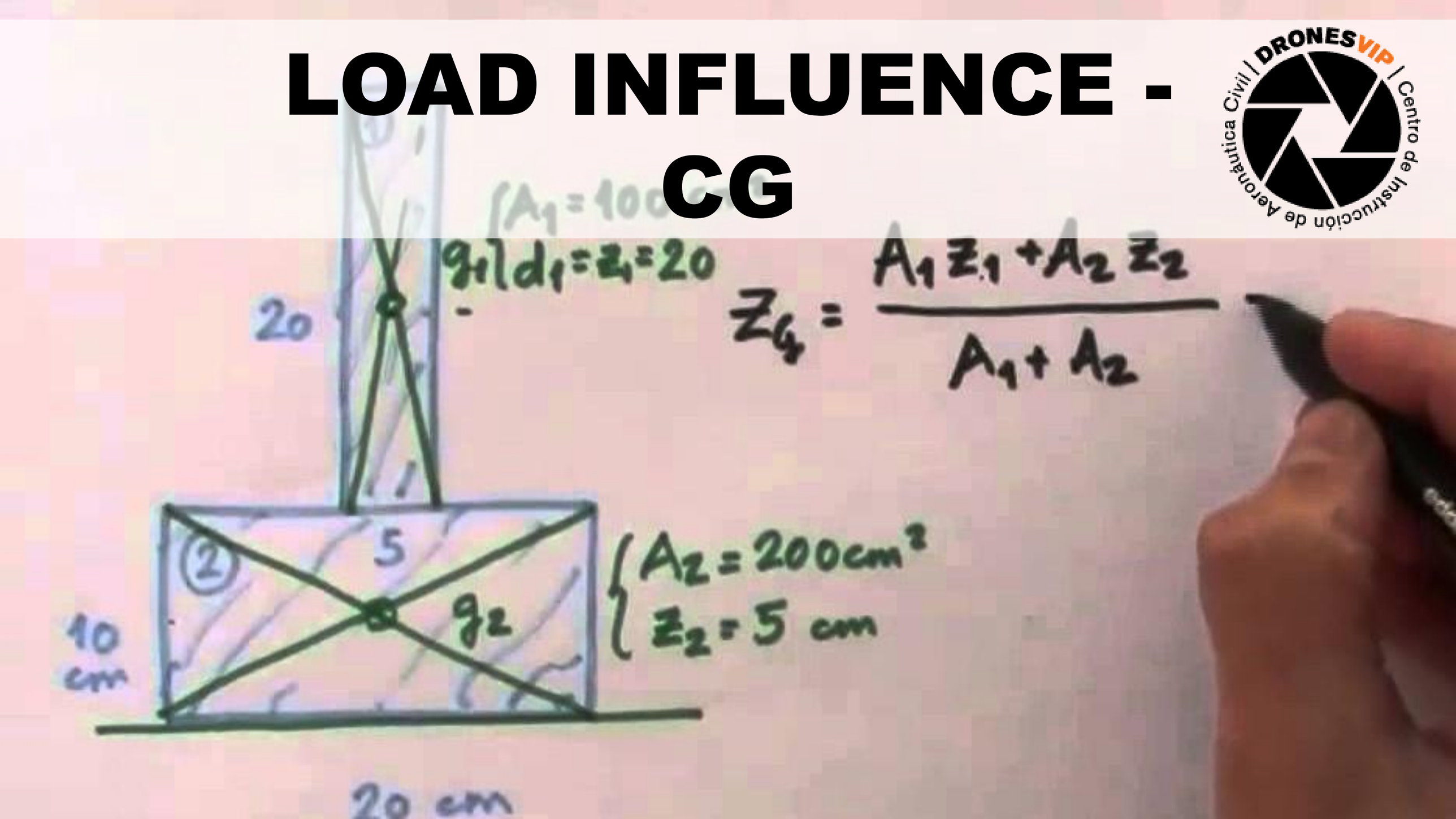
LOAD INFLUENCE - CG



Objectives of this unit

- Know the importance of weight and balance management for a safe and efficient operation. Know the basic data necessary to carry out the weighing and balancing process of a UAV. Identify the effects of loads and their locations on UAV behavior. Interpret the basic parts of a weight and balance sheet. Recognize the existence of critical differences between different classes of UAVs with respect to freight transport.

