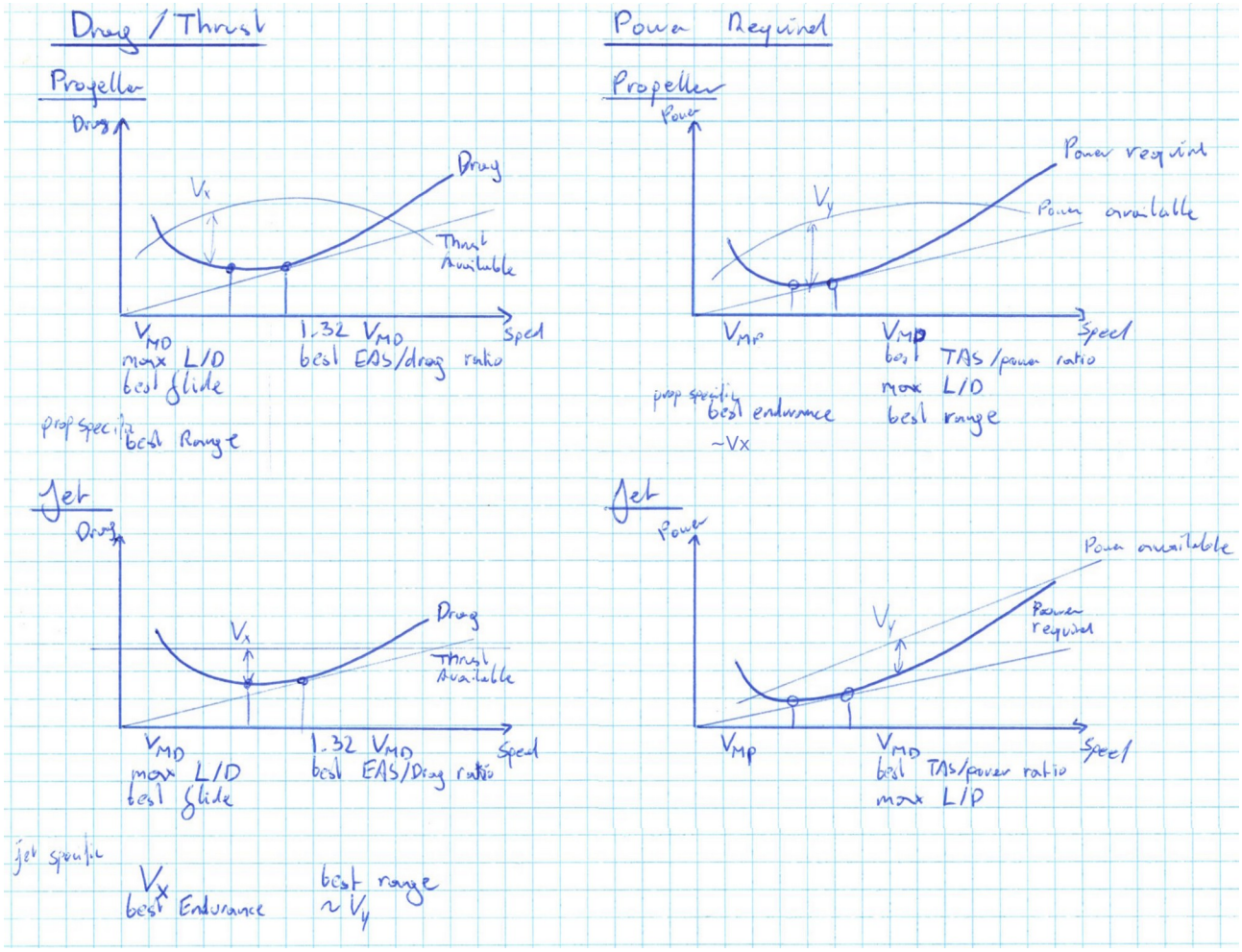
032 Performance

032-01 General



$$Climb\ Gradient = \frac{T - D}{W}$$

$$Descent\ Gradient = \frac{D - T}{W}$$

$$Climb\ Gradient = \frac{ROC}{\text{Speed (ft/min)}}$$

$$Descent\ Gradient = \frac{ROD}{\text{Speed (ft/min)}}$$

$$Specific\ Range = \frac{TAS}{Total\ Fuel\ Flow} = \frac{TAS}{SFC \cdot Drag}$$

climb: $T = D + W \cdot \sin\gamma$ $\text{gradient (\%)} = \tan\gamma$ $Power = Thrust \cdot TAS$

