FPP Notes

Check Graph 2.3 types from 1st set for performance again.

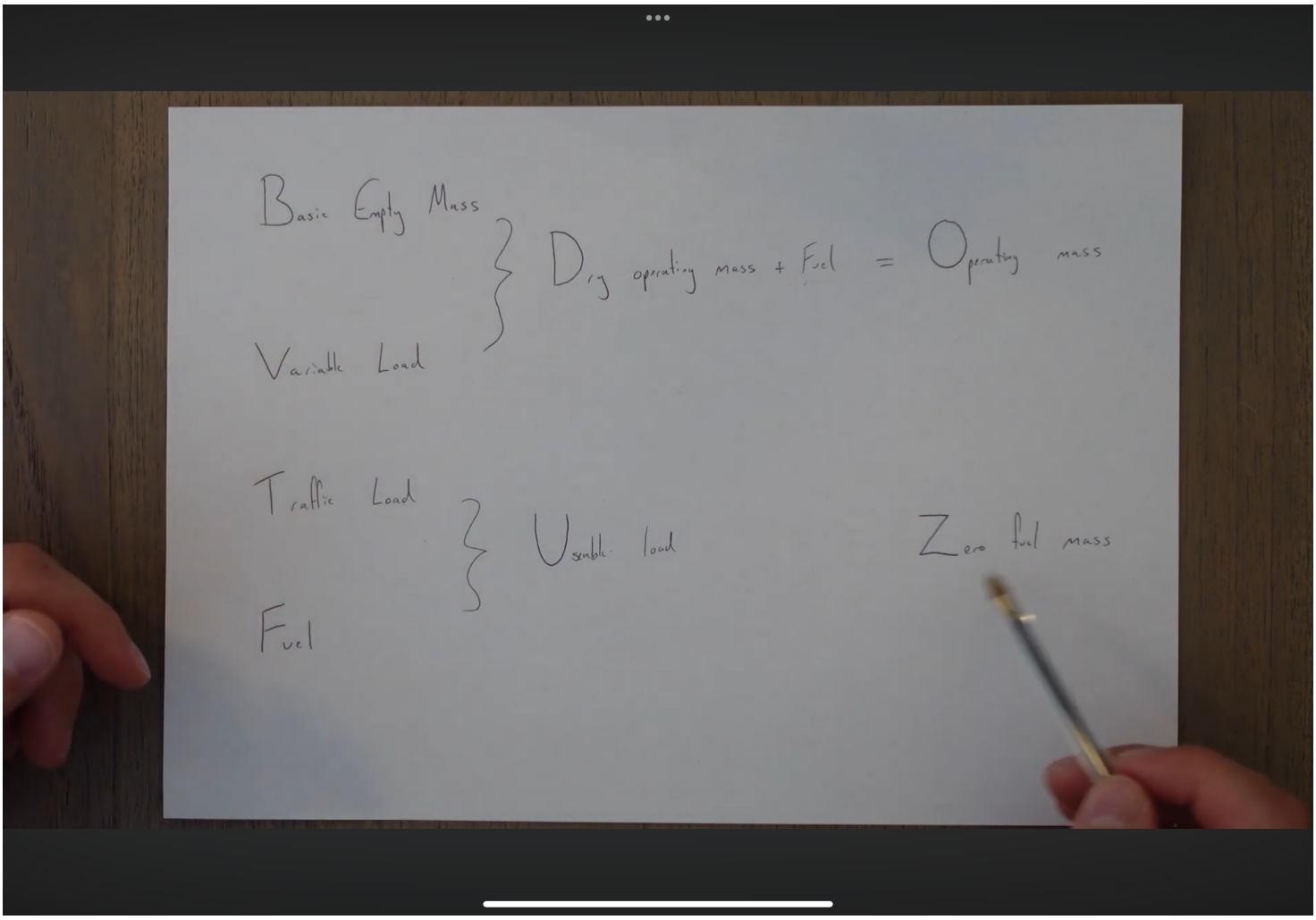
CG

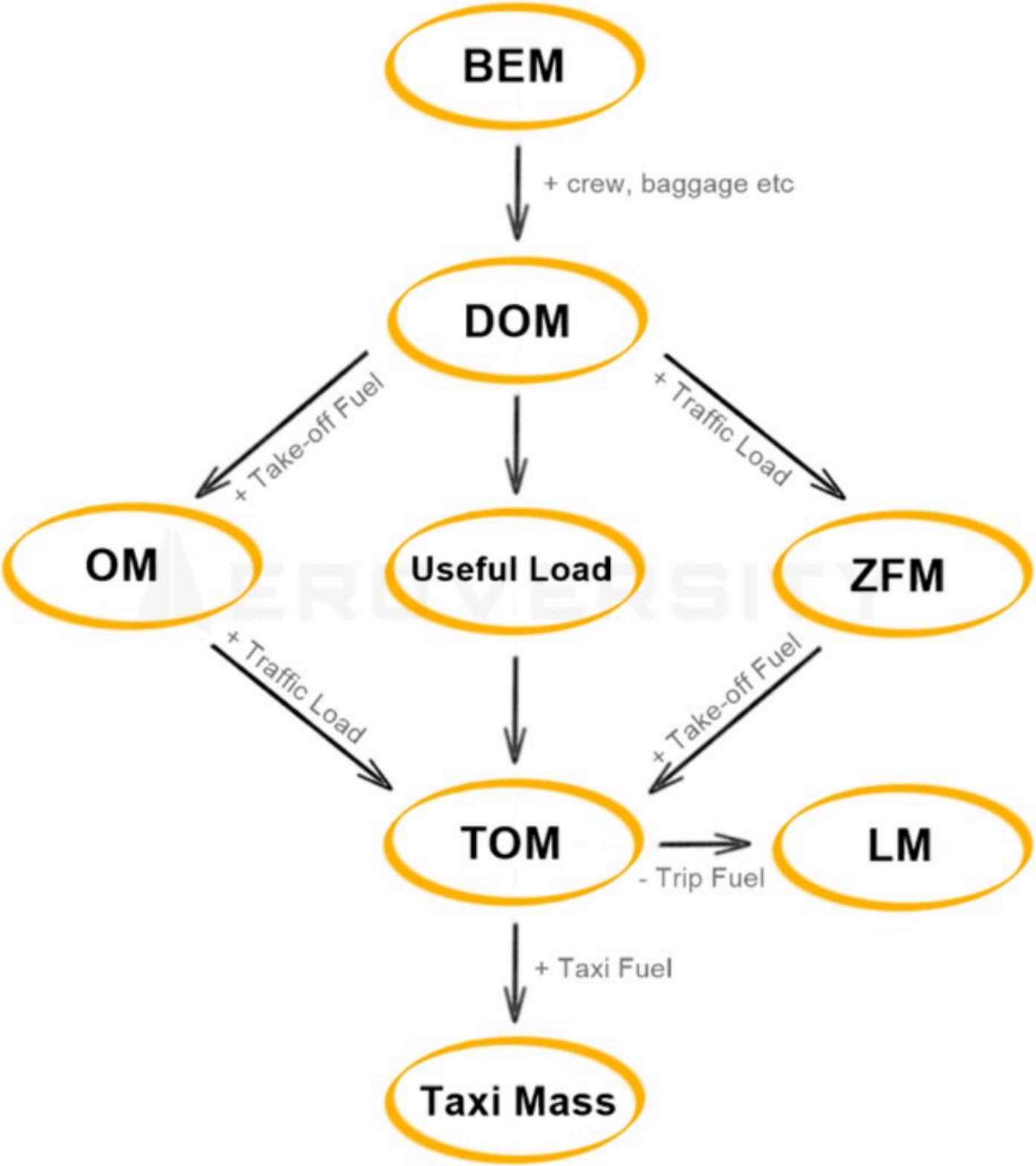
Neutral stability (CG BEHIND rear limit)
CG between front and rear CG limits and includes both
Fuel data of litres entered in KG, stick force on rotation will be lighter
Changing of tailplane (horizontal stab) incidence angle has NO effect on CG
Stabiliser trim setting does not affect the centre of gravity
Datum is a fixed vertical plane and not a point

