Elastic Launched Glider & Wright Stuff

Building Concepts and Flight Techniques

Presenter

Matt Weiker

Objective:

Longest Flight Time, with bonuses if possible, and NO PENALTIES

Stability of the plane / glider is key

Robustness / repairability is important

Document your Experiments (flight logs)!

Scientific Method-

For those who think of Wright Stuff as a Flying Event are only partially correct.

Wright Stuff and other flying events are actually Science Investigation Events using Aircraft.

Best Success comes from using Scientific Method-

Construction Restrictions

	Elastic Launched Glider	Wright Stuff
Mass	3.0 to 10.0 g	> 8.0 g
Wingspan	< 28.0 cm	< 30.0 cm
Chord	Unrestricted	< 8.0 cm
Stab Span	Unrestricted	< 12.0 cm
Stab chord	Unrestricted	< 6.0 cm
Propeller diameter	NA	< 8.0 cm
rubber band motor	Unrestricted	Any size
Materials	Restricted	Unrestricted

- **Wright Stuff has more variables to control than other flying events. It is best to *Document Everything* on building and flying.**

- **Add markings on parts so that models may be pre-adjusted or set-up to a baseline before a trim flight session.**

Elastic Launched Glider Factors and variables to record – (must have at least 4)

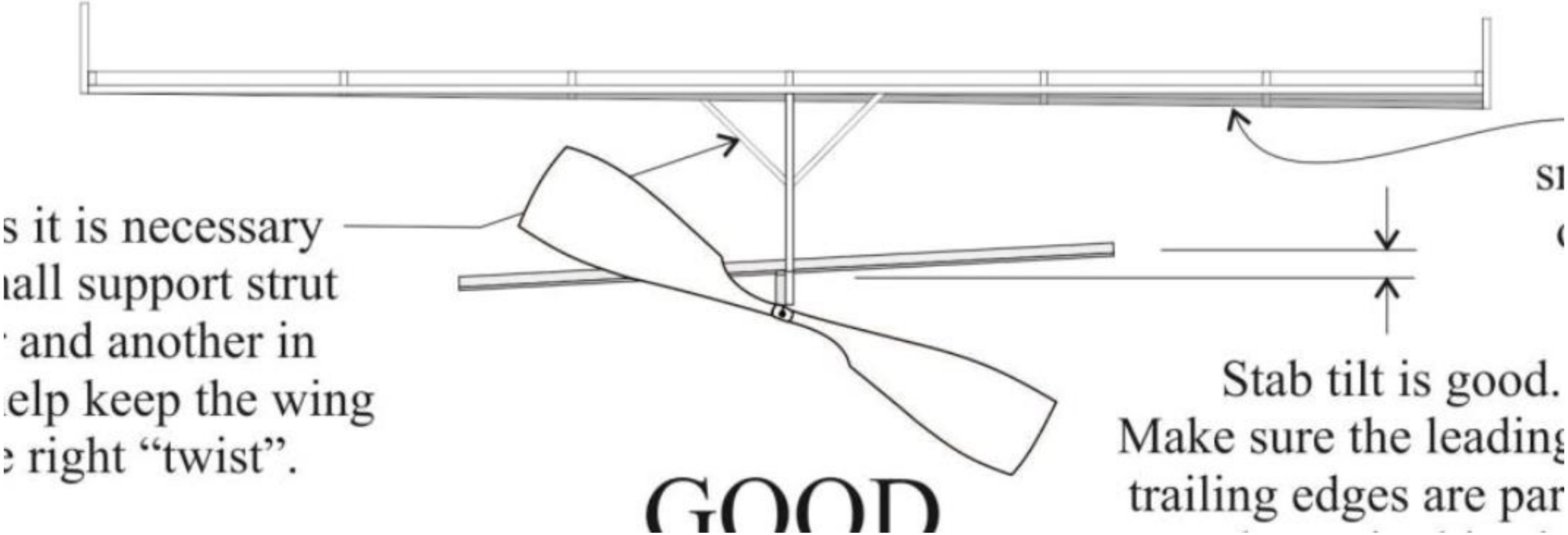
A) Estimated Height of Flight - *Required*
B) Rubber Motor Length while relaxed- *Required*
C) Flight Time- *Required*
D) Orbit Diameter
E) Angles of launch (pitch and roll)
F) Temperature – affects air density and rubber composition.
G) Humidity- affects rubber composition
H) Height and Available Footprint- guesstimate optimum flight orbit
I) Blowers On?- means fly lower power or heavier model for penetration
J) Drift?- low movement air flow, observe orbit shifts, launch accordingly

Wright Stuff Factors and variables to record as Data- (must have at least 6)

A) Rubber Motor Size Before Winds- *Required*
B) Number of Turns on the Motor (at Launch)- *Required*
C) Flight Time- *Required*
D) Number of Turns after models lands- indicates efficiency of Power
E) Torque on Motor at launch (compare with winds, indicates weakness)
F) Temperature – affects air density and rubber composition.
G) Humidity- affects rubber composition
H) Height and Available Footprint- guesstimate optimum flight orbit
I) Highest point achieved- Use a Helium balloon to mark
J) Blowers On?- means fly lower power or heavier model for penetration
K) Drift?- low movement air flow, observe orbit shifts, launch accordingly

