80
60
40
20
0
Thrust Horsepower Required
Maximum Endurance Speed
Maximum range speed
0 10 20 30 40 50 60 70 80 90 100 150 160 170 180 190 200
0
TRUE AIRSPEED

POWER + ATTITUDE

=

PERFORMANCE

$$\text{Lift} = C_L \times \tfrac{1}{2} \times \rho \times V^2 \times S$$

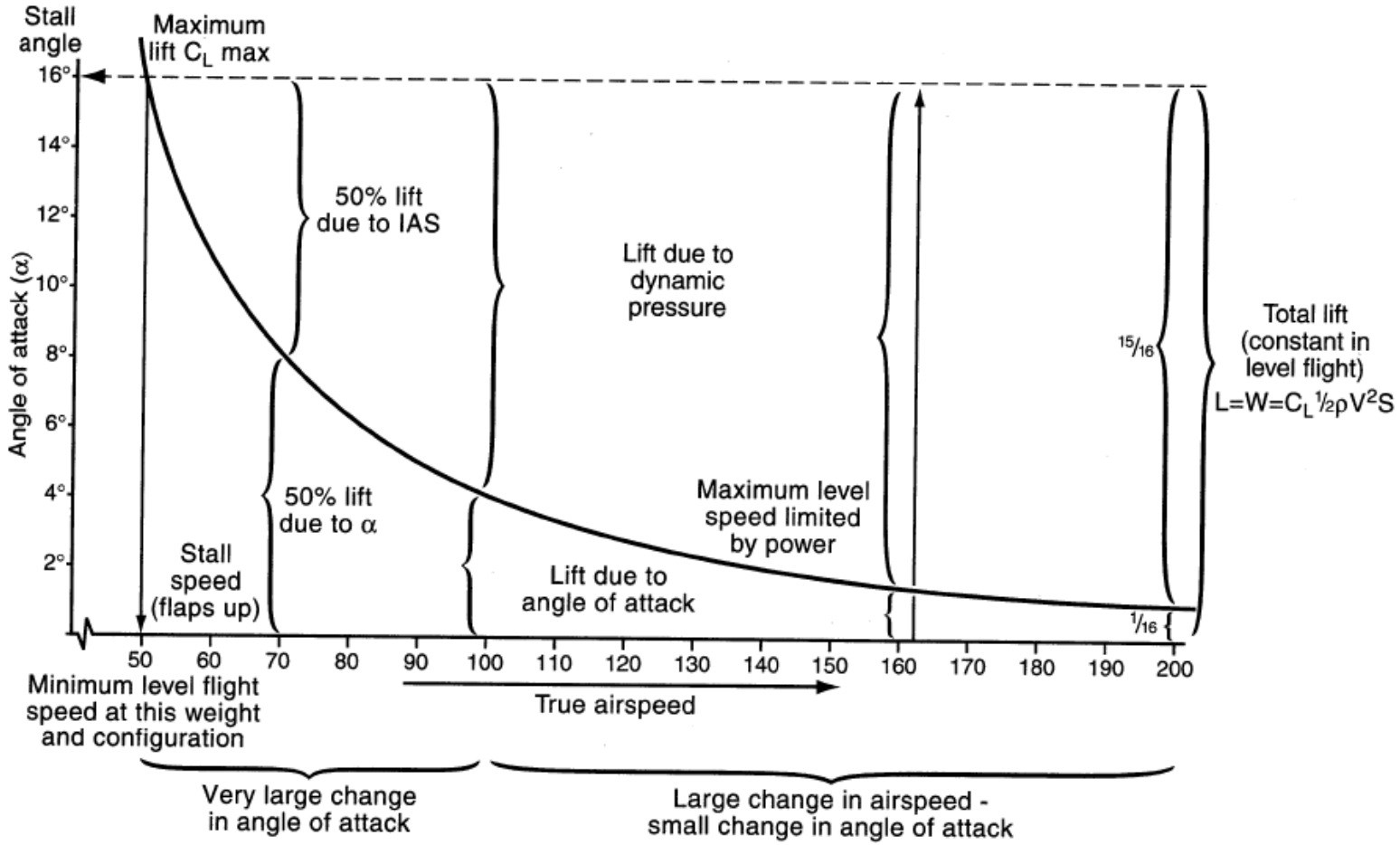
$$L = C_L \tfrac{1}{2} \rho V^2 S$$

During straight & level flight

$$W = L = C_L \tfrac{1}{2} \rho V^2 S$$

$$= C_L \tfrac{1}{2} \rho V^2 S$$


VH-RDN
ALT



IAS increases AoA decreases

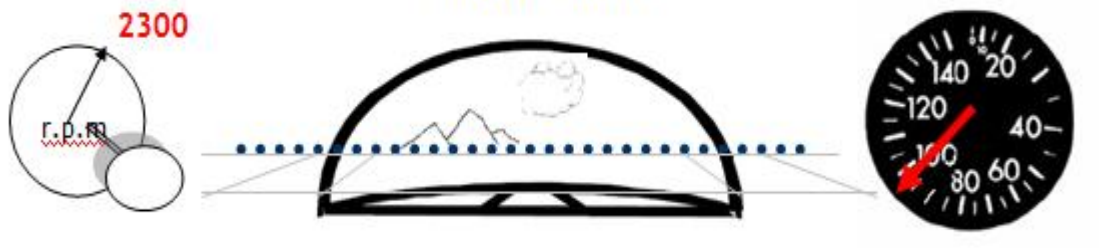
IAS decreases AoA increase

