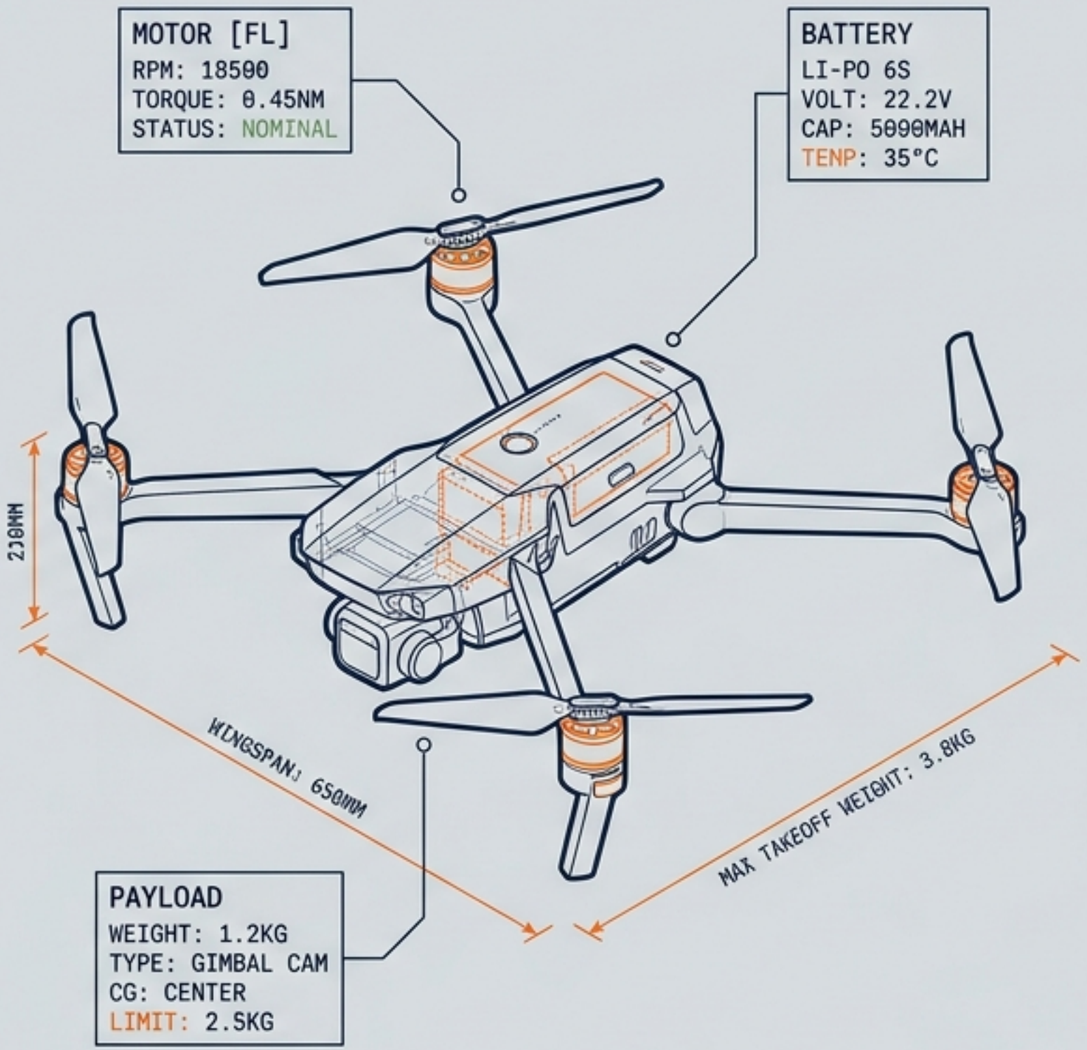
THE INVISIBLE ENVELOPE

MODULE 05 // AIRCRAFT LOADING, PERFORMANCE & MAINTENANCE

SYS.CHK..... OK
PHYSICS.ENG..... ONLINE
PART.107.LIMITS... ENFORCED



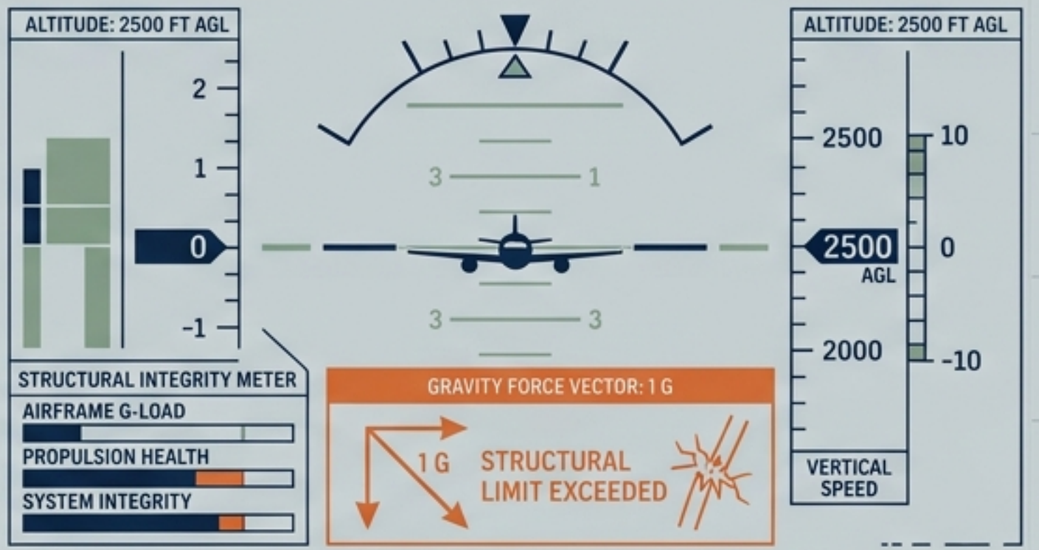
Gemini Notebook

DIGITAL ENVIRONMENT



- LIMITS ARE **HARDCODED.**
