Rules of Thumb: (Conventional Airplane)

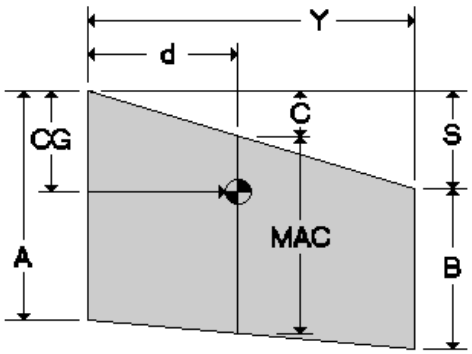
Balance Point	Note
Less than 25%	Nose heavy – Will need lots of airspeed for the tail to produce the needed downward force to keep the nose up. May not be able to raise the nose for take-off. Landings will need to be fast.
25% - 27%	Stable, tending toward nose-heavy. A safe starting point for the first flights. May tend to drop nose on power reductions, and not be very responsive to pitch inputs. Make sure you have enough airspeed to flare on landing.
27% - 30%	Usually results in a good, stable flyer. Mildly responsive to pitch inputs.
30% - 33%	Less stable, but more responsive. May have to reduce control throws. Good location for aggressive aerobatic / 3D flying.
33%	Neutrally stable: Nose will stay where last perturbation put it. May have to hold nose-down on landing flare.
More than 33%	Tail heavy & UNSTABLE: Plane will be difficult or impossible to fly.

Calculating the CG:

Online Mean Aerodynamic Cord Calculator

The form shown below will calculate the percentage of the Mean Aerodynamic Cord (%MAC) of a model airplane wing for a given position of the CG. If you would like to know the position of the Center of Gravity (CG) as measured from the leading edge of the Root Cord, you should use the form on The Center of Gravity Page.

Enter Root Cord (A):	12
Enter Tip Cord (B):	9
Enter Sweep Distance (S):	3
Enter Half Span (Y):	50
Enter Center of Gravity (CG):	25
Click Me to Compute:	
Sweep Distance @ MAC (C) =	1.43
Mean Aerodynamic Cord (MAC) =	10.57
MAC Distance from Root (d) =	23.81
% Mean Aerodynamic Cord (%MAC) =	223%



The Equations

C = (S(A+2B)) / (3(A+B))

MAC = A-(2(A-B)(0.5A+B) / (3(A+B)))

d = (2Y(0.5A+B)) / (3(A+B))

%MAC B.P. = ((CG-C) / MAC)*100

Reposted with permission from the Palos R/C Flying Club.

http://www.nasascale.org/p2/wp-content/uploads/mac-calculator.htm

Click here to close this window.

Another Calculator:

eCalc

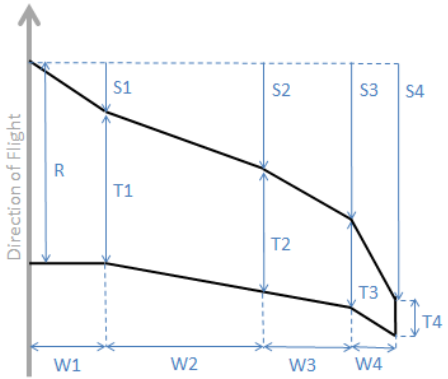
cgCalc - Center of Gravitiy (CG) Calculator

The *cgCalc* of eCalc.ch not only calculates and evaluates the center of gravity (CG), neutral point (NP) and mean aerodynamic chord (MAC) but also visualizes your design of conventional aircraft, flying wing, delta or canard. Approximate complex wing design with **5 trapezoidal wing panels**. For further instructions see below...

Never ever exceed Center of Gravity on first flight!

Aircraft or Project Name:	SBach 342 (Example)						
Wing:							
Root Chord [R]:	47	cm					
Tip Chord [T1-T5]:	47	22.5	18.7	1	0	cm	
Sweep [S1 - S5]:	0	5	8	25.2	0	cm	
Panel Span [W1 - W5]:	7	81	3	2	0	cm	
Tail:	std. Stabilizer (80%)	(Tail Effectivness)					
Root Chord [R]:	17.5	cm					
Tip Chord [T1-T5]:	17.5	24.5	14	12.6	0	cm	
Sweep [S1 - S5]:	0	0.75	3	4	0	cm	
Panel Span [W1 - W5]:	4	7	24	1	0	cm	
Distance LE Wing to Tail [D]:	88	cm (use negative value for canard)					
AC Position:	25	% of MAC (default: 25%)					
Static Margin:	15.0 ... 10.0	% of MAC (advice: between 15 and 5%)					