POWER + ATTITUDE

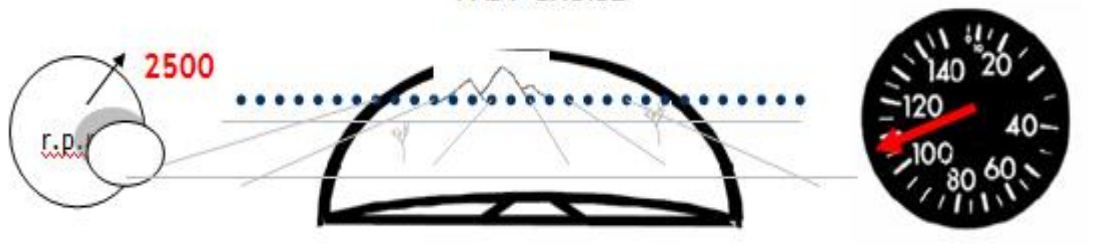
= PERFORMANCE

POWER + ATTITUDE = PERFORMANCE

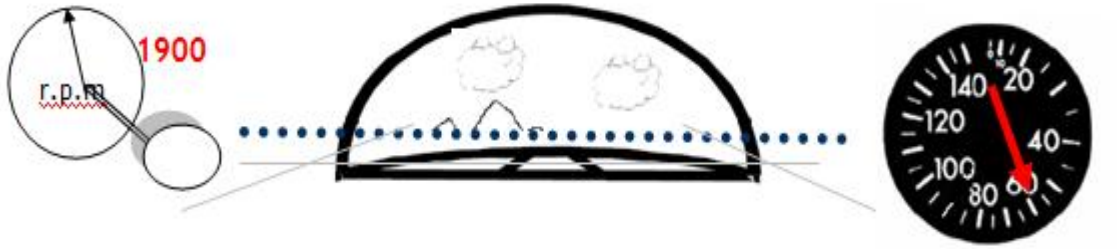
NORMAL CRUISE



FAST CRUISE



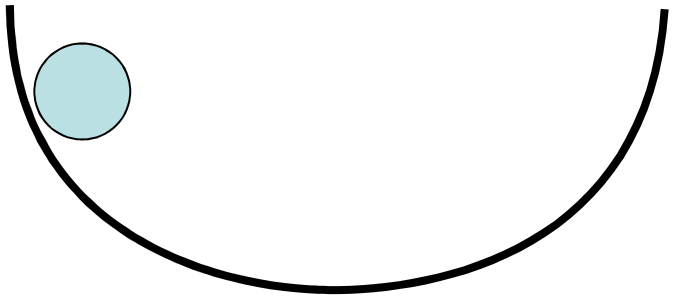
SLOW CRUISE



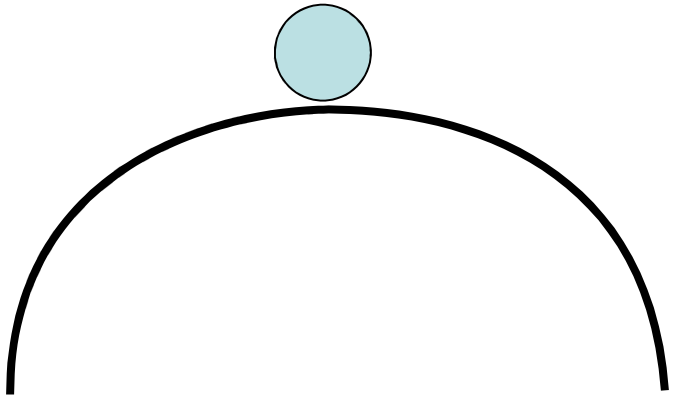
TRIMMING TECHNIQUE

STABILITY

NEUTRAL STABILITY



POSITIVE STABILITY

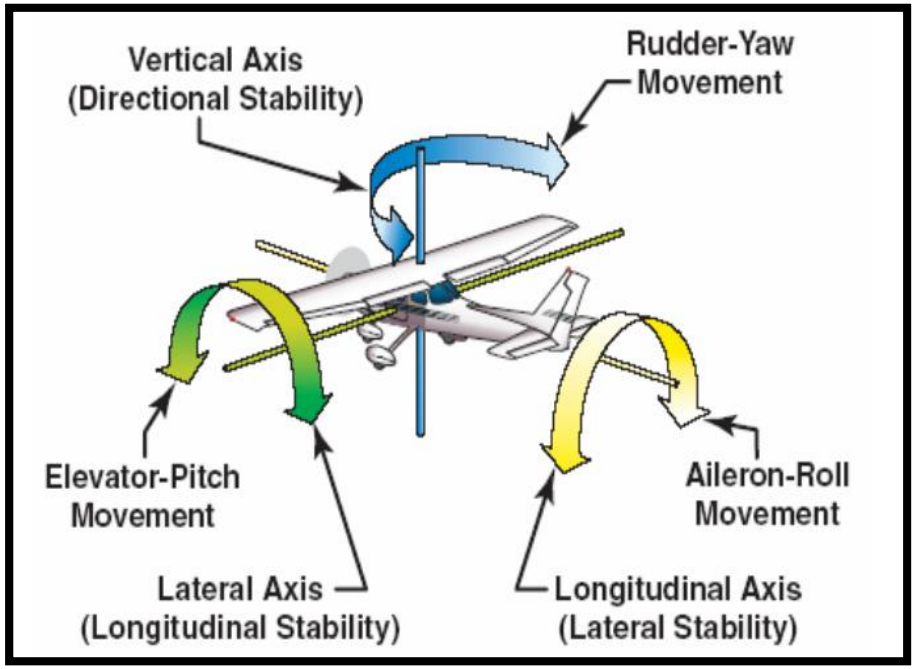


NEGATIVE STABILITY

Stability

Stability is the aircrafts ability to return to normal flight path after a disturbance, Without any corrective action taken by the pilot.