- CRASHES COST **XP.**
- FAILURES END IN A **RESPAWN.**

COMMERCIAL OPERATION (PART 107)

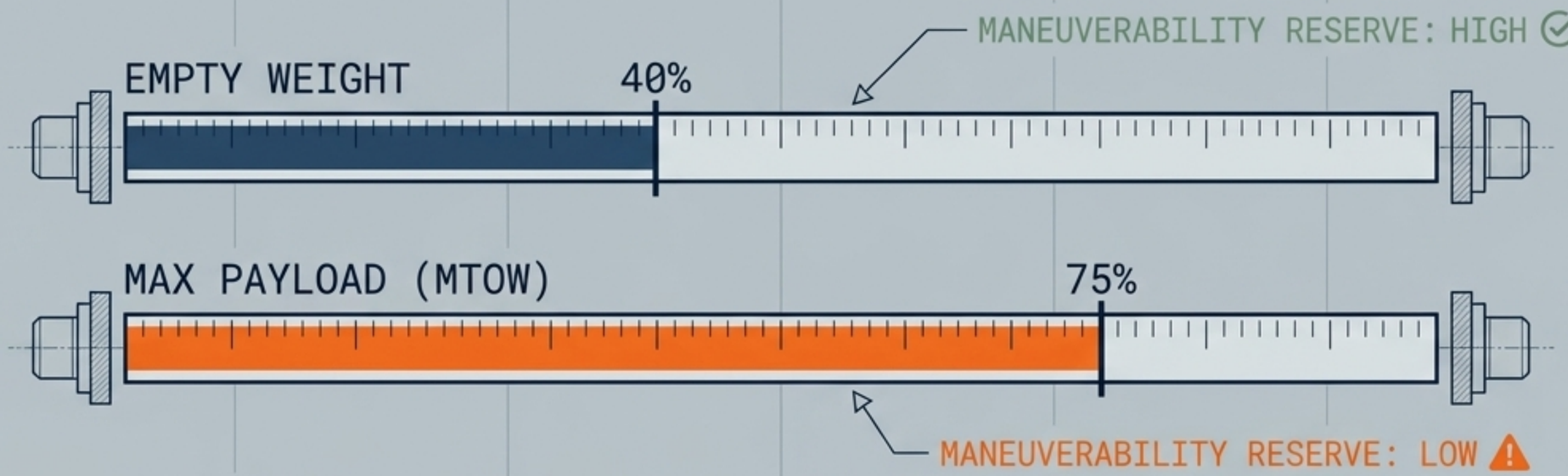


- LIMITS ARE **PHYSICS.**
- CRASHES COST **LICENSES** AND **CAPITAL.**
- FAILURES REQUIRE **ROOT-CAUSE MAINTENANCE.**

IN THE NAS, GRAVITY IS THE ULTIMATE ANTI-CHEAT MECHANISM.