Mass & Balance

Individual weight 5 years
Fleet weight 9 years (Min. 9 aircraft) [48 months gap max]
DOM by Operator
Mass & COG by operator prior to initial entry in service
Weighed in enclosed non air-conditioned hangar
3 points of support for weight
MZFM in Flight Manual
The basic empty mass of an aeroplane is recorded in the weighing schedule and is amended to take account of changes to the modifications of the aeroplane

Floor load = Weight / Surface Area
Mass * Arm = Moment
Change in CG = (Mass Change / Total Mass) * Distance Moved


Basic Empty Mass
Variable Load
Dry operating mass + Fuel = Operating mass
Traffic Load
Fuel
Usable load
Zero fuel mass


BEM
+ crew, baggage etc
DOM
+ Take-off Fuel
+ Traffic Load
OM
Useful Load
ZFM
+ Traffic Load
+ Take-off Fuel
TOM
- Trip Fuel
LM
+ Taxi Fuel
Taxi Mass

Calculating CG Shift

Adding Mass:

$$\frac{Mass\ Change}{New\ Total\ Mass} = \frac{Change\ in\ CG}{Distance\ between\ Mass\ and\ CG}$$

Removing Mass:

$$\frac{Mass\ Change}{Old\ Total\ Mass} = \frac{Change\ of\ CG}{Distance\ between\ Mass\ and\ CG}$$

Moving Mass:

$$\frac{Mass\ Change}{Total\ Mass} = \frac{Change\ in\ CG}{Distance\ Moved\ by\ Mass}$$