Build Techniques

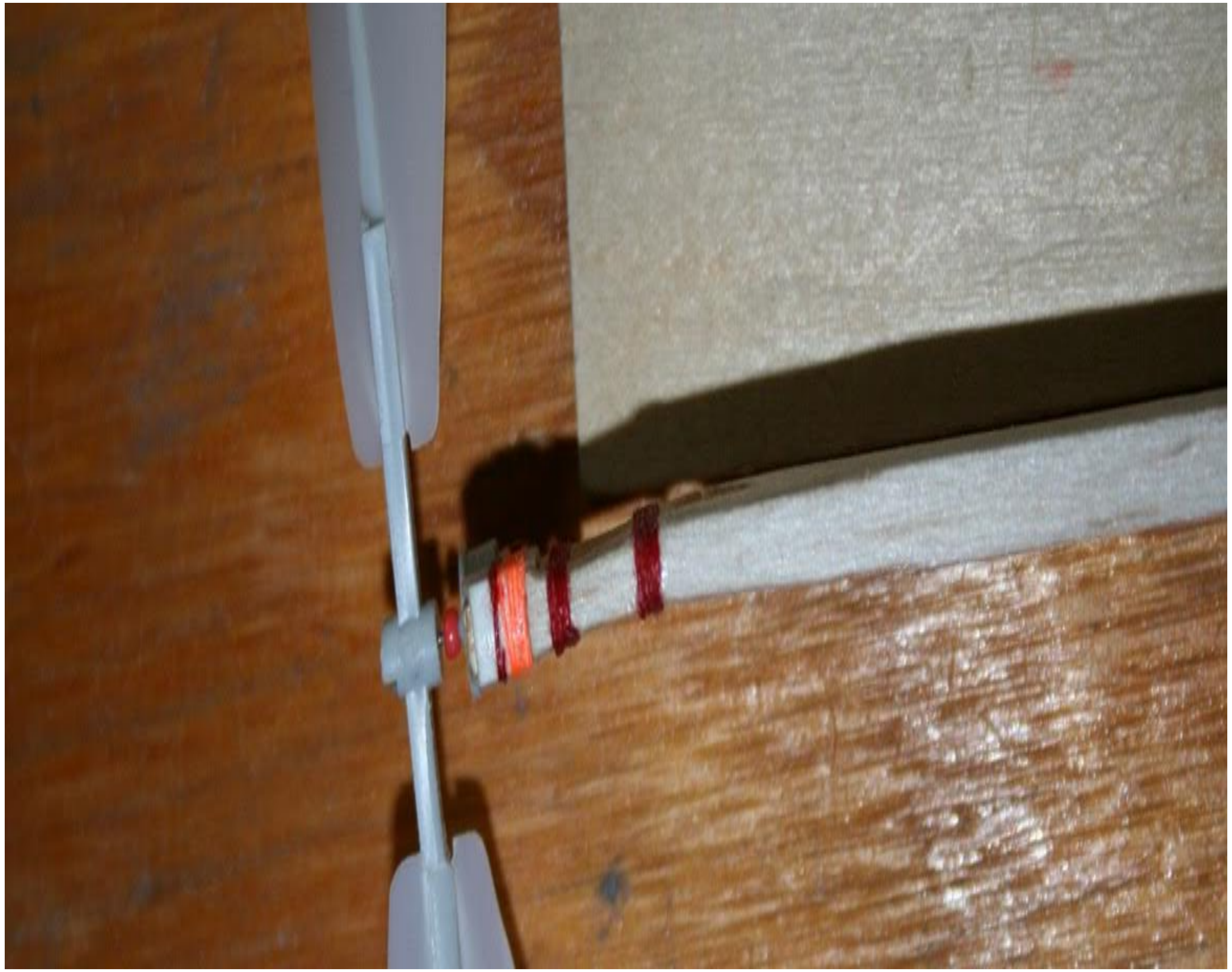
Airplane Set-Up:
Stab Tilt and Wash-in on Left Wing



Wright Stuff Build Secrets

Always include at least 2^{o} LEFT THRUST to help track the model in a left hand orbit

The nose can be cracked and re-glued or left-thrust built-in.



- **Always avoid the INFINENTLY CHANGING VARIABLE! (or the ICV)**
- **Typically it is caused by a weak motorstick**

a) **Choose BALSA that is stiff with good cross section… 3/8” x ¼” or ¼ x ½” based on density.**
b) **NEVER use Basswood (too dense)**
c) **Never reduce Aircraft mass by using a thin, weak motorstick (ICF!)**

- **Wings should be slightly asymmetrical with more area to the left of the motorstick. This helps counteract the propeller/motor torque that tends to rotate the model to the left (left roll) on the roll axis. This is seen with the left wing dropping down on high power launches.**

- **Cambered wing ribs provide more lift, less drag and allows the model to recover sooner.**

- **Weigh and record parts as you build. Makes an excellent resource for the next build.**

- **All parts must have full surface to surface contact!! Glue is never used as a gap filler.**

  Poor joints equals a weak model. Every repair adds more mass (extra baggage to haul).