Gemini Notebook

MANUFACTURER LIMITS VS. OPERATIONAL REALITY

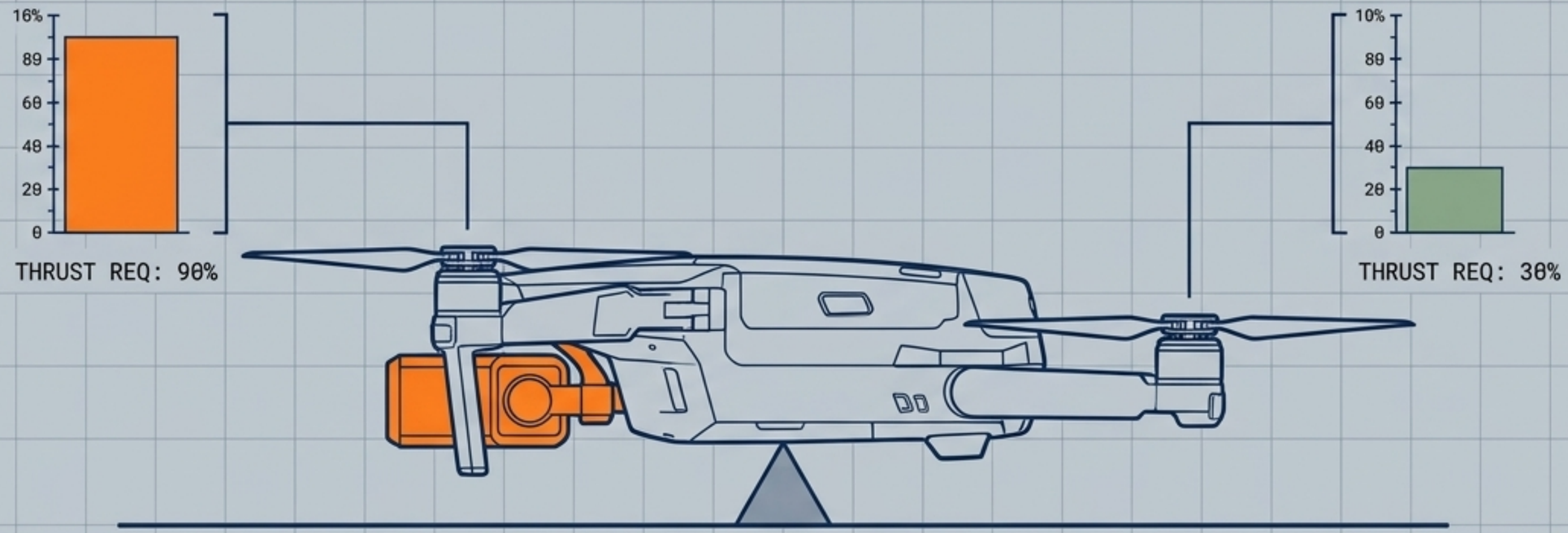


THE WEIGHT PENALTY

ADDING PAYLOAD DOES NOT JUST REDUCE BATTERY LIFE; IT DIRECTLY STEALS FROM YOUR MANEUVERABILITY RESERVE. WHEN MOTORS WORK HARDER SIMPLY TO FIGHT GRAVITY, THEY HAVE LESS RPM AVAILABLE TO FIGHT UNEXPECTED WIND GUSTS OR EXECUTE EMERGENCY EVASION.

