

Elastic Launch Glider

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Overview

- What the event is about
- Critical takeaways
- Resources
- Building
- Record Keeping
- First flights, initial trim

<https://www.youtube.com/watch?v=2TqtYQwsrd0>

<https://www.youtube.com/watch?v=otyLYfc1W1w>

What Elastic Launch Glider is about

- This event isn't about designing an glider.
- It IS about collecting data and evaluating it to optimize a complex system
- While it isn't about designing a glider, unless you can build a glider that flies, you can't get to the meat of the event, so I'll spend a lot of time on that.
- So, why a glider? Frankly because they are a complex non-linear system. They are third entry into the flying rotation. AND, they're FUN!
- Note, while the point is test and eval, there are lots of opportunities to explore math and science at all stages of building and flying!

Critical takeaways

- **WARNING:** the gliders are fragile, you will break it, others will break it even easier if you let them, sometimes you break it intentionally, **GET OVER IT!**
- Rule 1, build the glider as light as you can
- Rule 2, make sure your glider doesn't weigh too much
- Rule 3, go back and read rules one and two!
- Rule 4, build accurately, spend time preparing materials, making jigs & patterns, etc. Build fast.
- Rule 5, take **LOTS** of data, which means fly lots!

Resources

- Where to find help?
 - Everything I cover here and more is on the internet somewhere, the National SO page is a good starting point http://soinc.org/elastic_launched_glider_b
 - I monitor several discussion boards (I like www.scioly.org best) on the net and respond to e-mail questions
 - Check you local AMA clubs, especially those focusing on free flight
 - <http://www.amaglider.com/> was written by one of the best practioners of gliders, study, read and understand this site!!! In fact, I'll reference it a lot in this presentation.

Resources

- Building Tools, must have
 - A flat building board, able to take pins and covered with wax paper, I use foam insulation board
 - Sharp knives with lots of spare blades
 - A good metal edge rule/straight edge
 - Some sort of thickness micrometer
 - Sandpaper and sanding blocks
 - Lots of pins & scrap balsa blocks
 - A good scale accurate to 0.01 gm, cheap (less than \$20) electronic ones available on the net or build your own for less

Resources

- Building tools, nice to have
 - Precision micro super glue applicator, two pins stuck through a stick at an angle to come together at their ends
 - Balsa stripper
 - Mat board, tablet backs or foamboard, not poster board, for jigs
 - ¼ inch thick balsa sheets for jigs
 - Misc square blocks for jigs



Resources

- Building materials
 - A complete kit, easy way to get everything to build 1 or 2 gliders, costly
 - **OR...**
 - Balsa, 1/32, 1/16, 3/32 and 1/8 inch thick sheets, or suitable width sticks, light to medium density
 - Covering, indoor mylar, tissue, grocery store bags (maybe?)
 - Glue, Superglue (also called: cyanoacrylate or CA) or balsa cement
 - If using CA, instant setter

Resources

- Flying
 - Necessary:
 - Catapult handle, limit this year, under 1 meter in size
 - Rubber, varying widths for varying heights
 - Stop watch, NOT your cell phone, you'll get DQ'd
 - Your flight LOG and a pen/pencil!
 - A good carrying/storage box
 - Darned Nice to have:
 - Stoooge to hold the glider, remember, they break, often when they fall off a table
 - Repair Kit, CA, setter, knife, spare covering, spare balsa