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MZFM + take-off fuel

ATOM = RTOM

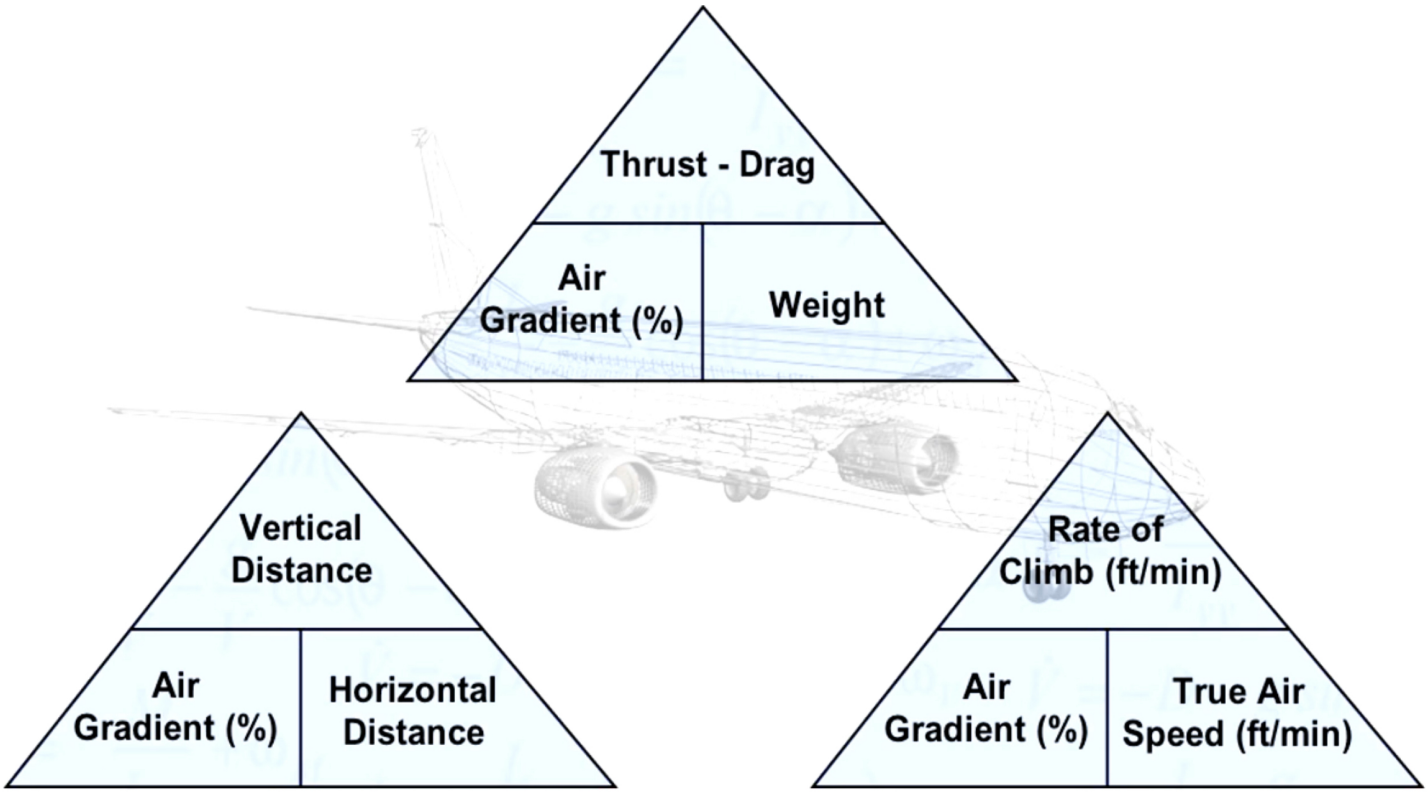
RLM + trip fuel

The aircraft's mass will increase by a factor 1.125:

$$135000 \div 120000 = 1.125$$

Therefore, the stalling speed will be increased accordingly:

$$\sqrt{1.125} \times 180 = 191\text{kts}$$



Loading

Useful Load for LIGHT AIRCRAFTS = Pilots + Operating Items + Passengers + Baggage + Cargo + Usable Fuel

UNUSABLE FUEL is a part if MZFM
Structural Max Mass is a fixed value in Aeroplane Operating Manual

MZFM is a regulated limitation limited by +2.5G and based on centre tank consumption first but at permissible bending moment at the wing root

Passenger mass by verbal statement if seats<10

Conversion of fuel volume to mass must be done using fuel density values of **0.79 for JP1 and 0.76 for JP4 as specified in SA CATS and CARS**

Performance

Class A CS25- Turbo-prop (10+ seats or 5701KG+) & all JET

Class B CS23- All propellers (9- seats or 5701-KG)

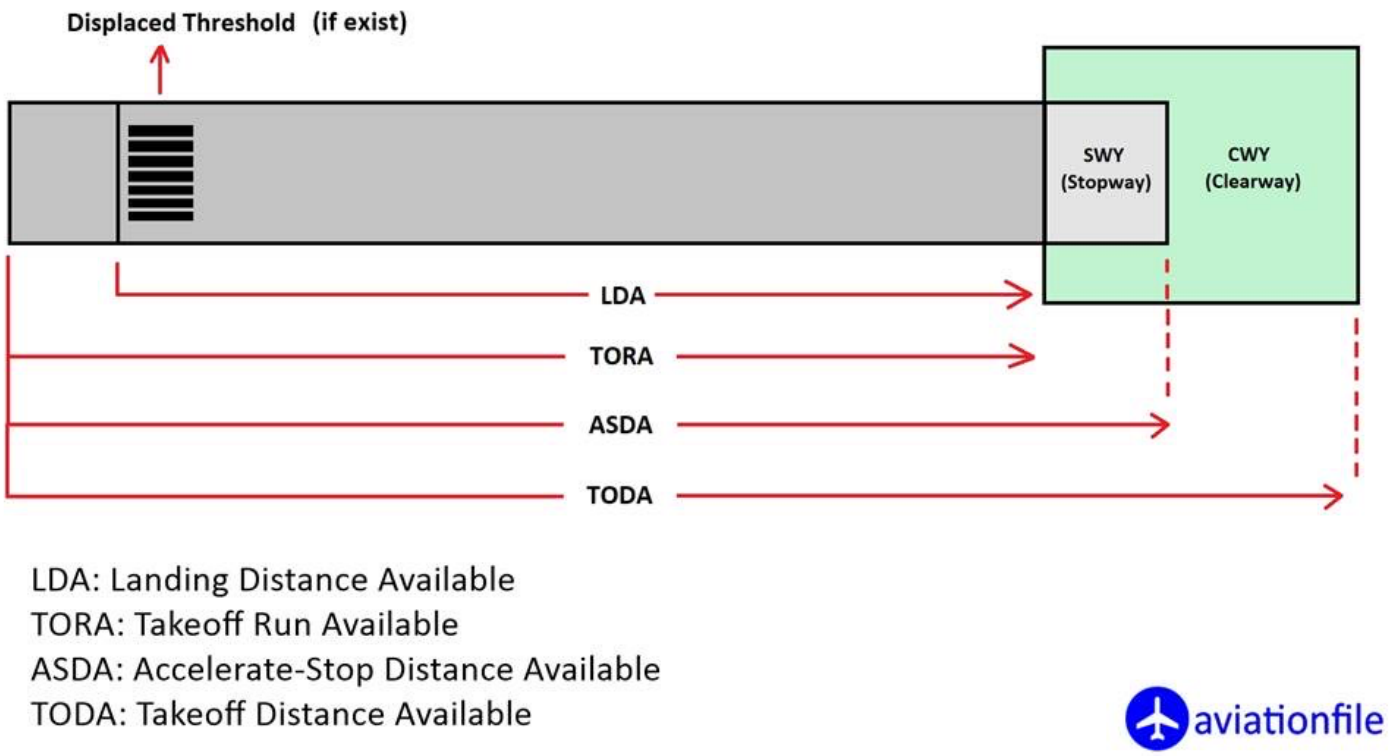
Class C- All pistons (10+ seats or 5701KG+)