$$climb\ gradient = \frac{T}{W} - \frac{D}{L}$$

specific range (jet) = nm / unit mass fuel

jet: max range = minimum SFC

tan(y) = D / L ROD = V * D / L

032-02 Performance Class B: Single-engine Aeroplanes

takeoff

50ft speed: ≥ 1.2 V_{S1}

1.25 TOD ≤ TORA, with stop/clearway: TOD ≤ TORA & 1.3 TOD ≤ ASDA & 1.15 ≤ TODA

surface	condition	factor
grass (on firm soil)	dry	1.2
up to 20 cm long	wet	1.3
paved	wet	1.0
upslope per 1%		1.05

landing

V_{REF} = 1.3 V_{S0}

1.43 LD ≤ LDA

surface	condition	factor
grass (on firm soil)	dry	1.15
any	wet	1.15
downslope per 1%		1.05

NGM = NAM * GS / TAS

032-03 Performance Class B: Multi-engine Aeroplanes

Takeoff

50ft speed: ≥ 1.1 V_{MC}, ≥ 1.2 V_{S1}

	Track Changes 0-15°	Track Changes >15°
VMC	300 m	600 m
IMC	600 m	900 m

obstacle requirements

* from 50 ft to the cloud base, gradient needs to be all-engine gradient * 0.77

* when reaching clouds: OEI ROC

enroute

not above altitude exceeding that at which the ROC equals 300 ft/min with all engines max continuous power

032-04 Performance Class A: Aeroplanes Certificated Under CS25 Only

032-04-01 Takeoff

1st segment	ends when gear is up
2nd segment	minimum of 400 ft, flaps are not retracted
3rd segment	transition or acceleration segment change from takeoff config to clean may be limited by take-off thrust time limit max continuous thrust at the end
4th segment	transition to enroute, at least 1500 ft

V_R	rotation speed, > 1.05 V_{MCA}
V_{MC}	minimum control speed with critical engine inoperative

V_{MCA}	minimum control speed in take-off config
V_{MCG}	minimum control speed on the ground (determined by engine thrust & rudder deflection)
V_{MU}	minimum unstick speed
V_{MBE}	maximum break energy speed
V_1	take-off decision speed
V_2	take-off safety speed (free air safety speed) – minimum speed to be reached at screen height usually lower than V_X
V_{2MIN}	minimum take-off safety speed >1.13 V_{SR} turbojets, 2/3 engine turboprops >1.08 V_{SR} turbojets with provisions for significant V_{SR} reduction during OEI, 4 engine turboprops >1.1 V_{MCA}
V_{SR}	stall reference speed (usually 1.06 V_S)
V_{LOF}	lift off speed
V_{SR0}	reference stall speed in landing config (usually 6% higher than V_{S0})

reduced take-off thrust	engine life, reduce noise, same speeds, TODR & ASDR increase
derated take-off thrust	reduced speeds, reduce of V_1 if limited by VMCG, shorter ASDR, higher TOM if limited by ASDA. TODR increases, ASDR decreases

obstacle clearance (increasing width):

for wingspan < 60 m: 60 m + ½ of wingspan + 0.125 * D

for wingspan > 60 m : 90 m + 0.125 * D

ACN < PCN (rigid * 1.05, flexible * 1.1)

032-04-02 Climb

cross over altitude – when IAS and Mach are same TAS

032-04-03 Cruise

CI = TIME / FUEL

032-04-06 Approach and Landing

$V_{REF} \geq 1.23\ V_{SR0}$

jets LDA * 1.67

props LDA * 1.43

weg LD * 1.15