- **Only use Medium Viscosity Super Glue with drip Accelerator (no sprays!). Classic model airplane cement such as DUCO cement is also good but takes longer to set.**

- **Make sure the rear motorhook and prop shaft allow wound motor to work without contact to wood. Try to suspend the hooks so that there is less contact (friction) with the motorstick.**

- **Always design models with modular construction for storage and parts change options. Design model to incorporate Stab-Tilt capabilities for more or less turn.**

- **Use a sheet of ¾” pink insulation foam with Midwest Grip pins for assembly. Tape down plan then wax paper before assembly. Only use a translucency of glue to attach wood joints.**

- **Find wing location? Set-up model with all parts except the wing. This includes motorstick, prop assembly, tail assembly and rubber. Find the balance point. That point will be the aft location for the trailing edge of the wing.**

- **Design the model to easily pass though the Official's Go-No-Go gauges.**
  Many officials will refuse a model that touches the gauges. And if they allow a team to modify, chances are that the modification, on-site will be a disaster!

- **Always Opt for black tissue to make markings and not a Magic Marker.**
  Using a marker on Mylar covering just invites a rip or tear. Tissue offers absolute dark markings.

- **Add front braces to wings for stronger support especially if wing sets 1-1/2" off the motorstick.**

- **Always have secure storage. Design container for mobility. Make sure model is immobilized during transport!**

- **Test Your Students' Build Skills with simple structures before building an expensive kit.**

Secrets to Success- Wright Stuff Trim Flights PHASE II

- **Weigh your prop assembly and make a matching mass of clay and put on the nose. Do simple glides to see if the model is stable in the glide.**

- **Always use rubber O-Rings (2 ea) on every rubber motor. Just over the motor’s width will work for easy assembly. These o-rings will make the handling of wound lubricated motors much easier to manage.**

- **Make up a number of motors for flight testing. Come as close as possible to weight requirement without going over weight. Double knot the two ends together, add a drop of CA behind the knots, trim off excess rubber (extra baggage!) then lubricate.**

- **Stretch motor at least 3X its normal loop length to begin winds. Wind 50% of maximum winds at the 3X length. After reaching 50% gradually approach the opposite end of the motor as you finish up winds.**

- **USE A TORQUE METER! Much more reliable at being consistent with precise power at launch.**

- **Use a bench system to separately stage the model while precisely winding with a torque meter. Use a lock on the winder so that data on winds may be recorded per flight.**

- **Never Attempt Maximum Rubber Winds on first trim (ie test) flights. Work your way up gradually.**

- **Always hold model with two hands, one on the prop (bottom blade) and one on the motorstick. Release the prop first then push the model forward and release the motorstick.**

- **Use *Stab-Tilt* to increase or decrease orbit diameter.**

- **If students are winding together (not recommended) they must be absolutely focused on their partner and the model. NOTHING can be a distraction (excluding a fire drill!).**

- **Note that the Model should orbit. The launch point will be the outside point of the orbit's radius. Have some "court sense" when choosing where to launch.**

- **We are fly in a box and want to use as much air space as we can to get longer flights. Most kids stand at least 5’ high. That mean in 20’ high site, they just wasted 20% of the available air space. Launch the model from a kneeling or sitting position.**

- **Do Not Run through the air space. The vortices can cause a model to dive and be damaged.**

- **Record every variable and every observation on all flights whether trim or contest.**

- **If Possible, acquire a Rubber Stripper. This will allow teams to strip their rubber to a size (WIDTH not Length) to dial-in maximum power for the flying site. Thinner has less torque and more winds. Thicker has more torque (for climbing higher) but less winds. Use a higher pitch prop with thicker motors.**

• Model ***Dives***- Inspect the model Check to see these causes:

A) **Does the prop have down thrust? The prop shaft should be absolutely parallel with the bottom of the motorstick. The down thrust will literally point to model to the floor when launched. Is the prop assembly loose on the motorstick?**

B) **Is the Trailing Edge (back edge) (TE) of the wing higher than the Leading Edge? This will cause a nose-down flight attitude. *Negative Incidence***

C) **Is the Trailing Edge of the Stabilizer (rear wing) lower than the Leading Edge? This will cause a dive issue. *Positive Incidence***

A) **RULE OF THUMB- There should only be a 3º Incidence Combination between the wing and stabilizer. You can have :**

a) **3º Positive Incidence on the wing with 0º Incidence on the stab**

b) **2º Positive Incidence on the wing with 1º Negative Incidence on the Stabilizer.**

c) **Exceed these ratios and model will be either difficult to trim or have too much drag.**

A) **Is the Center of Gravity (balance point) too close to the nose? Shift the wing forward in increments until the dive stops.**

B) **The Motorstick is too weak and bows vertically under high power causing the prop to have more down thrust. Replace the Motorstick with a stiffer piece.**

Secrets to Success- Phase III
Wright Stuff Trim Flight Flow Chart, Issues, Causes, Optional Fixes

A bit like a Cheat Sheet for ***What is Wrong with my Model***?