Introduction

The following explanations are referenced to the generality of UAVs (rotary wing, fixed wing and aerostats). Their differences shall be specified, if necessary, in each case.

The correct weighing and balancing of the UAV will allow us to carry out an efficient and above all safe operation. This is because weight and roll directly affect: lift (produced by engines, propellers and/or wings), control and maneuverability (given by engines and/or control surfaces), take-off and landing distances (fixed-wing case), autonomy (time in flight or distance traveled), the flight height (service ceiling), the flight speeds (the heavier the UAV is), and the structure of the UAV (landing gear, arms, etc.).

Initial concepts

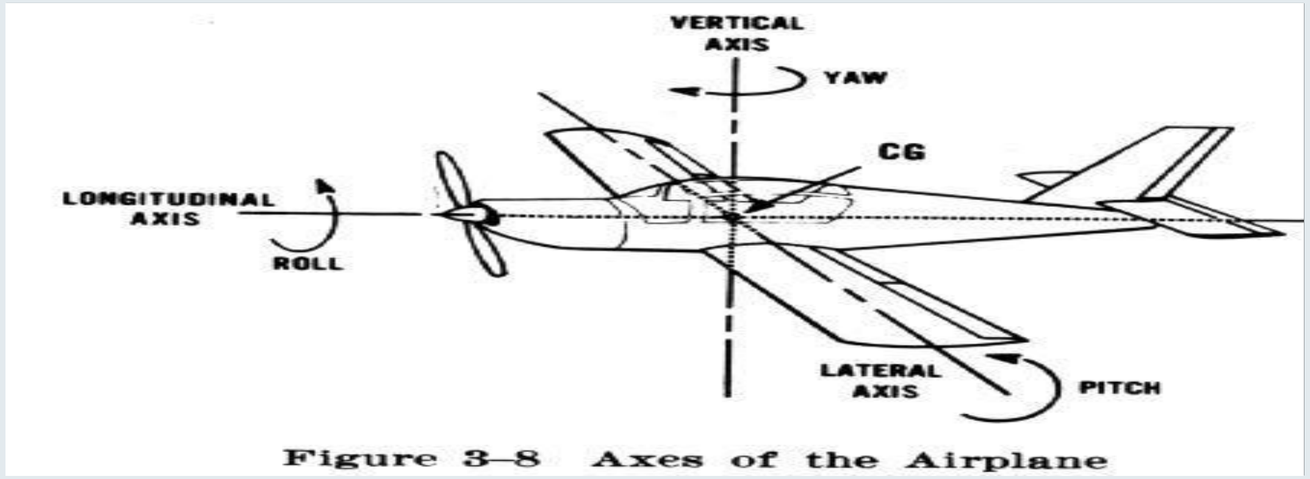
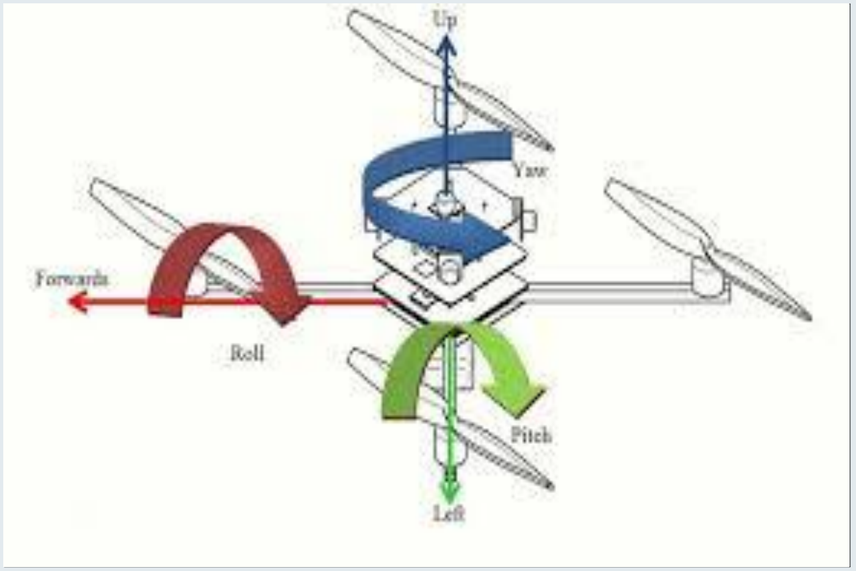