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The Center of Gravity (CG) Seesaw

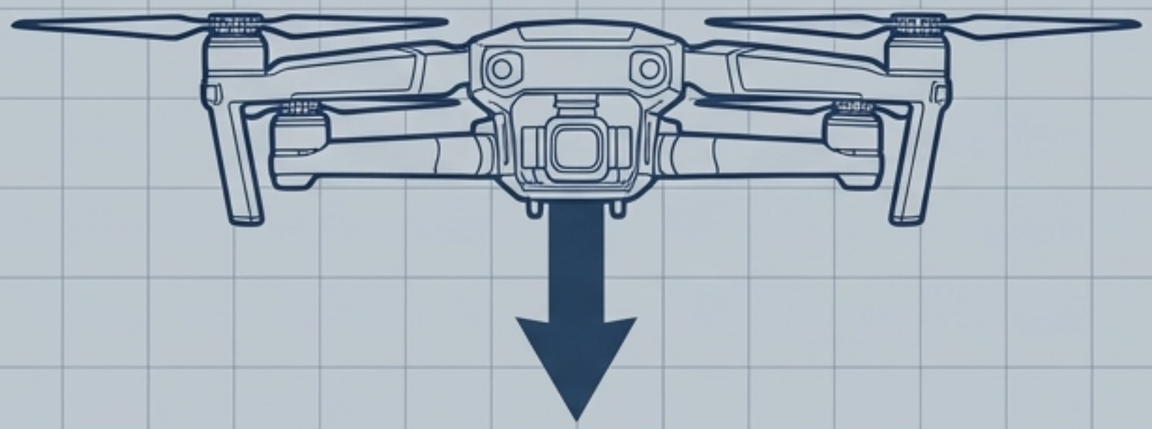


The Problem	The Result
To maintain a level hover, the flight controller must overdrive the front motors to compensate for the forward CG.	The drone is functionally maxed out on its fron axis while stationary. Any command to pitch forward or fight a headwind will result in motor stall or burnout.

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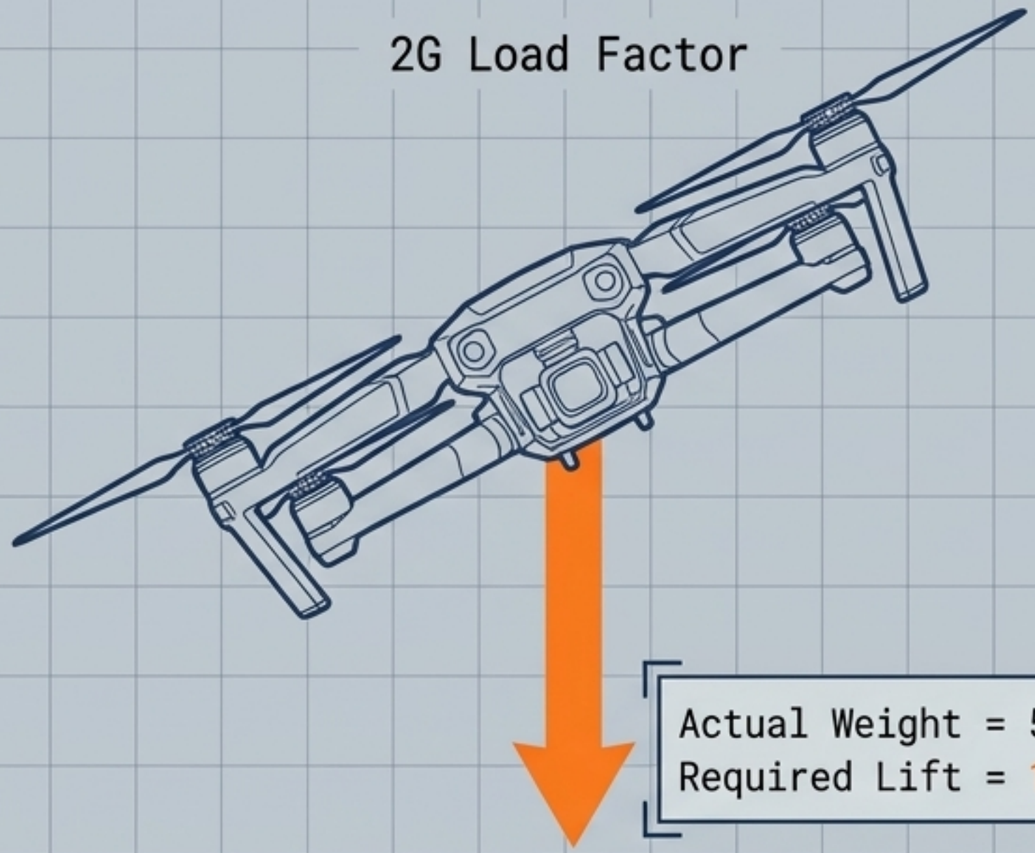
The Load Factor Multiplier (G-Force)