- **Model *Stalls*- Inspect the Model to see these causes:**

A) **Does the propeller have UP Thrust? The prop shaft needs to be absolutely parallel with the bottom of the motorstick.**

A) **Is the Leading Edge of the wing TOO HIGH when compared to the Trailing Edge? *Positive Incidence.***

A) **Is the Trailing Edge of the Stabilizer TOO HIGH when compared to the leading edge? *Negative Incidence.***

A) **Use the Rule Of Thumb above.**

A) **Is the Center of Gravity to far aft? Shift the Wing, in increments towards the tail until the stall is minimal.**

- ## Model ***<u>Dives and Rotates Left Wing Down</u>*** on Launch. Check these causes:

A) **The Left Wing NEEDS MORE Lift. See Options-**

a) **Crack the leading edge (LE) of the left wing at the root and bend up at least 2^o and glue. This adds more positive incidence to the left wing, thus more lift, than the right wing.**
b) **Shift the Wing more Left in relation to the thrust line (motorstick). This adds are to the left and less area to the right.**
c) **Add slight UP Elevator (trailing edge of stabilizer higher)**

- ## Model Flies Sort of Straight. Check these causes:

A) **The Left wing has Too Much Lift and/or the Right Wing Too Little Lift. Reduce the LE Incidence on the left wing.**
B) **Is the Trailing Edge of the Fin (Vertical Tail) more to the right than the Leading Edge? Reduce this angle to 0^o and possibly shift it more to the left. The Fin acts like the rudder on a boat.**
C) **The Motorstick is weak and bowing right pointing the propeller right- *<u>Right Thrust</u>* . ICV**

- **Model Flies in a Good Orbit left then tightens and maybe dives as power is used up.**

This is classic "Infinitely Changing Variable" ICV with the root issue being a weak motorstick the bows or twists with high power/torque. The only choice is to replace the motor stick with a stronger piece.

- **Model flies in a Good Orbit Left then the orbit gets bigger why?**

The ICV again. The Motorstick is either twisting or bowing under load changing the relative positions and angles of all the flying components. The best fix- New stiffer Motorstick!!

- **Model Flies Left then Right! Why?**

Something is moving. Most likely culprit is the ICV with the motorstick moving so much that the flight characteristics reverse themselves. The Fix? New Motorstick that is much stiffer.

- **Model zooms to the ceiling then Glides down “dead stick”, Why?**

A) The Rubber motor is too wide and too short. Too much Torque. Use a thinner, longer motor
B) The Prop Blade Pitch may be LOW Pitch. Like a wing the blade’s leading edge must be higher than the trailing edge. If this incidence is too low, the prop spin very fast and unloads its stored energy quickly.
C) There is an outside chance the model has high mass (8 grams and over). It flies fast to stay aloft but unloads its energy quickly. Build an airframe at least 1/3 lighter.

- **The Prop spins then Stops! Why?**

A) One reason is that the Knot on the motor is ***in front***. Always have it at the aft hook (Motorhook). With the knot in front, it will eventually bind between the prop shaft hook and the motorstick.
B) If the wound motors is not evenly distributed, it will bind up in the nose stopping the prop.

- **The model flies nice orbits and stalls at the end, Why?**

A) The CG balance point is just too far forward, to confirm, add some clay to the nose and see if the stall persists.
B) Good chance the motorhook is too close to the tail. When the rubber motor unwinds, it unwinds from the front and the remaining knots collect towards the tail changing the CG (tail heavy)