Units: cm Deutsch



(if less than 5 half wing panels are required, define the panel span = 0 starting from the far right with W5)

calculate

Results: Link to recall SBach 342 (Example)

Aircraft CG range [•]:	**12.75 ... 14.59** cm (= 28.80 ... 33.80% of MAC)	Aircraft NP [•]:	18.27 cm (= 43.80% of MAC)
Wing AC [•]:	11.35 cm (= 25% of MAC)	Tail AC [•]:	6.22 cm (= 25% of MAC)
Wing MAC @ Distance	36.85 cm @ 39.93 cm	Tail MAC @ Distance	19.69 cm @ 17.14 cm
Wing Span:	186.00 cm	Tail Span:	72.00 cm
Wing Area:	**6450.50** cm²	Tail Area:	**1384.60** cm²
Wing Aspect Ratio:	5.36	Tail Aspect Ratio:	3.74
		Stabilizer Volume (V_{bar}):	0.48

https://www.ecalc.ch/cgcalc.php

Considering the Tail:

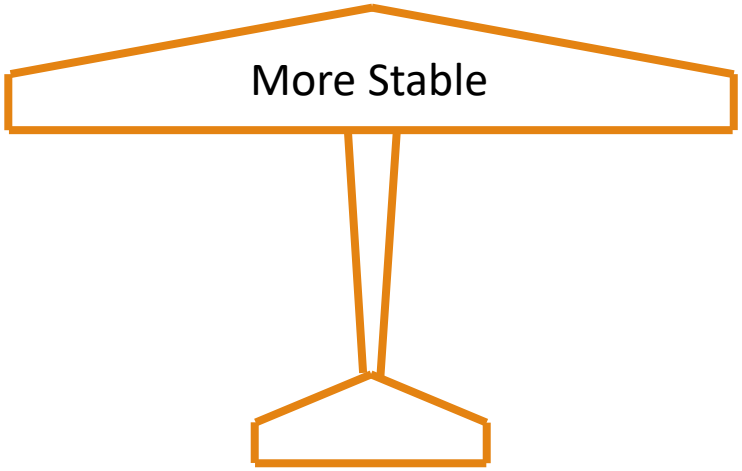
The size of the Horizontal Stabilizer (tail) affects stability

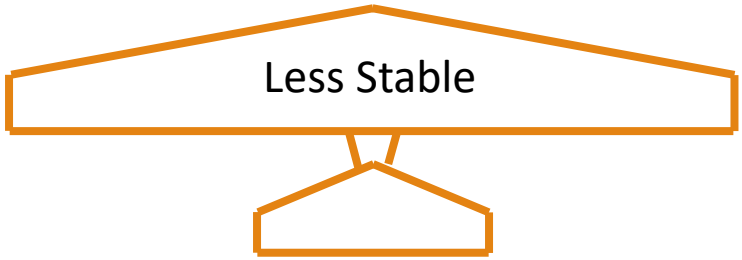
- Larger tail = more stability
  Larger tail → can fly with CG further aft

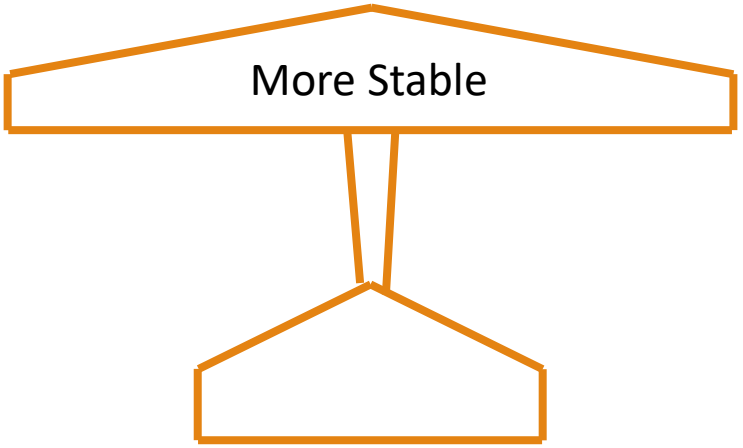
- Tail further from wing = more stability
- Tail further from wing → can fly with CG further aft