Unclassified- Sea planes or supersonic

Jet = Drag
Prop = Power

	Jet			Propeller		
	Equation	Speed	Altitude	Equation	Speed	Altitude
Range	$\frac{TAS\ (GS)}{SFC \times Drag}$	1.32 Vmd	High	$\frac{TAS\ (GS)}{SFC \times \text{Power Required}}$	1.32 Vmp (Vmd)	Manufacturers Design
Endurance	$\frac{1}{SFC \times Drag}$	Vmd	High	$\frac{1}{SFC \times \text{Power Required}}$	Vmp	Low

Field Length Requirements & Limitations



TODA = TORA + CLRWAY(50% of TORA only)
TORA = THRESH TO THRESH (including displaced)
ASDA = TORA + STPWY
LDA = THRESH TO THRESH (no displaced thresh)

Balanced field (TODA = ASDA) provided minimum required field length for engine failure.

Required RWY length is the same at destination and alternate.

CLRWAY- Upslope < 1.25%, min 500ft wide

TO Run is the horizontal distance from start to a point equidistant between point at which VLOF is reached and at point which the aeroplane is 35ft above the TO surface at speed 1.15(V2) [FOR ENGINE FAILURE]

ASDA increases on uphill slope. TODA increased more than ASDA.
Downhill increases TODR and reduces V1.

LDR (50ft to full stop)
JETS = 60% max of LDA
PROPPLERS = 70% max of LDA

> **Take-off Run and Take-off Distance:**
>
> TOD = Distance to 35ft with V2 x 1.15
>
> **If there is no Stopway or Clearway:**
>
> - TORA > TOD x 1.25
>
> - Must not be less than 1.25 times the gross take-off distance to 50 ft
>
> **If there is a Stopway or Clearway:**
>
> - TORA > TOD
>
> - ASDA > TOD x 1.3
>
> - TODA > TOD x 1.15

Screen height is reduced for wet runways for weight penalties.

Field length limited TO mass increases if clearway included in calculations.

Tyre speed is **NOT** affected by slopes.

Reduced TO thrust NOT ALLOWED when

1. Anti-skid INOP
2. Windshear
3. Icy or slippery RWY
4. Contaminated RWY

USED ONLY for better engine life and when actual mass < PLTOM

Anti-skid concerns both TO and LANDING.

LDR increases by 15% default if no correction mentioned in COA.