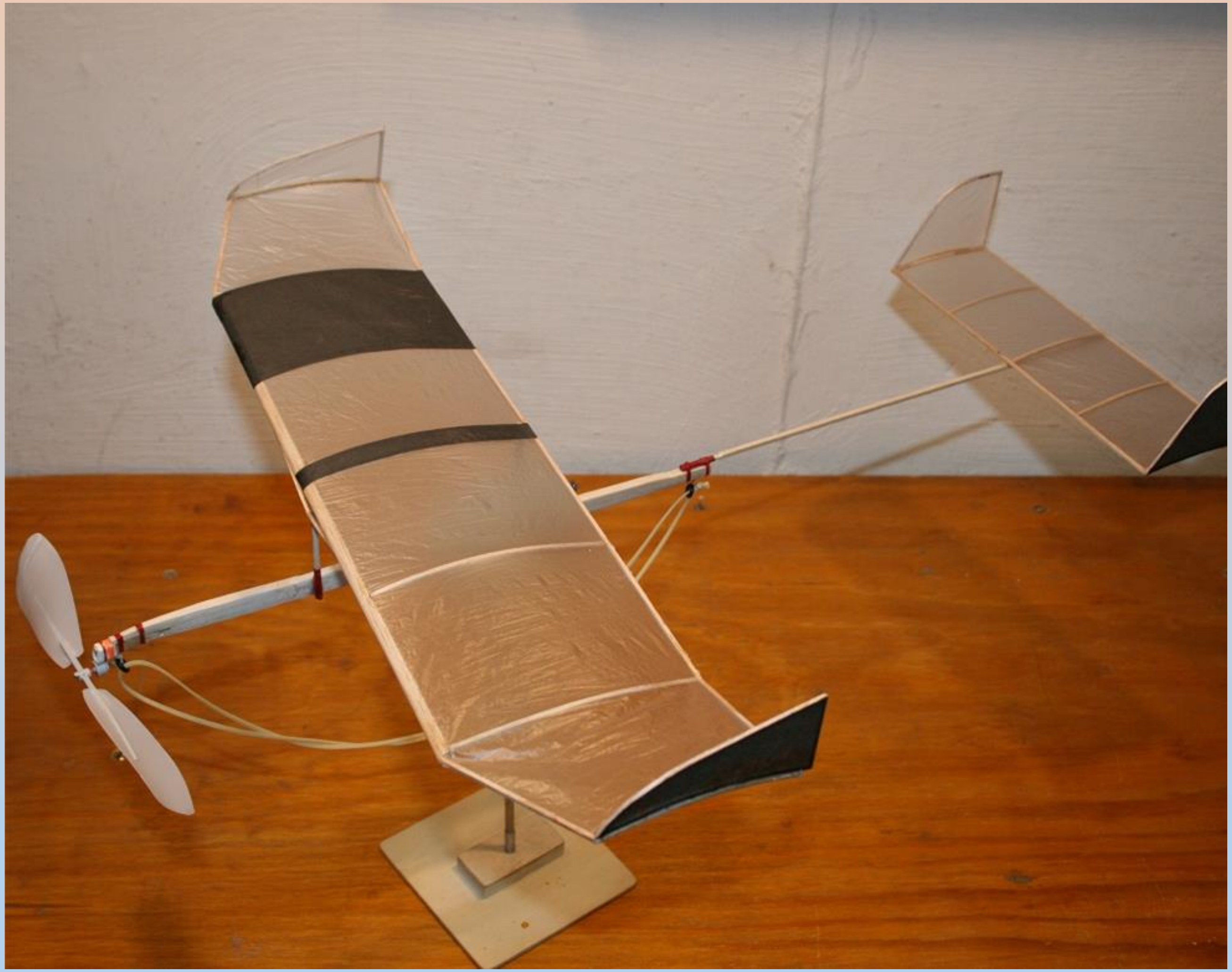
Secrets to Success-
Phase VI
Theoretical Positive Design Features

What Benefit are the Wingtip Vertical "Fins"?

Those are Anti-Vortices Fences/Tips.

When a wing moves through the air those molecules try their best to get out of the way. On a wing with square tips this creates horizontal tornadoes that induce great drag on the wing and airplane.

Using an Anti-Vortices Fence with a pointed tip at the backend greatly reduces this action and even aids lift as it forces the molecules to move front to back in a straighter path.



Why twin Fins?