Figure 3–8 Axes of the Airplane



Conceptos iniciales

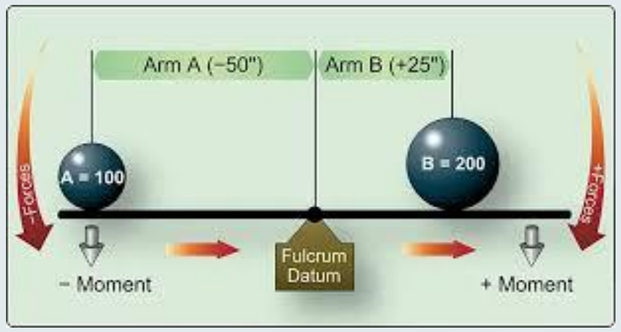
Reference line (Datum): Established by the manufacturer, it is used to calculate the distance from it to all the items that the UAV has.

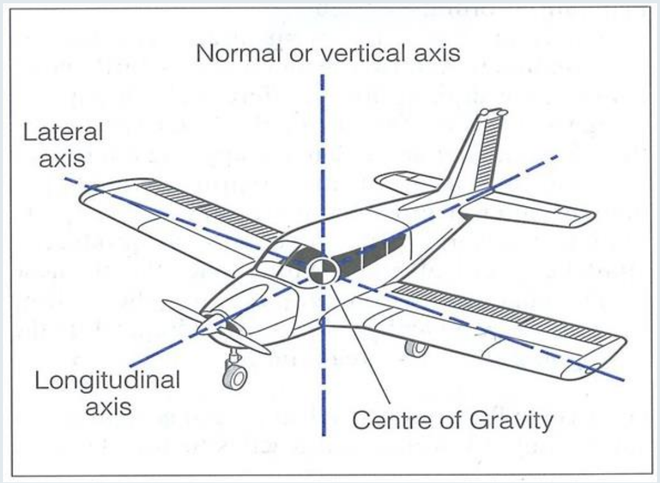
Arm: It is the horizontal distance between an item in the UAV and the Reference Line (Datum).

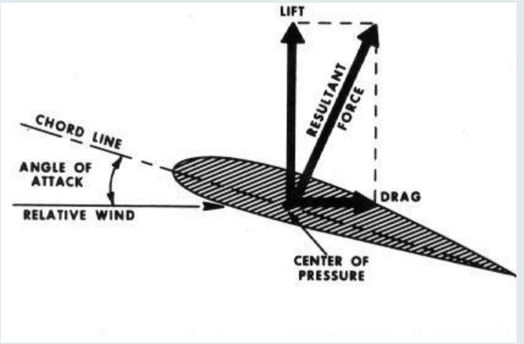
Moment: Corresponds to the multiplication of the weight of an item of the UAV by its Arm.

Center of Gravity (CG): It is the theoretical point where the entire mass of the UAV is assumed to be concentrated. From which the device could be hung and it would remain static and in balance.

Center of Pressure (CP): It is the theoretical point where all the lifting force generated by the propellers or wings is considered applied.







Conceptos iniciales

Weight empty (EW) : Corresponds to the addition of weights of the structure, engines, propellers, and all thecomponents operatives that HE find fixed and of manner permanent in he UAV.

Payload (PL) : It is all the load added to the Empty Weight (EW) of the UAV. As a container with parcel service either he fuel that HE requires for the operation (in he case of theUAV with engines to gasoline).

Maximum Weight Without Fuel (MZFW) * : Corresponds to the maximum weight allowed taking into account account all the items that will have either will load he UAV, without count with he fuel requested forhe flight.

Weight Maximum Certificate of Takeoff (MCTOW) : Is he weight maximum that can have he UAV to themoment of takeoff .