TO performance based upon failure of critical OR all engines whichever gives greater distance.

The half width of the obstacle corridor at distance D from end of TODA is minimum **90m+0.125D**

CLTOM is based ONLY on weight, altitude, and OAT. **(WAT)**

For SHORT LANDING OPS, max **Declared Safe Area is 90m**

For constant altitude and speed for JET, speed and SFC increase slightly.

Aerodynamics

Induced drag minimum at VS0 or lowest achievable speed in a given configuration.

Climb gradient is the increase of altitude to horizontal air distance expressed as %

The angle of climb with flaps extended is smaller than with retracted

Piston engine best climb Vy is min. burnfuel burn speed (holding)

Backside of power curve is unstable speed
Backside of thrust curve is lower airspeed requiring more thrust

Heavier aeroplane will have higher vertical and forward speeds for a given AOA

In a horizontal un.acc flight if the mass decreases, minimum drag decreases and IAS for it decreases

Piston engine, increasing altitude increases TAS but keeps drag same.

Streamlined flow of fluid has 2 energy types (PRESSURE + KINETIC)
Airstream velocity increases by factor 4, drag by 16
Frontal area of body by 3, drag by 3

Increase in wing loading increases stall speed

If speed doubles, CL = 1CL/4, CD = 1/16, drag = 1/4

COP of positive camber shifts forward until approaching critical AOA

For positive camber, when CL=0, nose is down.

L/D is unaffected by density.

If weight increases, L/D remains same but at a higher speed.
Highest L/D, D is lowest.

$$T+W\sin(GAMMA) = D$$

$$W\times\cos(GAMMA) = L$$

Gliding angle for min. drag speed is minimum (SUBSONIC)

L/D determines horizontal glide distance from a given alt. at wi0 wind and 0 thrust

Angle of climb (AOC) depends ONLY on weight and thrust
AOC = Still air gradient * TAS

NET flight path gradient is SMALLER than ACTUAL gradient.

4 forces act through CG

Power vs TAS graph, tangent is where L/D is MAX.

Turn radius and G factor ONLY depend on AOB.

Max. IAS for piston engine is reached at lowest possible altitude.

Increasing AOA, CP reaches its most FWD point just bellow the stalling angle
Also, stag.point moves down and LOW PRESS forward.

$$RADIUS\ OF\ TURN = (TAS)^2 / g\times\tan\theta$$

$$Load\ Factor = 1/\cos(BANK\ ANGLE)$$

SPEEDS

Vref:
Class A- 1.23VS
Class B- 1.3 VS

V2 Summary:
Take off climb speed or speed at 35ft
Must be at least 1.1 VMCA
V2 can be limited by:

- 1.1 VMCA
- 1.13 VSR
- 1.08 VSR
- 1.2 VS

- 1.15VS

V2 can be limited by VMCA when:

- Low take-off mass
- large flap extension
- low field elevation

V2 can be limited by VS when:

- High take-off mass
- Smaller flap extension
- High field elevation

V2 min (Basic Summary)

- 1.1 VMC
- 1.2 VS:
  - 2-3 engine turboprops
  - Turbojet aeroplanes without the provision for obtaining a significant reduction in the one-engine inoperative power-on stalling speed
- 1.15 VS:
  - 4 engine turboprops
  - Turbojet aeroplanes with the provision for obtaining a significant reduction in the one-engine inoperative power-on stalling speed
- 1.13 VSR:
  - 2-3 engine turboprops
  - Turbojet aeroplanes without the provision for obtaining a significant reduction in the one-engine inoperative power-on stalling speed
- 1.08 VSR:
  - 4 engine turboprops
  - Turbojet aeroplanes with the provision for obtaining a significant reduction in the one-engine inoperative power-on stalling speed

PET /CP

$$D = \frac{DH}{O + H}$$

PNR

$$D = \frac{EOH}{O + H}$$

$$D = \frac{FOB - Reserves}{\frac{f/c\ out}{g/s\ out} + \frac{f/c\ home}{g/s\ home}}$$

$$\text{Change in height} = \text{Gradient} \times \frac{\text{Dist. Trav}}{100}$$