- Directional stability
- Longitudinal stability
- Lateral stability

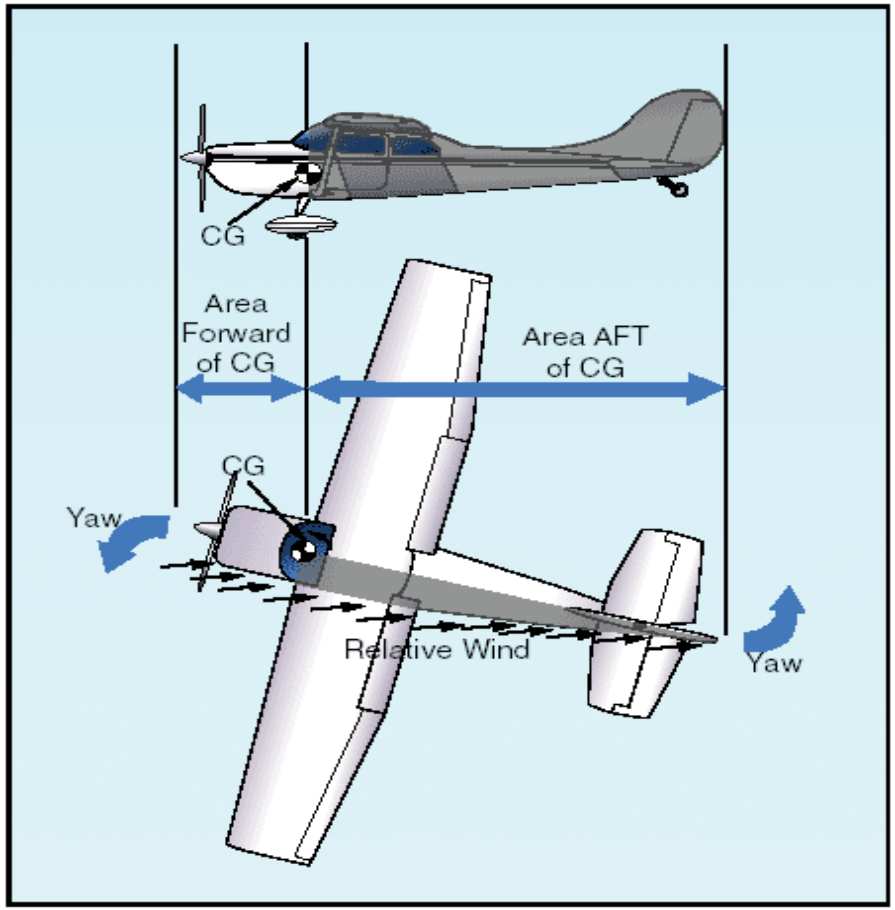


DIRECTIONAL STABILITY

Directional Stability

Stability is the aircrafts ability to return to normal flight path after a disturbance, Without any corrective action taken by the pilot.