1G Load Factor



Actual Weight = 5 lbs
Required Lift = 5 lbs

2G Load Factor



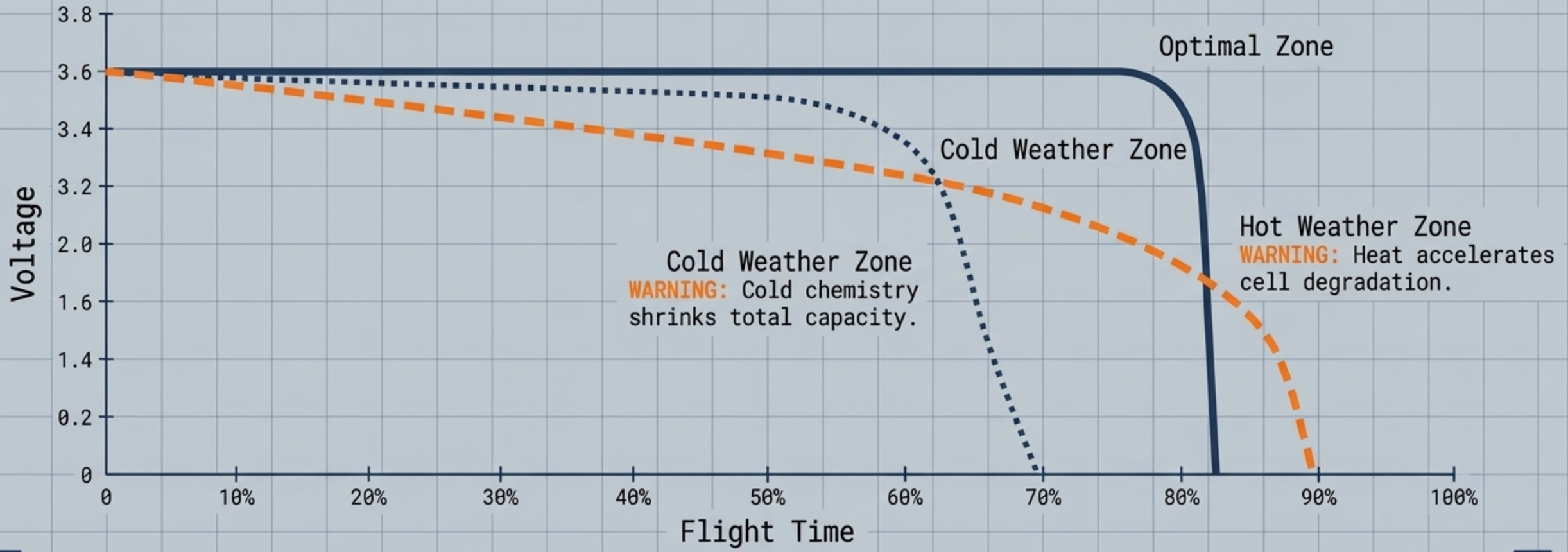
Actual Weight = 5 lbs
Required Lift = 10 lbs

Tactical Summary

A 60-degree bank instantly doubles the drone's effective weight. High-speed, aggressive cornering drains your energy envelope twice as fast as straight-and-level flight.

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The LiPo Voltage Cliff



Pilot Action:

Unlike AA batteries, LiPos do not slowly fade. They sustain high output and then suddenly fail. Never plan a mission that requires the bottom 20% of the curve.

Gemini Notebook

Lithium Polymer (LiPo) Management Protocols

Pre-Flight

`STATUS: VISUAL INSPECTION`

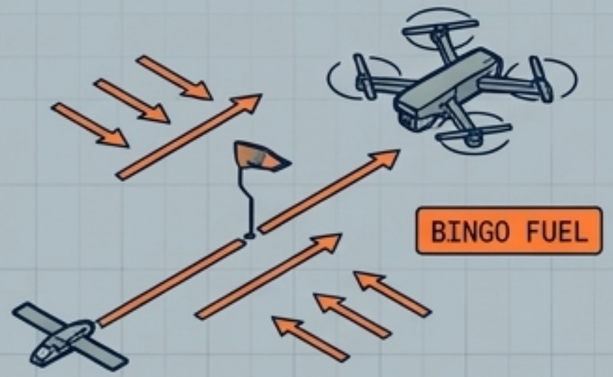
Check for swelling (puffing), punctures, or frayed leads. A damaged LiPo is a severe fire hazard, not just a dead battery.