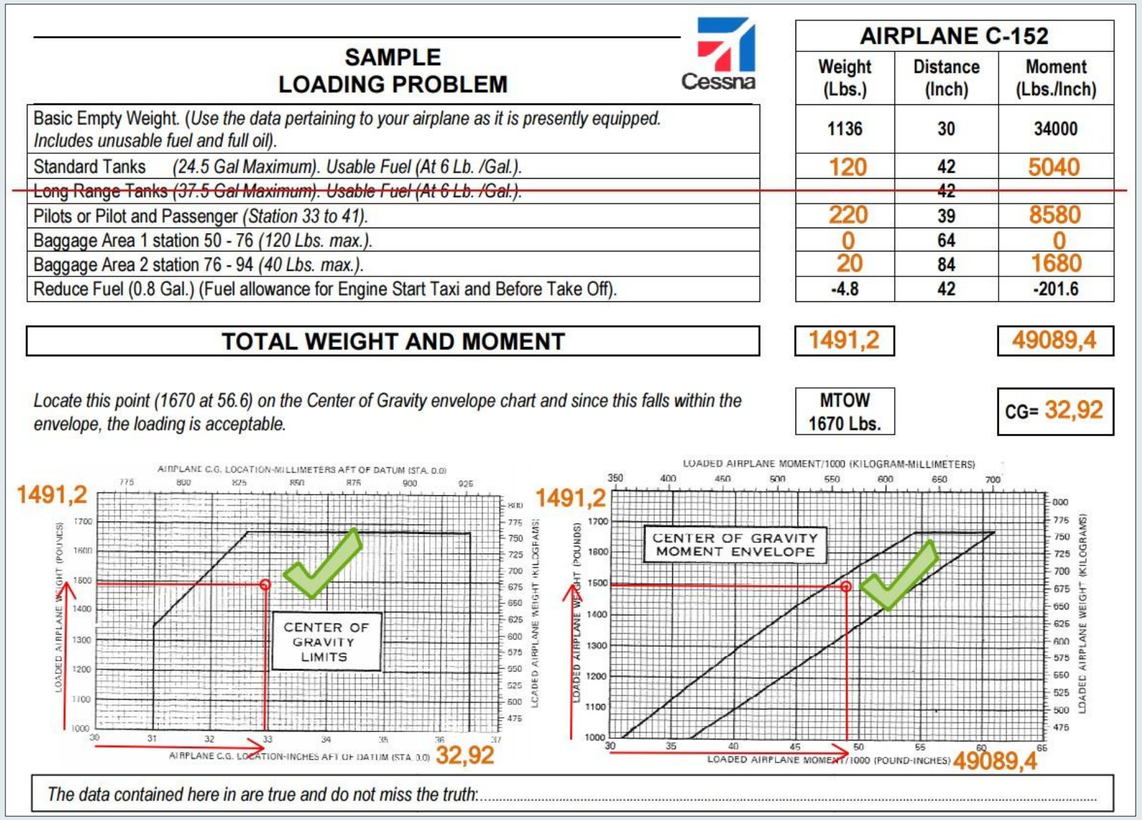
Weight Maximum of Landing (MLW) : Weight maximum that will be able to have a UAV to the moment of thelanding.

* No used in UAV electrical.

Calculations practical of Weight and Swinging

He calculation of weight and swinging It will depend of each UAV specifically and by so much will be able to vary theitems to be calculated , tables , graphs or procedures to arrive at the results. However , all will share data common, basics and extremely important for a operation safe:

- **Notes :**
  - Weight of the items as he EW and the PL.
  - Arm of each one of the items (Yeah No were already included in the tables).
  - Moments (Weight of the item - *multiplied* - Arm).
- **Summations :**
  - Weights of the item s , d a as result he Weight Total.
  - Moments, gives as result he Moment Total.
- **Calculation :**
  - CG (Moment Total - *divided* - Weight Total).
- **Checks :**
  - Don't get over it he MCTOW.
  - He CG I stayed inside of the boundaries certificates.



SAMPLE LOADING PROBLEM

Cessna

	AIRPLANE C-152 Weight (Lbs.)	Distance (Inch)	Moment (Lbs./Inch)
Basic Empty Weight. (*Use the data pertaining to your airplane as it is presently equipped. Includes unusable fuel and full oil).*	1136	30	34000
Standard Tanks (*24.5 Gal Maximum). Usable Fuel (At 6 Lb. /Gal.).*	120	42	5040
~~Long Range Tanks (37.5 Gal Maximum). Usable Fuel (At 6 Lb. /Gal.).~~		~~42~~	
Pilots or Pilot and Passenger *(Station 33 to 41).*	220	39	8580
Baggage Area 1 station 50 - 76 *(120 Lbs. max.).*	0	64	0
Baggage Area 2 station 76 - 94 *(40 Lbs. max.).*	20	84	1680
Reduce Fuel (0.8 Gal.) (Fuel allowance for Engine Start Taxi and Before Take Off).	-4.8	42	-201.6
TOTAL WEIGHT AND MOMENT	1491,2		49089,4