- **Directional stability**
- Longitudinal stability
- Lateral stability



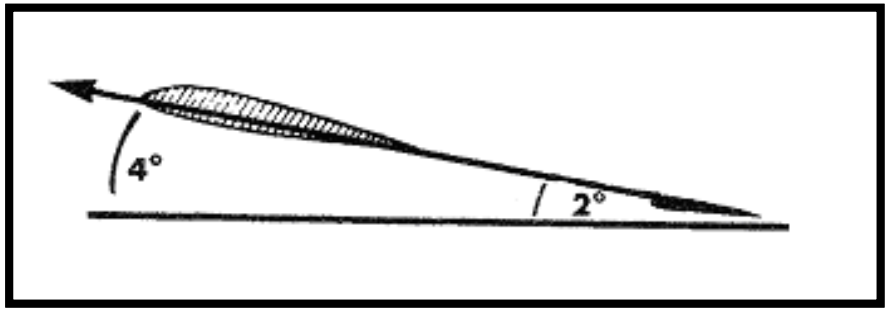
Keel Surface

LONGITUDINAL STABILITY

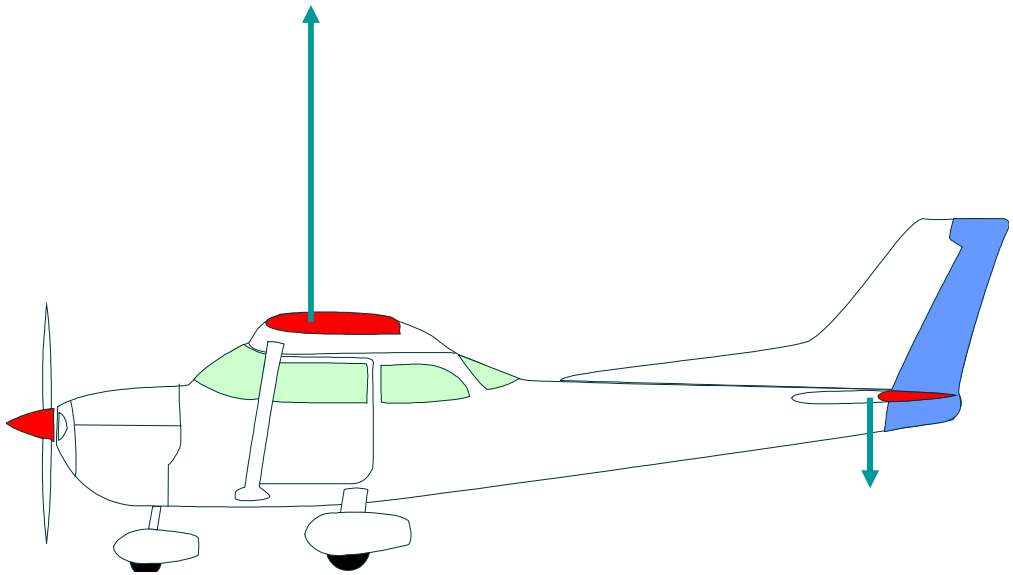
Longitudinal Stability

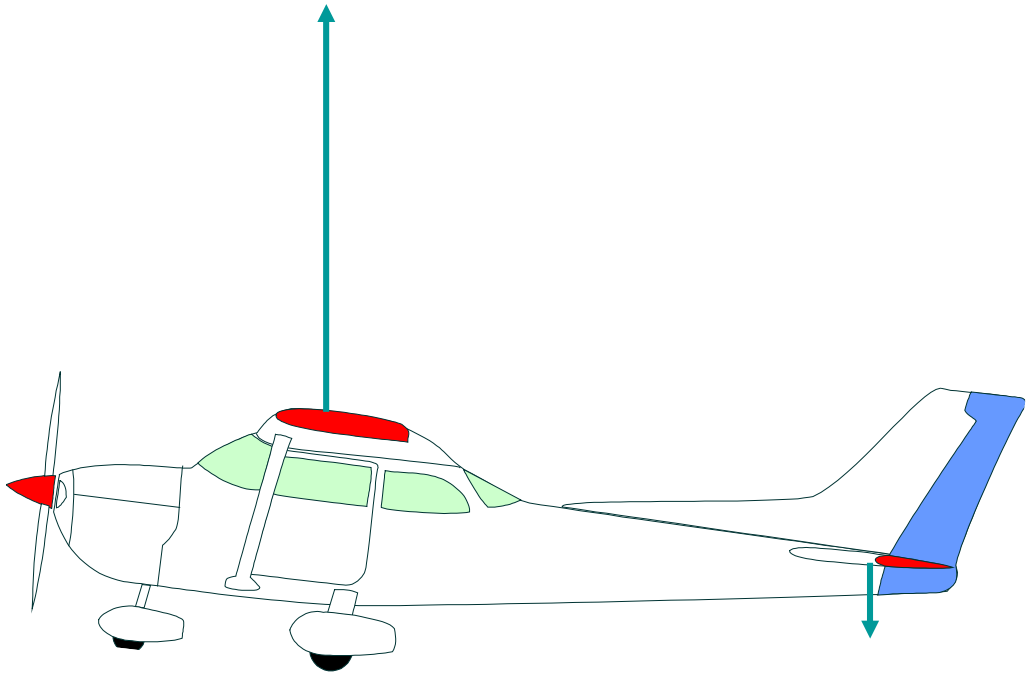
Stability is the aircrafts ability to return to normal flight path after a disturbance, Without any corrective action taken by the pilot.

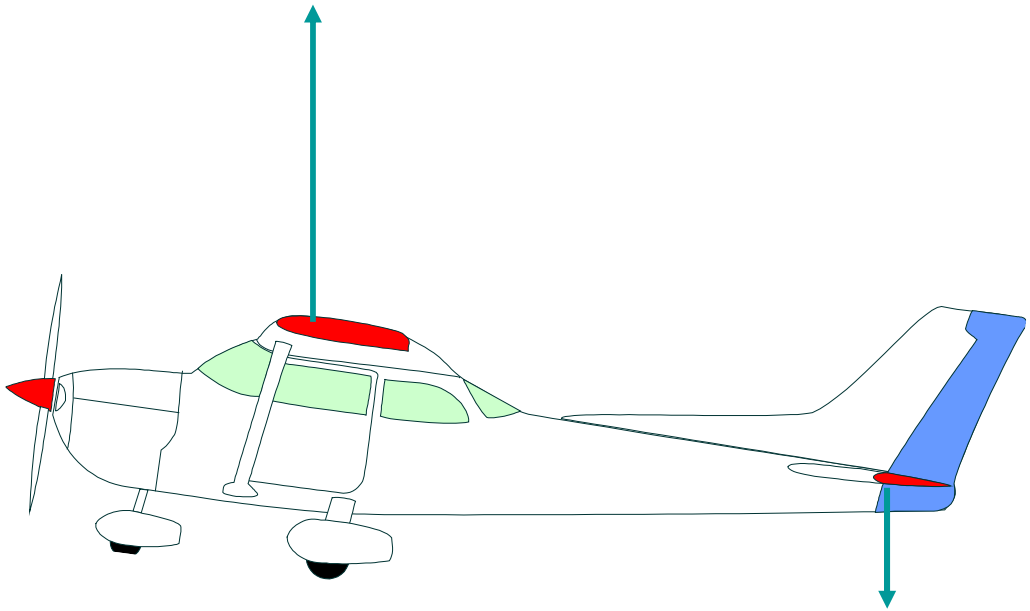
- Directional stability