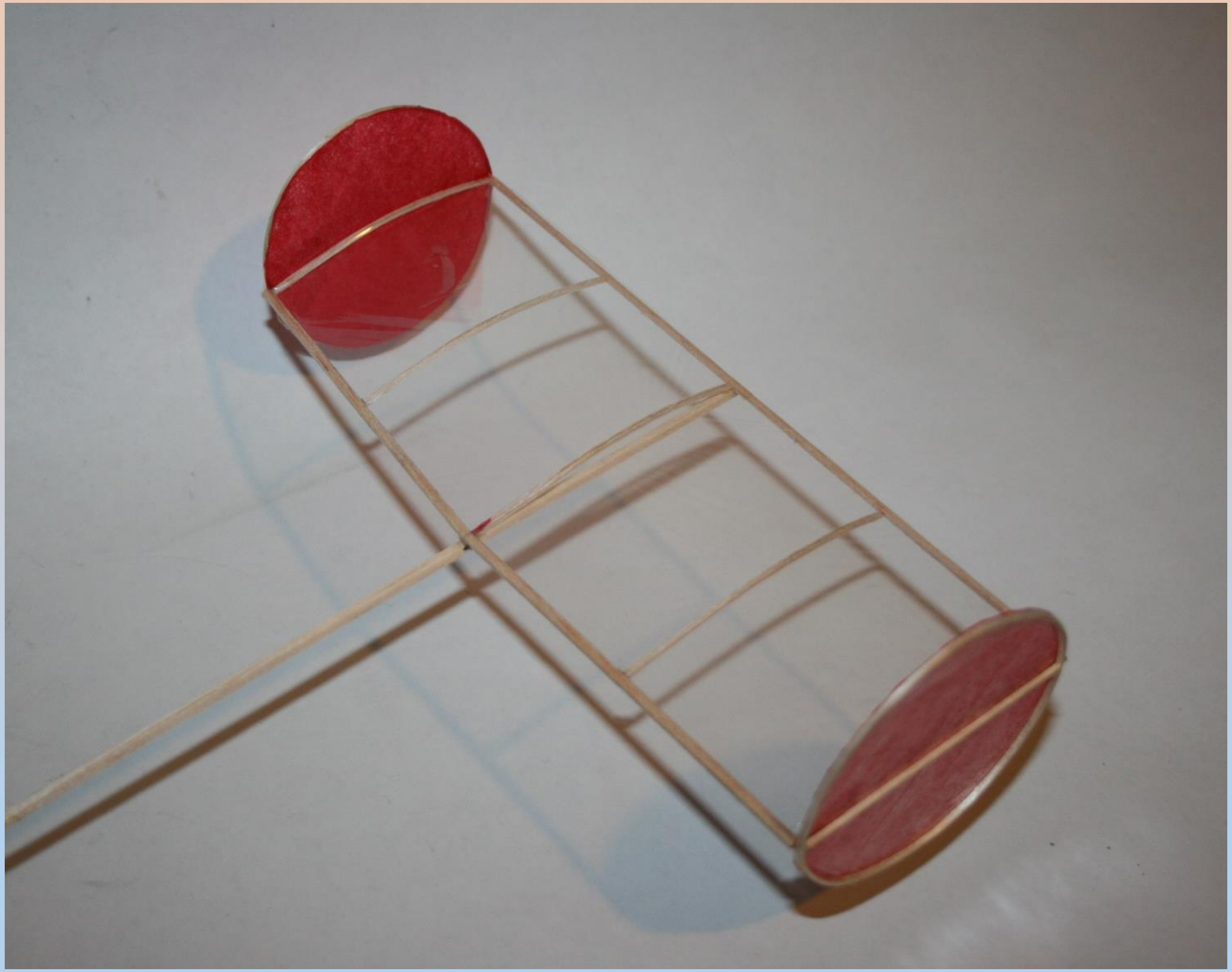
We use the stabilizer in two different ways.

Primarily its function is to stabilize the aircraft in the pitch axis (Nose Up- Nose Down).

It also can function like a second wing creating lift. For the same reason that wings use Anti-Vortices fences, we can have the fins also function in a similar way.

The down side is added drag but the extra lift from the stabilizer makes up for this effect.

The last benefit is to have the fins flying in "cleaner" air from the prop's turbulence.



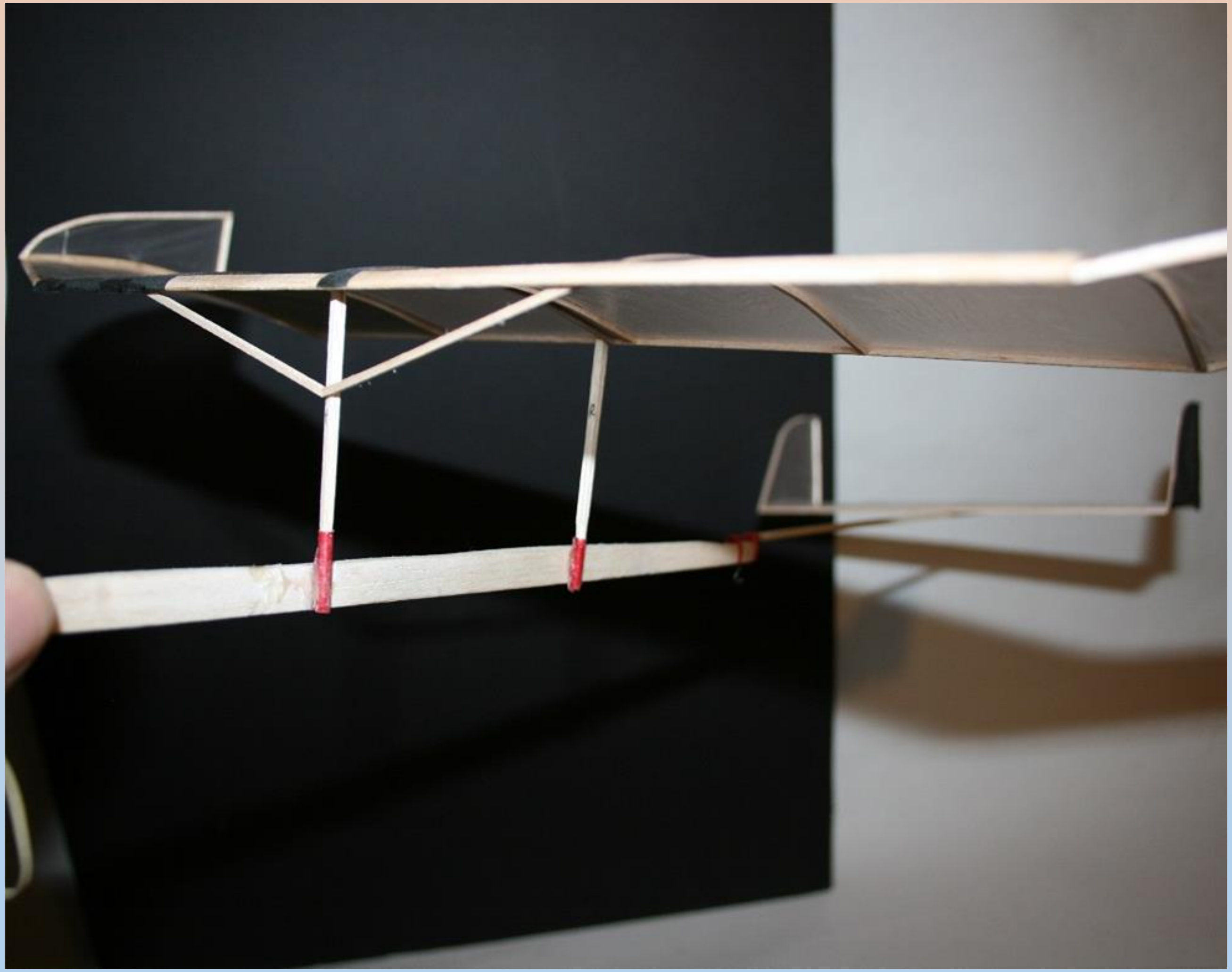
Point-Down Leading Edge, Why?