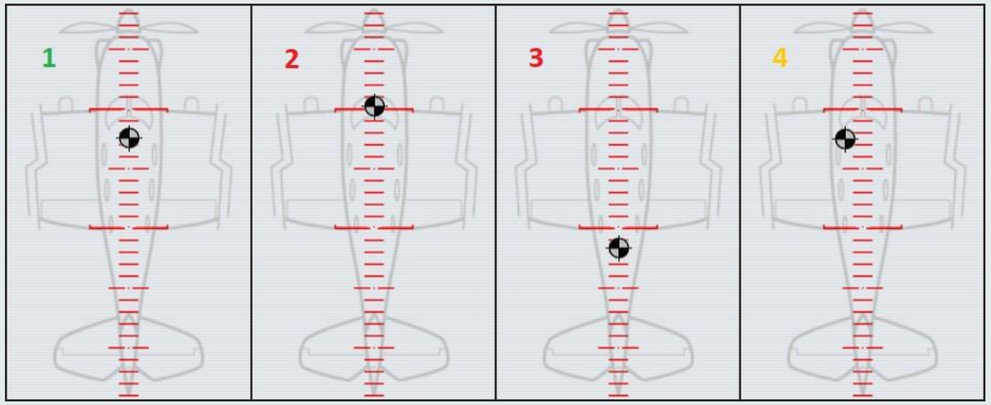
Locate this point (1670 at 56.6) on the Center of Gravity envelope chart and since this falls within the envelope, the loading is acceptable.

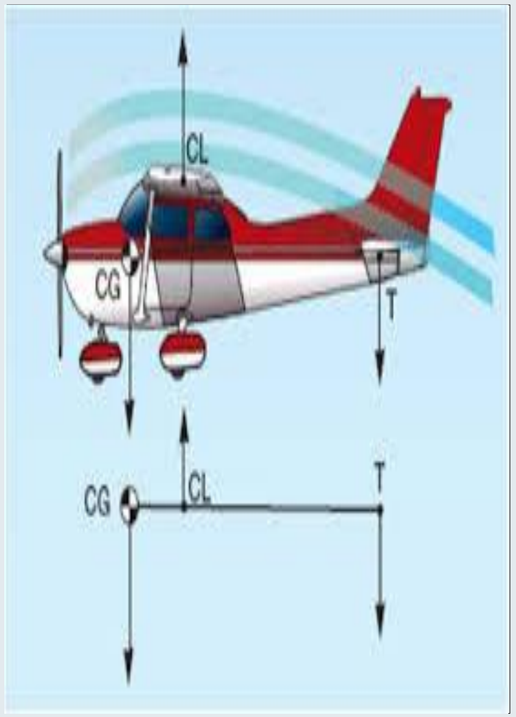
MTOW 1670 Lbs.