In-Flight

`STATUS: ENDURANCE PLANNING`

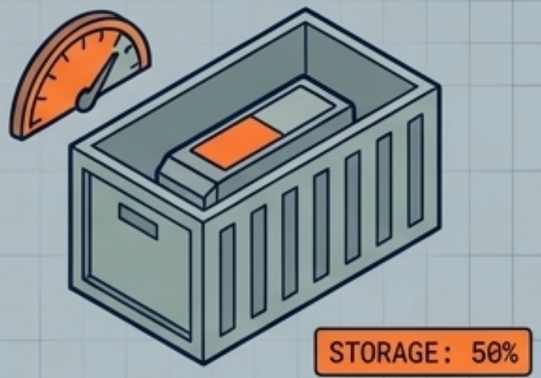
Establish a hard Bingo Fuel (return-to-home) reserve. Factor in headwinds on the return leg—flying back against the wind costs more energy than flying out.



Post-Flight

`STATUS: THERMAL LOGGING`

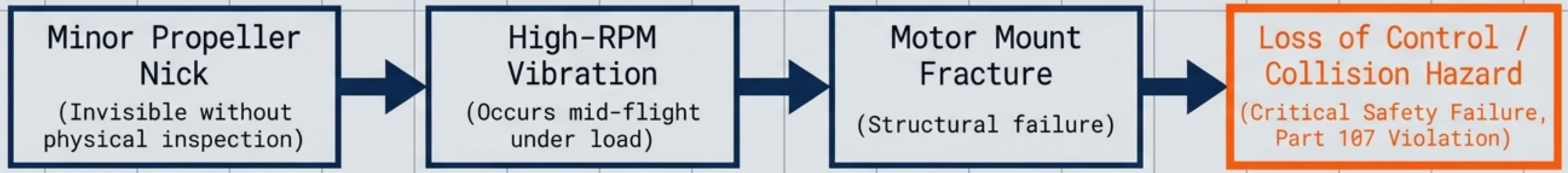
Never charge a hot battery immediately after a flight. Inspect for abnormal heat generation. Store at storage voltage (approx. 50%), never fully charged or fully depleted.



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The Maintenance Shield (Preflight & Postflight)

Core concept: A skipped preflight is how an invisible defect becomes a catastrophic mid-air failure.



In the Dakdan Academy Practical Standard, knowingly bypassing a preflight safety item or launching with a defect is an automatic evaluation failure.

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Inspection Architectures: Preflight vs. Postflight