Years ago a NASA Scientist, Cezar Banks, discovered that a slow flying model with a drooping leading edge was far more efficient.

Apparently the turbulated air flow UNDER the wing gave the wing more buoyancy.

The WW2 German Fiesler Storch used this concept with wing slots for exceptional STOL (Short Take-Off and Landing) characteristics.

This is complimentary to the basic Wright Stuff flight format which is fly slow and have plenty of lift.



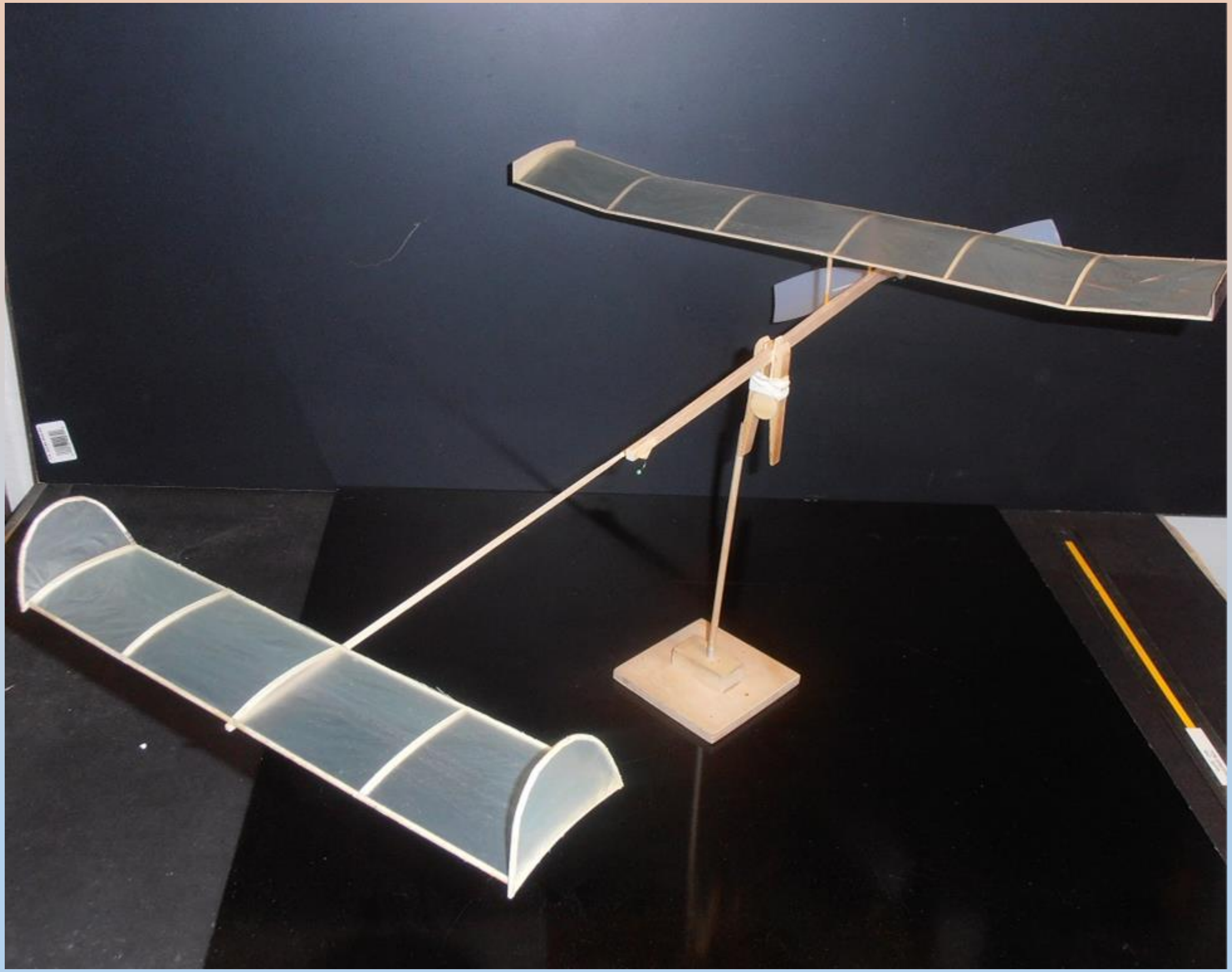
Is there an Advantage having a longer Fuselage?