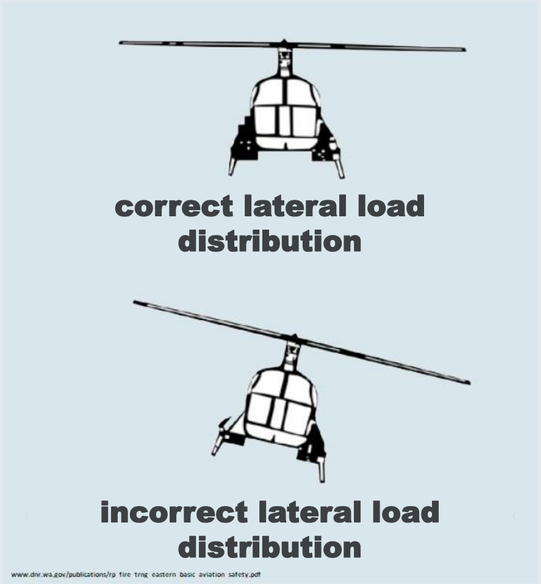
CG= 32,92

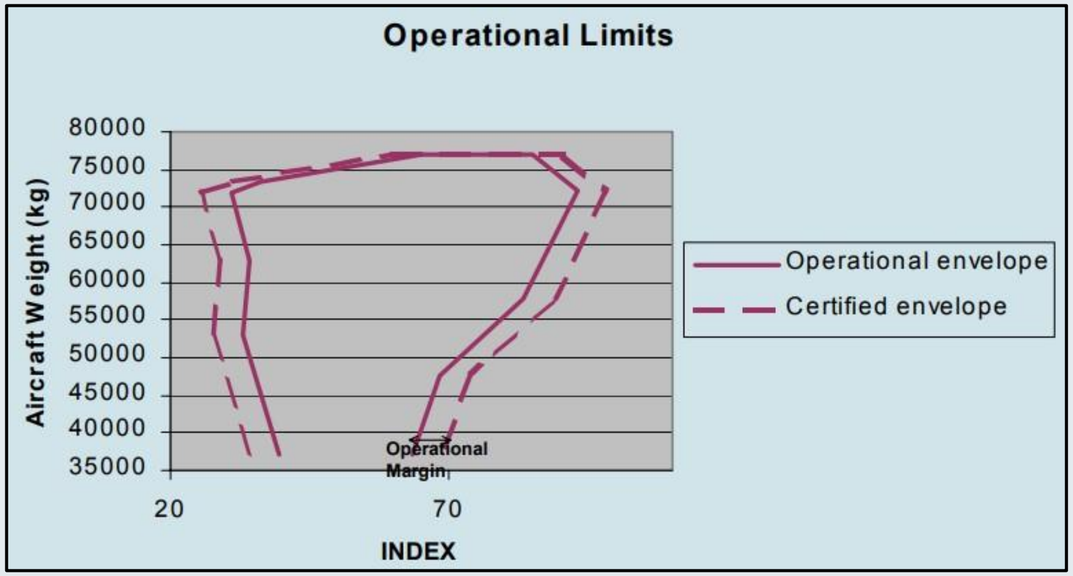
The data contained here in are true and do not miss the truth:.....

Influence of the loads and his distribution about the performance and he control of the UAV









Influence of the loads and his distribution about the performance and he control of the UAV

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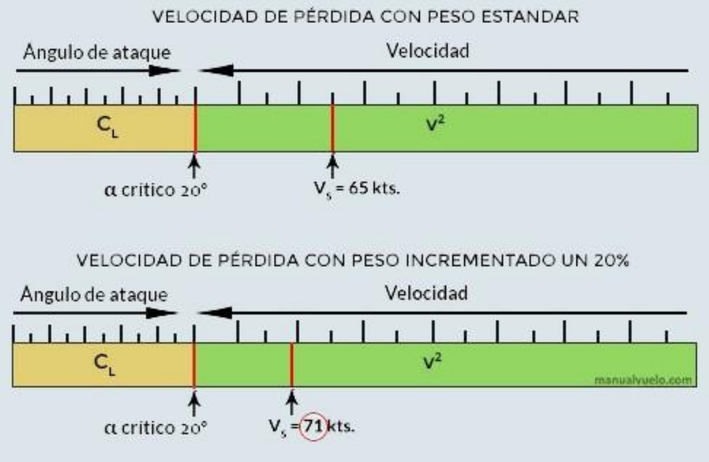
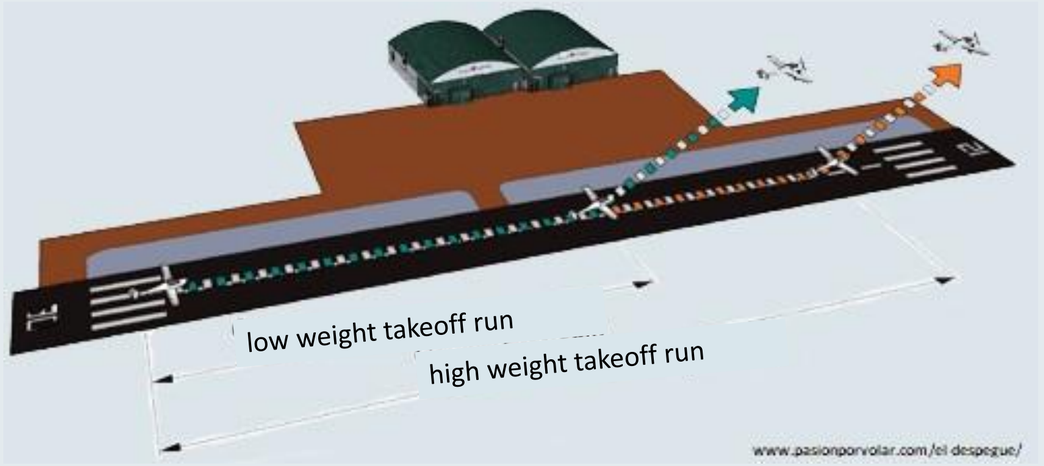
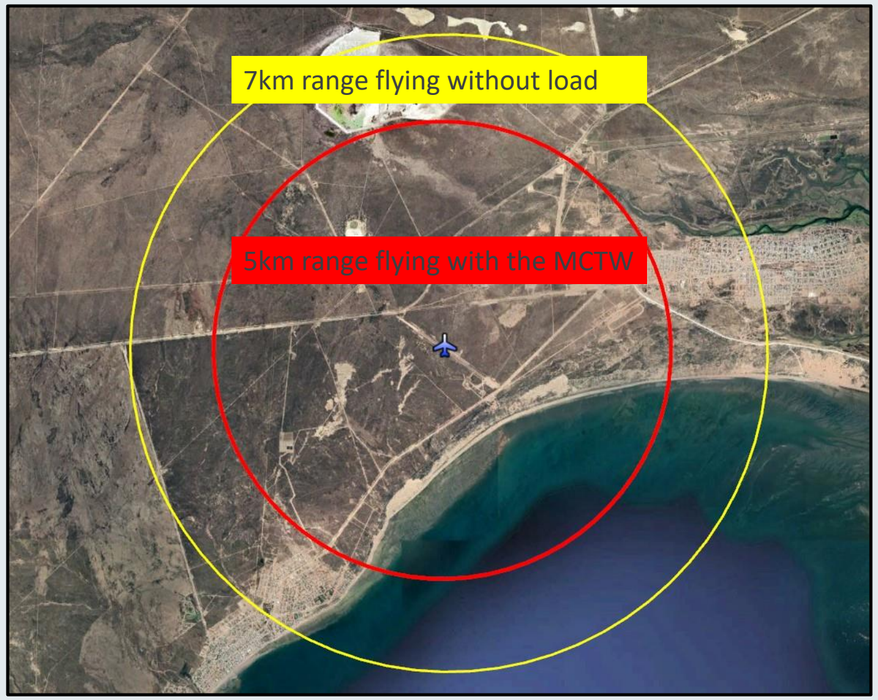