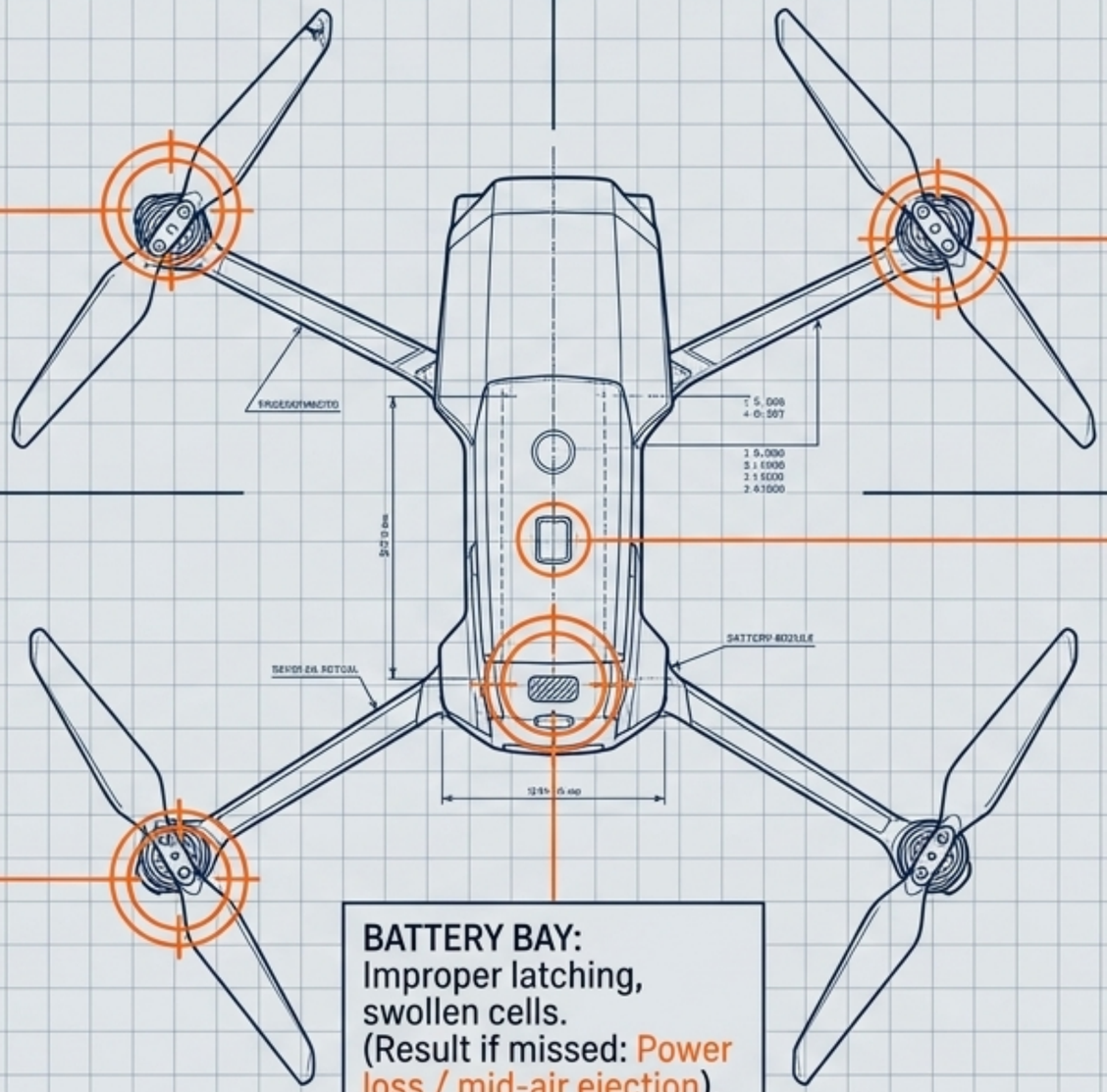
	PREFLIGHT (Prevention)	POSTFLIGHT (Preservation)
Primary Intent	Defect hunting and airspace verification.	Damage assessment and operational closeout.
Aircraft Focus	Props, motors, structural integrity, battery charge, Remote ID active.	Thermal checks (hot motors/batteries), new micro-fractures, safe power-down.
Data & Environment	Weather go/no-go, airspace authorizations (LAANC), crew roles set.	Flight time logged, mission files secured, incidents/exceptions documented.

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Target Recognition: Preflight Defect Hunting

PROPELLERS:
Leading-edge chips, hairline cracks at the hub.
(Result if missed: In-flight shattering).

MOTORS:
Grinding sounds when spun manually, debris inside the bell.
(Result if missed: In-flight stall).