Yes! The rule of thumb is that you add a minimum of 10% to the wingspan to establish a base line length for the fuselage.

This length allows the tail assembly to be smaller as it flies through cleaner, less turbulent air.

When the tail assembly (empennage) is further away it actually has more authority.

Airplanes designed with a short tail moment (arm) become very pitch sensitive and difficult to trim for consistent flight patterns.



- **I have seen really long flying airplanes that seem to fly nose high, why?**

This actually is true and not an illusion.

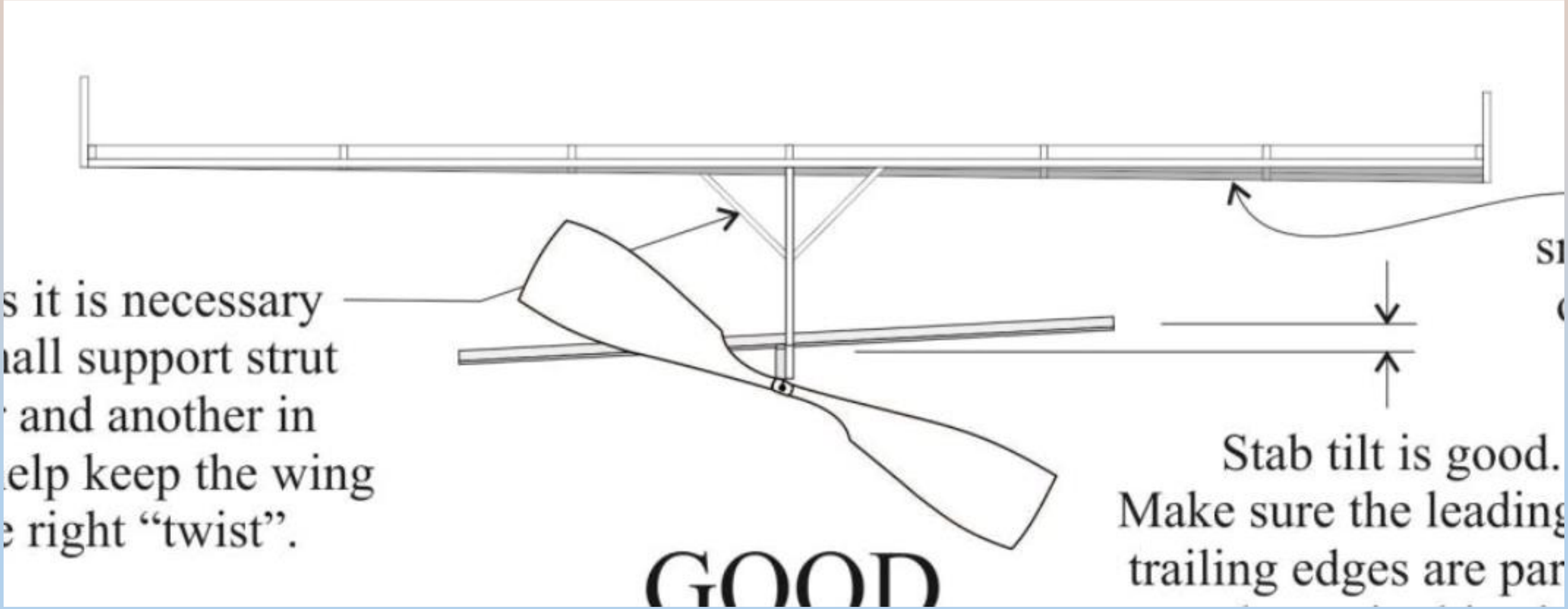
Models that are well trimmed will be stable flying with the nose up slightly with a couple degrees higher.

The model has been “dialed-in” to fly that way and is flying on the edge of a stall without actually entering a stall.

This is the optimum point of high lift. It actually slows the model down so that the prop struggles to spin off its stored energy.

All these factors add to the length of the flight. Design features will be long fuselage, cambered wing and stabilizer surfaces and a CG a bit more aft by the tail. Though such model are stable in level flight, if they have an abrupt change in flight attitude and enter a dive, their recovery to level flight will take much longer or not at all.

What is and why use Stab Tilt?



Whew! Any Questions???