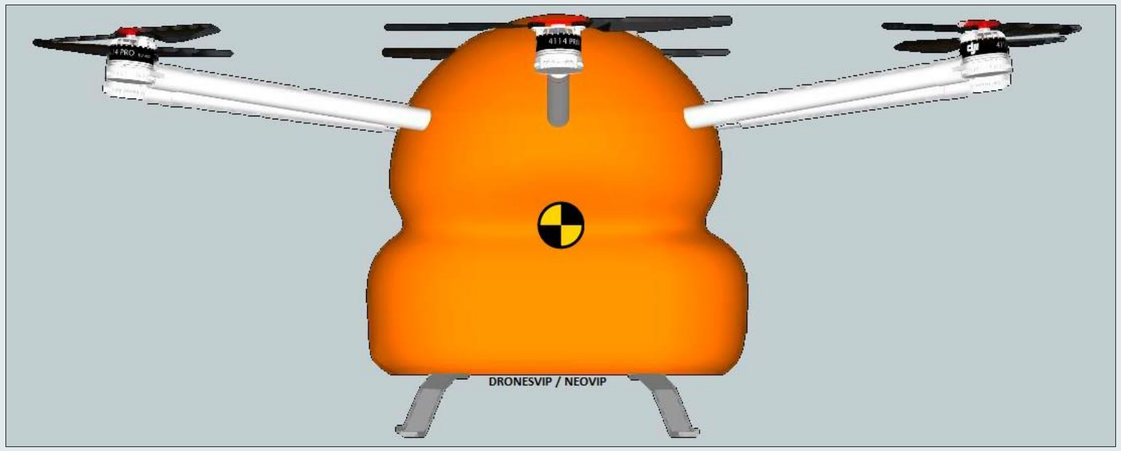


Performance Dispatch — **Chapter PD**
Enroute — **Section 31**

Long Range Cruise Maximum Operating Altitude
Max Cruise Thrust
ISA + 10°C and Below

WEIGHT (1000 KG)	OPTIMUM ALT (FT)
85	30300
80	31600
75	33000
70	34500
65	36000
60	37700
55	39500
50	41000
45	41000
40	41000