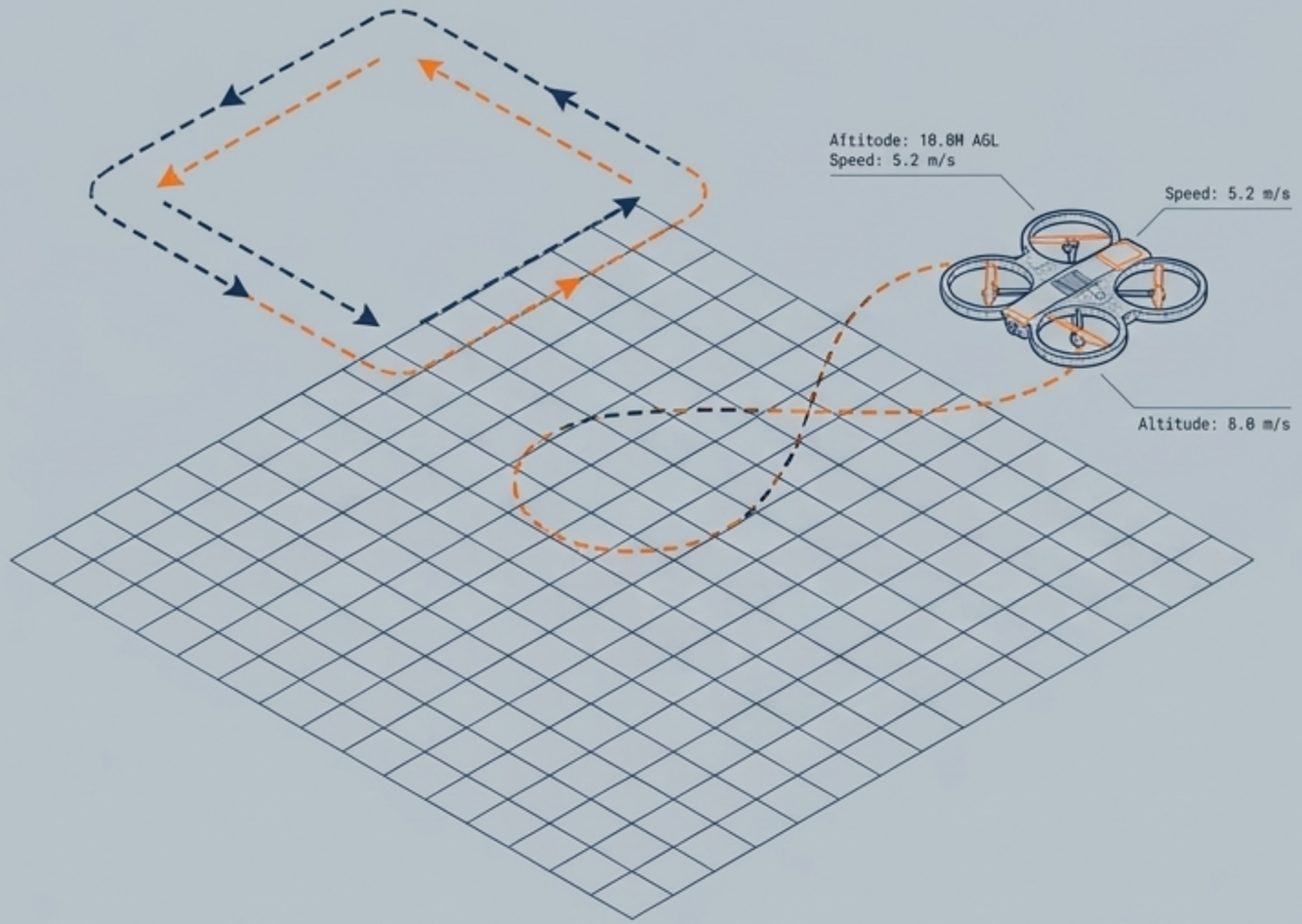
CHASSIS/LEGS:
Stress fractures near load-bearing joints.
(Result if missed: Hard landing collapse).

BATTERY BAY:
Improper latching, swollen cells.
(Result if missed: Power loss / mid-air ejection).

DIGITAL MARKERS:
FAA Registration marking clearly visible.
Remote ID module active and broadcasting.

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Basic Flight & Control Precision



Hovering & Translation

Requires continuous micro-adjustments against wind. A poorly balanced CG makes crisp stops impossible.

Pattern Work (Square/Circle/Figure Eight)

Tests orientation awareness (nose-in vs. tail-in) and the ability to maintain consistent altitude under banking (managing the Load Factor).

Precision Landing

The final procedural step. A controlled descent onto a targeted pad, ensuring no bounce or drift that could cause a prop-strike.

Gemini Notebook

The Commercial Operations Loop

LOADING & CG

Payload distribution dictates the physical envelope.

...dictates...

FLIGHT PERFORMANCE

Motor strain, G-forces, and maneuverability reserve.

...dictates...

BATTERY DRAIN

LiPo voltage drop and weather impact.

...dictates...

FLIGHT TIME & MAINTENANCE

Safe endurance limits end in postflight preservation.

...resets...

SYSTEM HARMONY

Mastery of Module 5 means managing the entire loop, not just flying the drone.

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