- **Longitudinal stability**
- Lateral stability



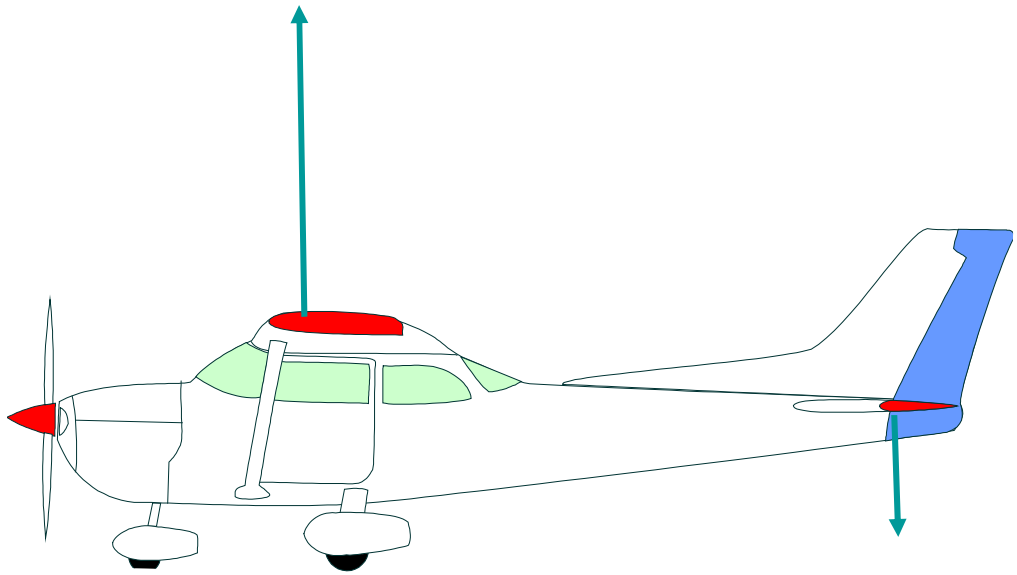
Tail Plane







NOSE UP PITCH ATTITUDE INCREASES
TAIL NEGATIVE ANGLE OF ATTACK,
INCREASING TAIL-DOWN FORCE



AIRCRAFT RETURNS TO ORIGINAL TRIMMED PITCH ATTITUDE BEFORE DISTURBANCE, IE, POSITIVE PITCH STABILITY

LATERAL STABILITY

Lateral Stability

Stability is the aircrafts ability to return to normal flight path after a disturbance, Without any corrective action taken by the pilot.