Influence of the loads and his distribution about the performance and he control of the UAV



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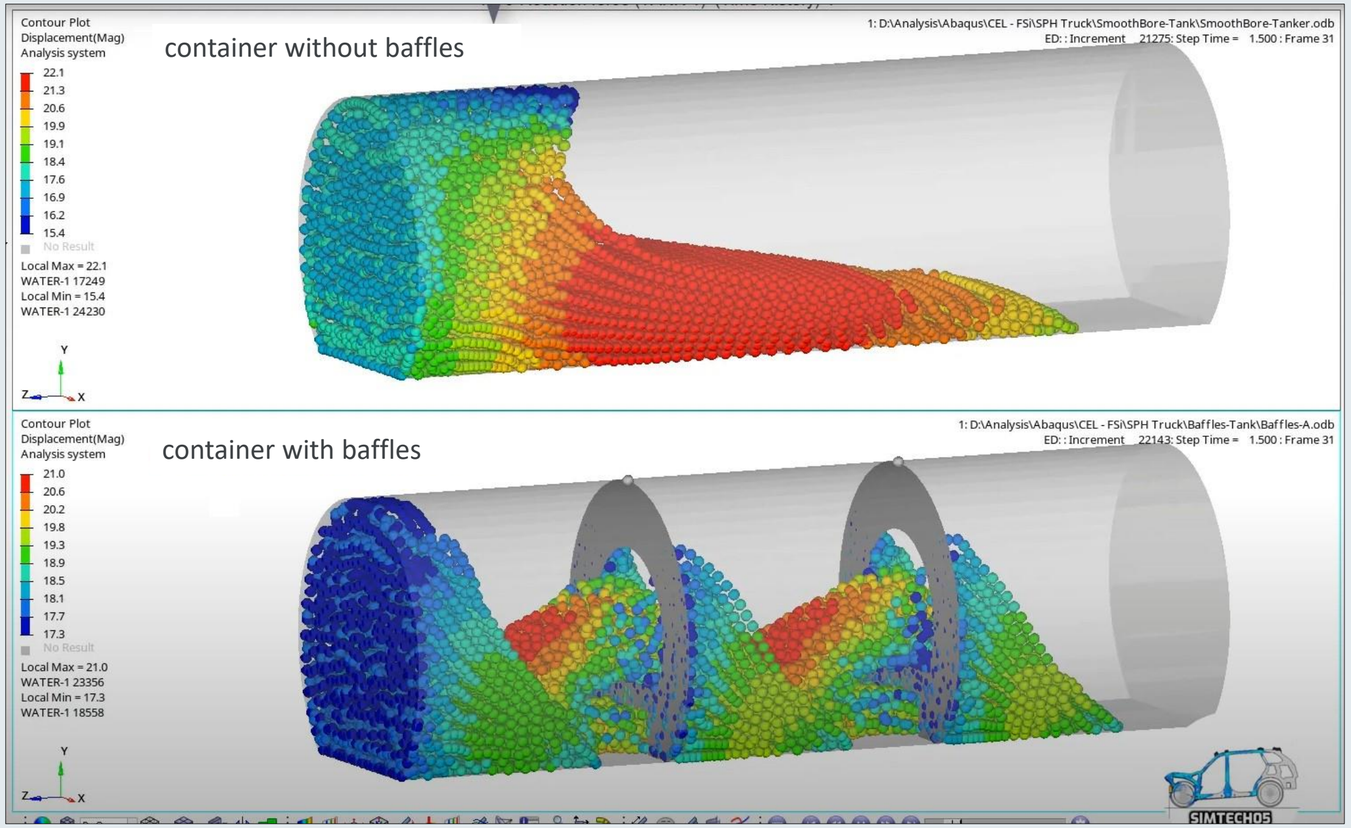

Class and Category Limitations

Types	Advantages	Disadvantages	Example
Fixed wing	Long range Endurance	Horizontal take-off, requiring substantial space or support Inferior maneuverability compared to VTOL (Vertical Take-Off and Landing)	
Tilt wing	Combination of fixed wing and VTOL advantages	Expensive Technology complex	
Unmanned Helicopter	VTOL Maneuverability High payloads possible	Expensive Comparably high maintenance requirements	
Multicopter	Inexpensive, Low weight Easy to launch	Limited payloads Susceptible to wind due to low weight	

THANKS

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