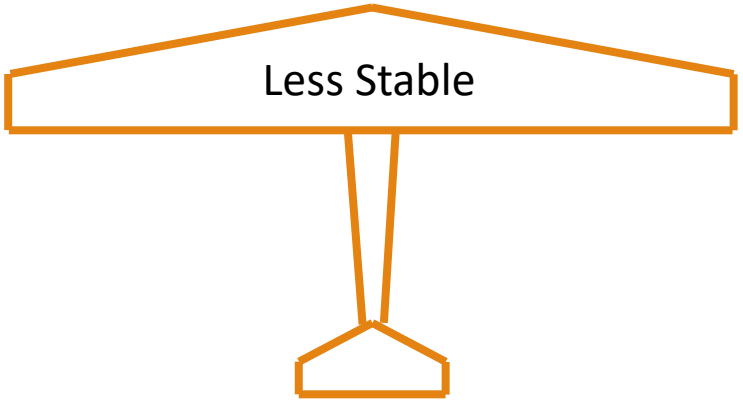
Some calculators account for this…

Stability: Tail Effects









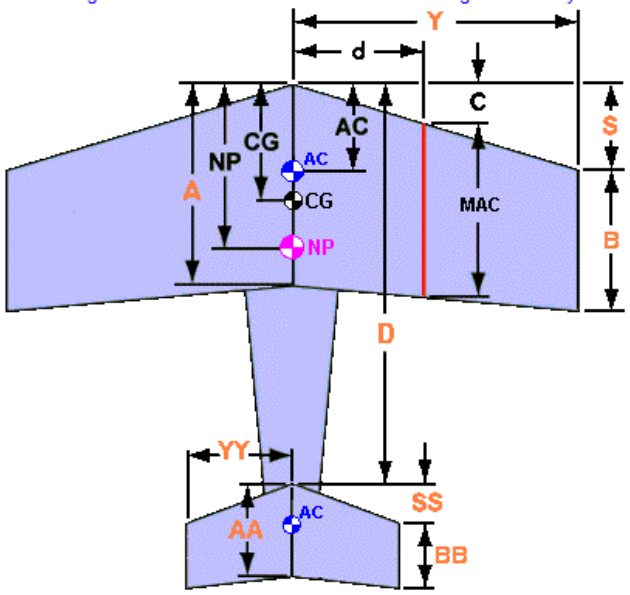
CG Calculator with Tail:

Aircraft Center of Gravity Calculator

Aerodynamic Center (AC), Mean Aerodynamic Chord (MAC), Center of Gravity (CG), Neutral Point (NP) and Wing Area

Wing Root Chord (A):	
Wing Tip Chord (B):	
Wing Sweep Distance (S):	
Wing Half Span (Y):	
Stabiliser Root Chord (AA):	
Stabiliser Tip Chord (BB):	
Stabiliser Sweep Distance (SS):	
Stabiliser Half Span (YY):	
Distance between both LE's (D):	
Stabiliser Efficiency*:	Std.
Enter Static Margin, then Click	%
Mean Aerodynamic Chord MAC =	-----
Sweep Distance at MAC (C) =	-----
From Root Chord to MAC (d) =	-----
From Wing Root LE to AC =	-----
From Wing Root LE to NP =	-----
From Wing Root LE to CG =	-----
Wing Area =	-----
Stabiliser Area =	-----
Wing Aspect Ratio =	-----
Tail Volume Ratio, Vbar =	-----

Enter the variables at left using the same units for all entries.
For an aircraft to be stable in pitch, its **CG** must be forward of the Neutral Point **NP** by a safety factor called the **Static Margin**, which is a percentage of the **MAC** (Mean Aerodynamic Chord).
Static Margin should be between 5% and 15% for a good stability.



Low Static Margin gives less static stability but greater elevator authority, whereas a higher Static Margin results in greater static stability but reduces elevator authority.
Too much Static Margin makes the aircraft nose-heavy, which may result in elevator stall at take-off and/or landing.
Whereas a low Static Margin makes the aircraft tail-heavy and susceptible to stall at low speed, e. g. during the landing approach.

*Choose Low Stabiliser Efficiency if the tail is close to the wing's wake or behind a fat fuselage in disturbed flow.

Here they use the term: "Static Margin"

We won't cover "Static Margin" in this presentation except to say…

Target 5% to 15% Static Margin for "good stability"

https://rcplanes.online/cg_calc.htm

MAC Calculators

Multi-Panel with tail (eCalc):

https://www.ecalc.ch/cgcalc.php

Multi-Panel with tail (RCPlanes):

http://rcplanes.000webhostapp.com/cg_calc.htm

Wing panel alone (scaleaero):

https://www.scaleaero.com/CG_Calculator.htm