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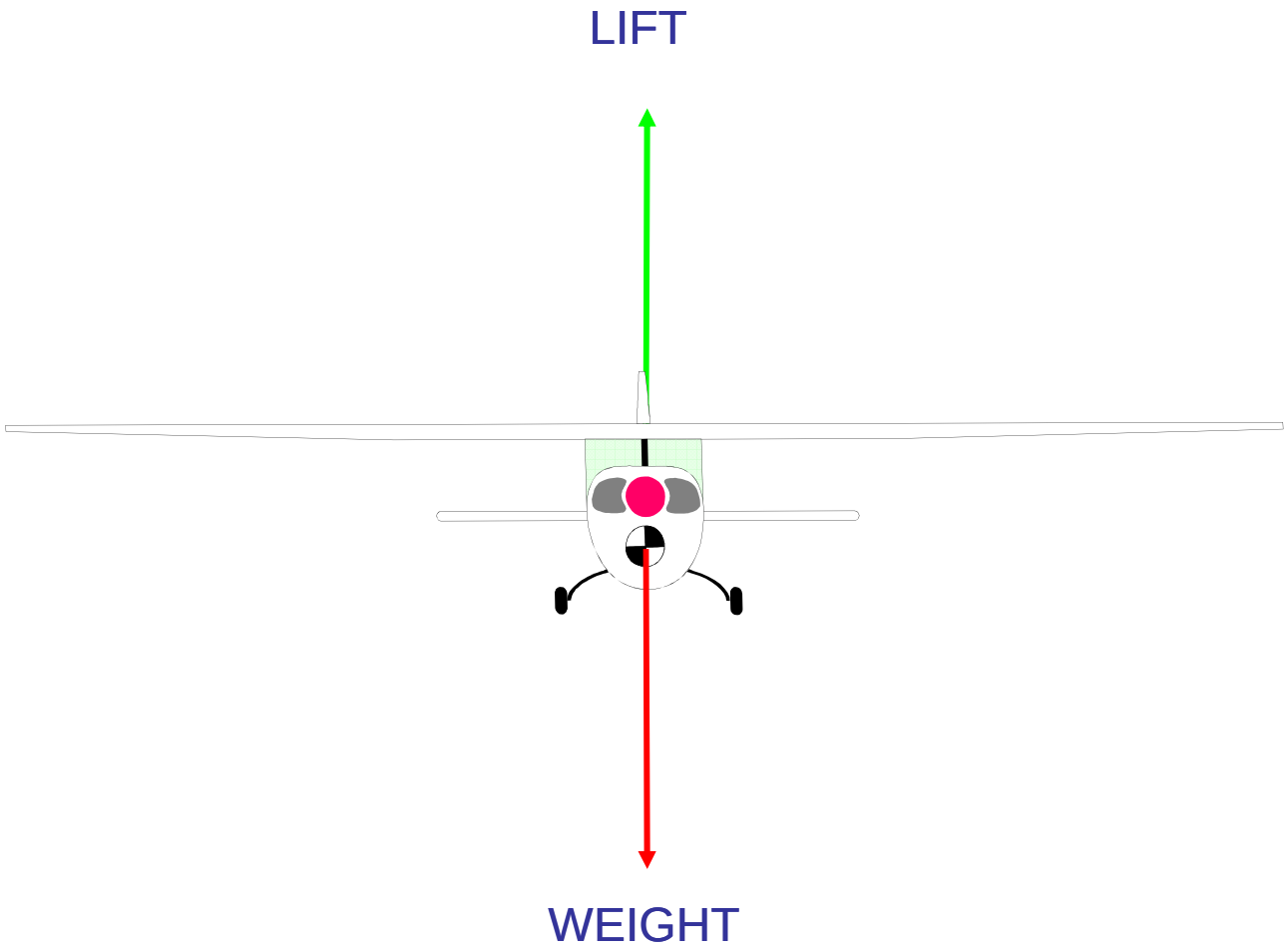
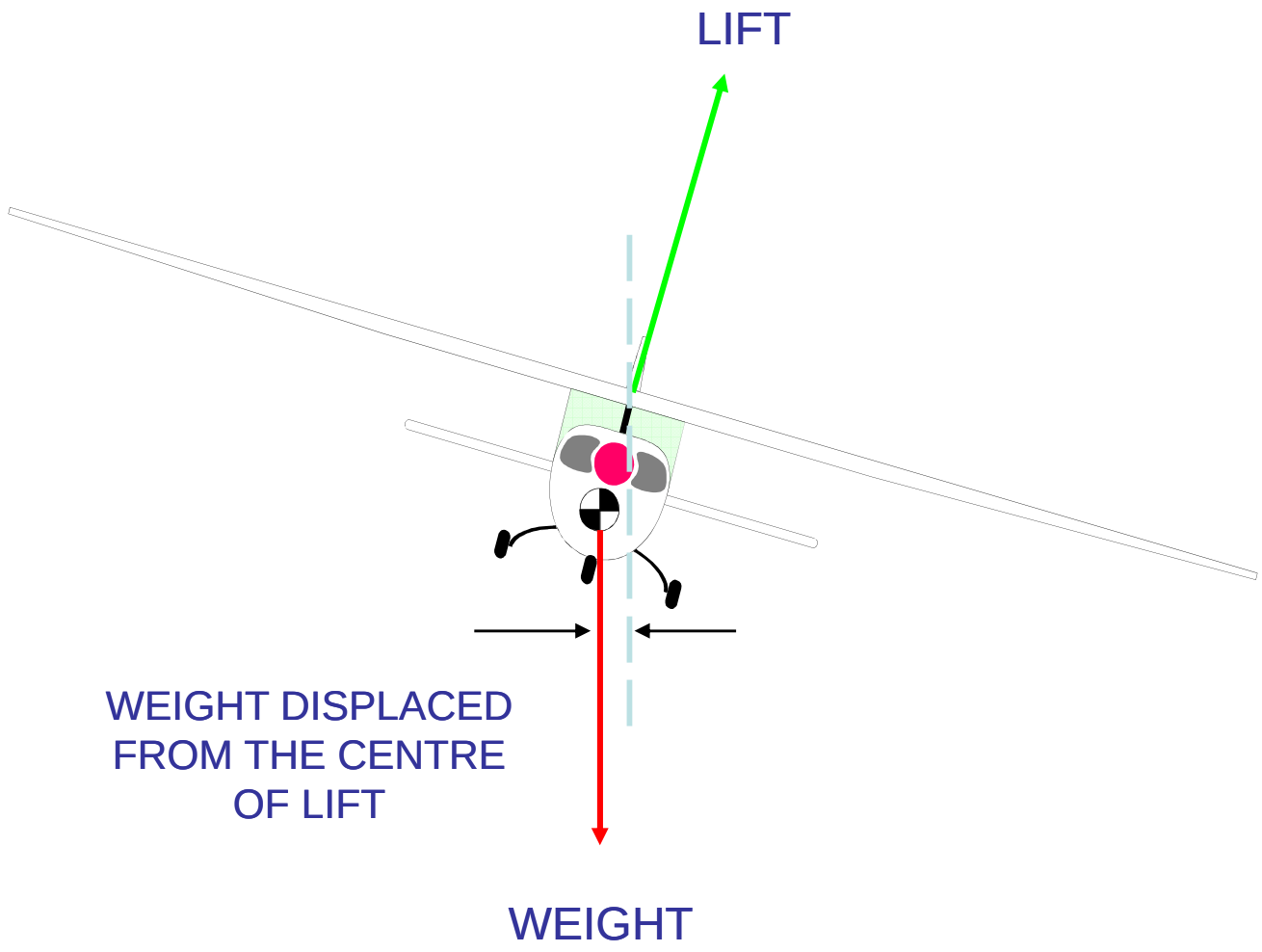
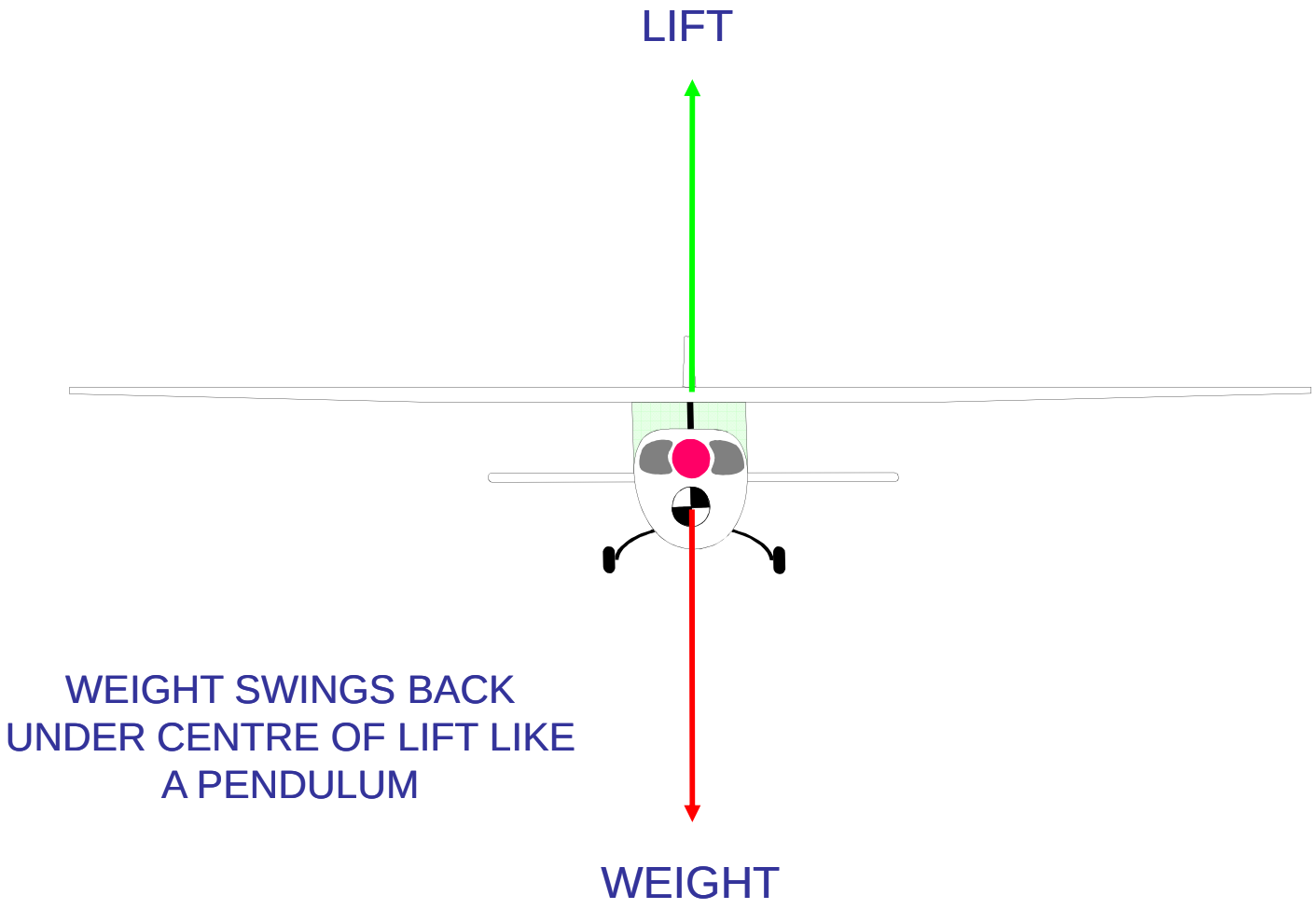
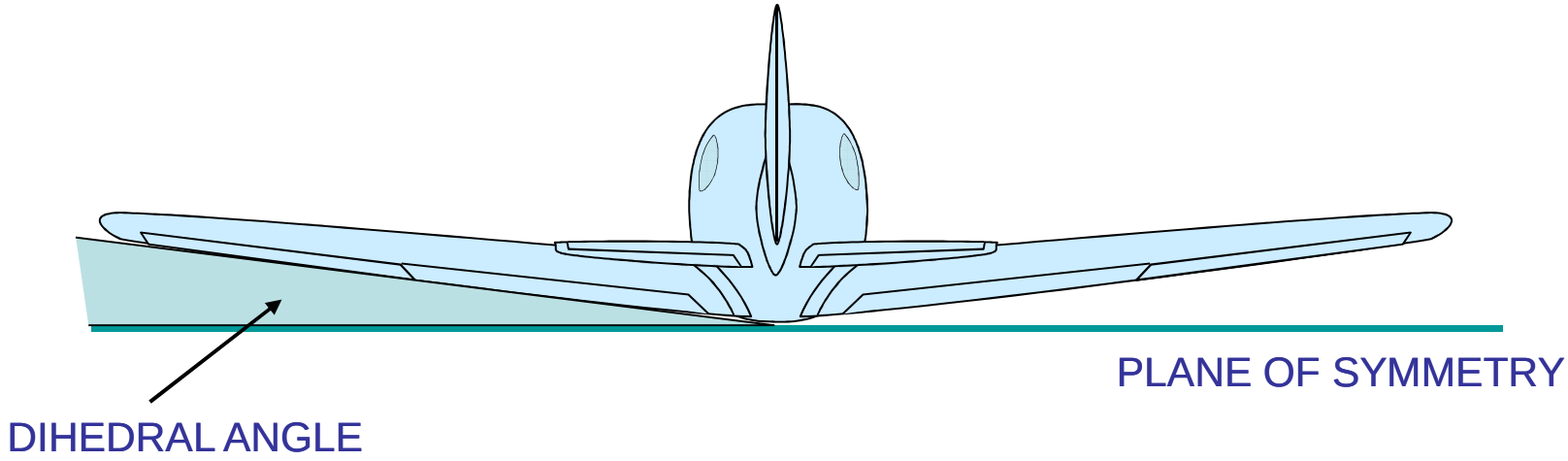
- Longitudinal stability
- **Lateral stability**

Dihedral

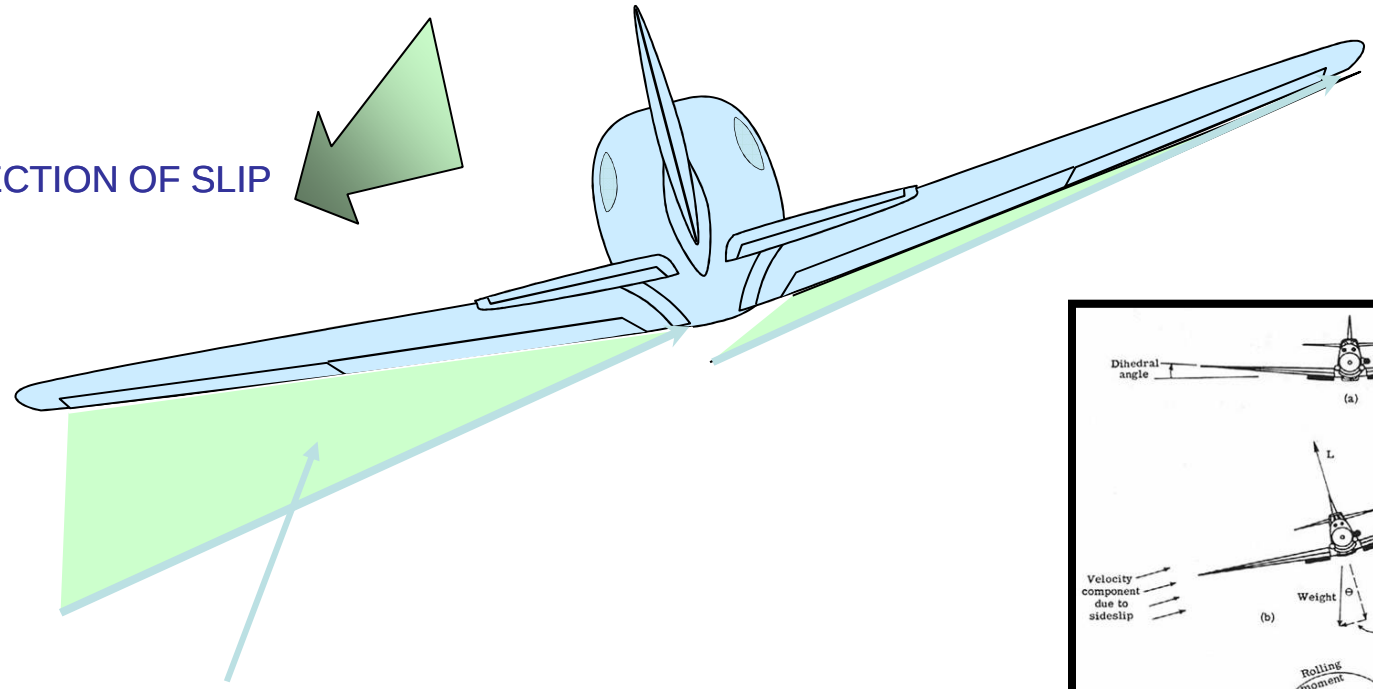

LIFT
WEIGHT


LIFT
WEIGHT DISPLACED
FROM THE CENTRE
OF LIFT
WEIGHT

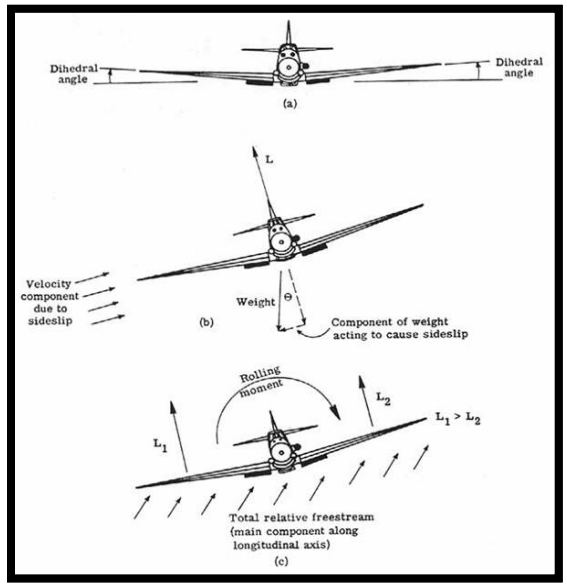

LIFT
WEIGHT SWINGS BACK
UNDER CENTRE OF LIFT LIKE
A PENDULUM
WEIGHT

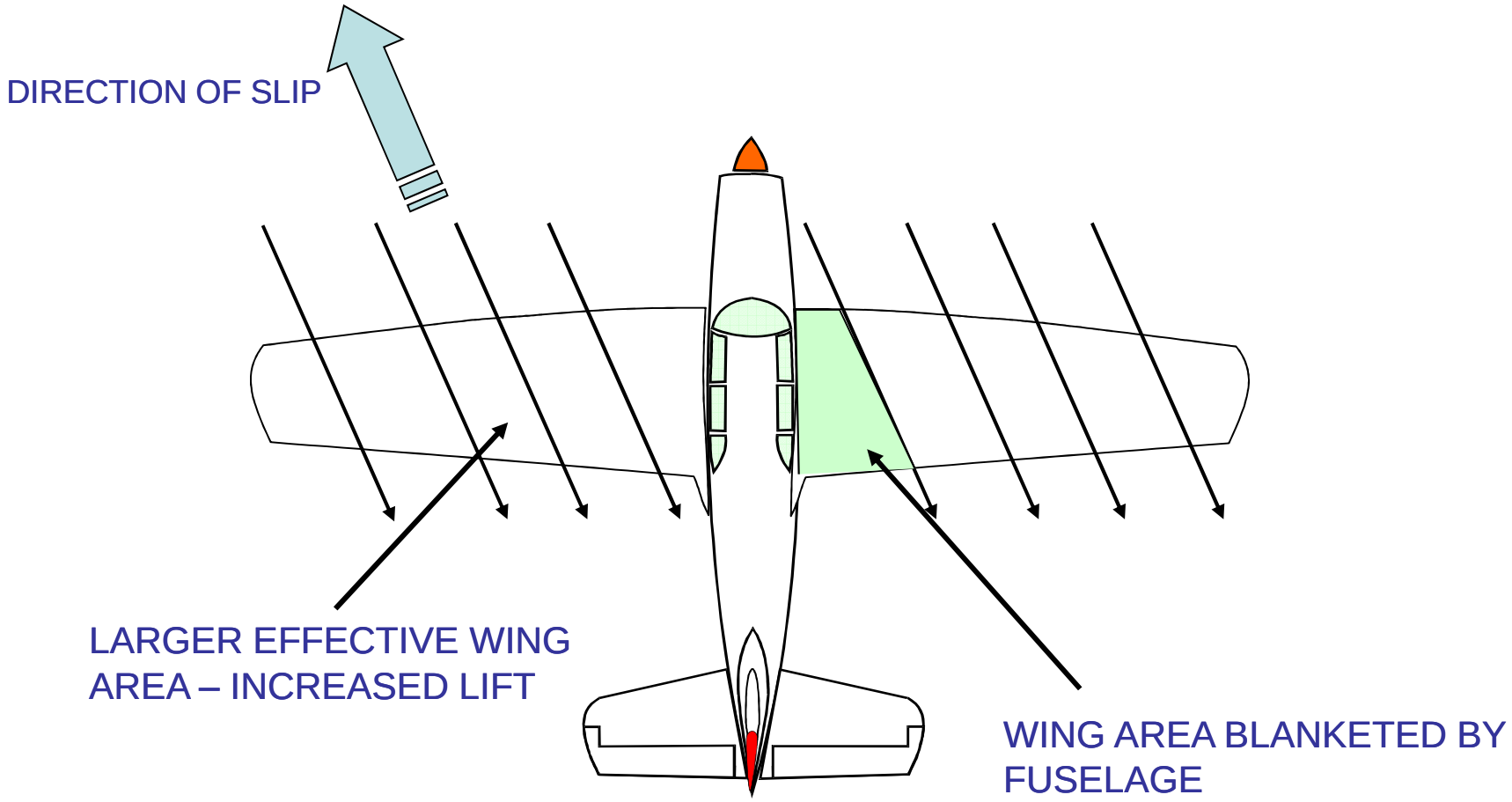

PLANE OF SYMMETRY
DIHEDRAL ANGLE

DIRECTION OF SLIP



HIGHER ANGLE OF
ATTACK ON LOWER WING




DIRECTION OF SLIP
LARGER EFFECTIVE WING AREA – INCREASED LIFT
WING AREA BLANKETED BY FUSELAGE

Airmanship

- LOOKOUT - traffic
- ORIENTATION – VTC, training area
- HANDING OVER / TAKING OVER - correct procedure
- SITUATIONAL AWARENESS – being aware of everything around you

SITUATION AWARENESS IS KNOWING where you are and what's going on. It's "the big picture", and one of the very foundations of pilot competence.

Straight and Level Flight

Aim

To teach the student how to fly the aeroplane in straight and level flight at varying airspeeds.

Objectives:

At the end of this briefing the student should be able to….

1. State with the aid of a model, the forces acting on an aircraft in steady straight and level flight.

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