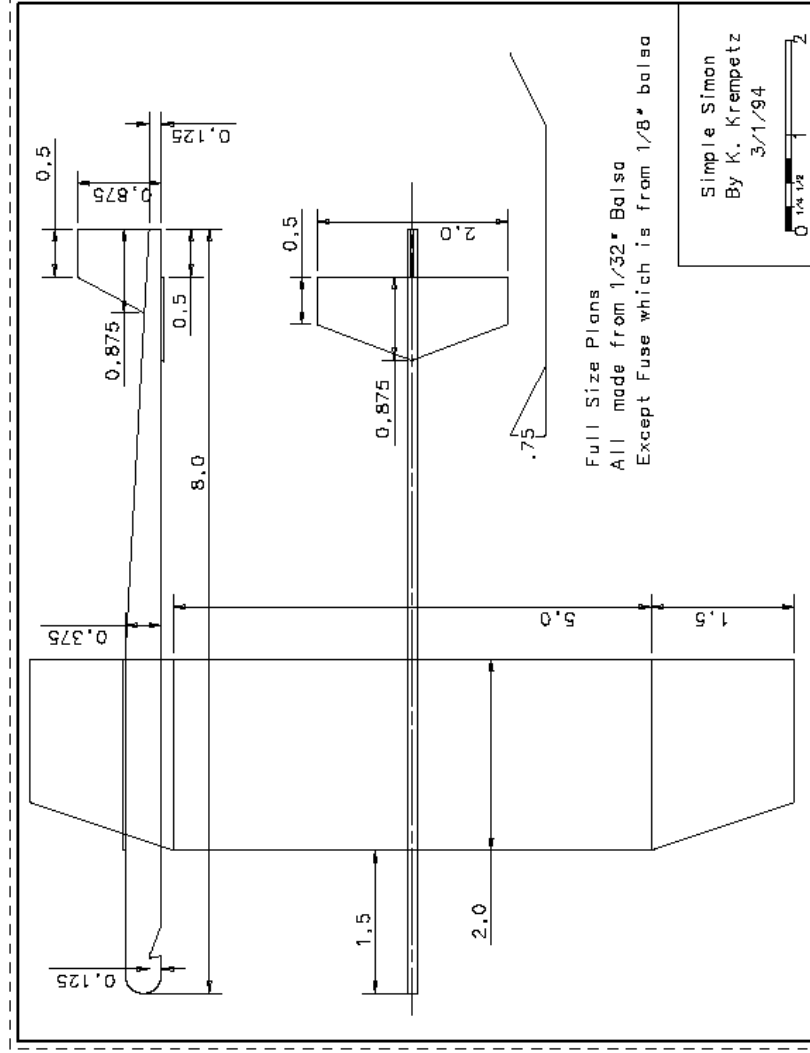
Building

- Overview
 - Select a plan
 - Gather and prepare materials
 - Make jigs
 - Make wing, sand carefully to shape
 - Make stabilizers
 - Make fuse
 - Assemble using jigs
 - Check settings, go fly!

Select Plan

- Plans come with kits, and are available on the internet. Make sure they comply with the rules or adjust accordingly
- Plans have two key elements
 - Drawing of glider showing dimensions and arrangement of all parts
 - A bill of materials, often missing, you probably will have to make it yourself
- Comment: There are a lot of 'GOOD' designs to AMA rules. BUT, AMA rules AREN'T SO rules.
 - AMA rules don't allow folding wings, SO does.
 - <http://www.rcgroups.com/forums/showthread.php?t=793903>
 - <http://www.americanjuniorclassics.com/interceptor/interceptorpatent.htm>
 - AMA rules require monoplane, SO does not.
 - I don't know that AMA designs won't turn out best, but...
- Remember, the purpose is to test, collect data and adjust!!

Select Plans: The Drawing



Select Plan: Bill of Materials

Simple Simon							SO sized Simple Simon						
Part name	Length	Width	Thickness	density	mass	actual	Part name	Length	Width	Thickness	density	mass	
Fuse	8.0000	0.1250	0.3047	7.0000	0.5604	0.3450	Fuse	12.3716	0.2148	0.0938	9.0000	0.5892	0.745
Wing	8.0000	2.0000	0.0313	7.0000	0.9196	1.1150	Wing	12.3716	3.0929	0.0313	7.0000	2.1991	2.8150
Hor stab	2.0000	0.6875	0.0313	7.0000	0.0790	0.1	Hor stab	3.0929	1.0632	0.0313	7.0000	0.1890	0.1400
Ver stab	0.8750	0.6875	0.0313	7.0000	0.0346	0.025	Ver stab	1.3531	1.0632	0.0313	7.0000	0.0827	0.0400
Glue					0.2	0.1800	Glue					0.2	0.2100
					1.7935	1.7650						3.2600	3.9500
	span	7.598076			ballasted	2.6400		span	11.75				5.0000
	dihedral	0.75						dihedral	1.159833				
	flat span	5						flat span	7.73222				
	area	15.19615						area	35.25				
								Nose radius	0.53937				

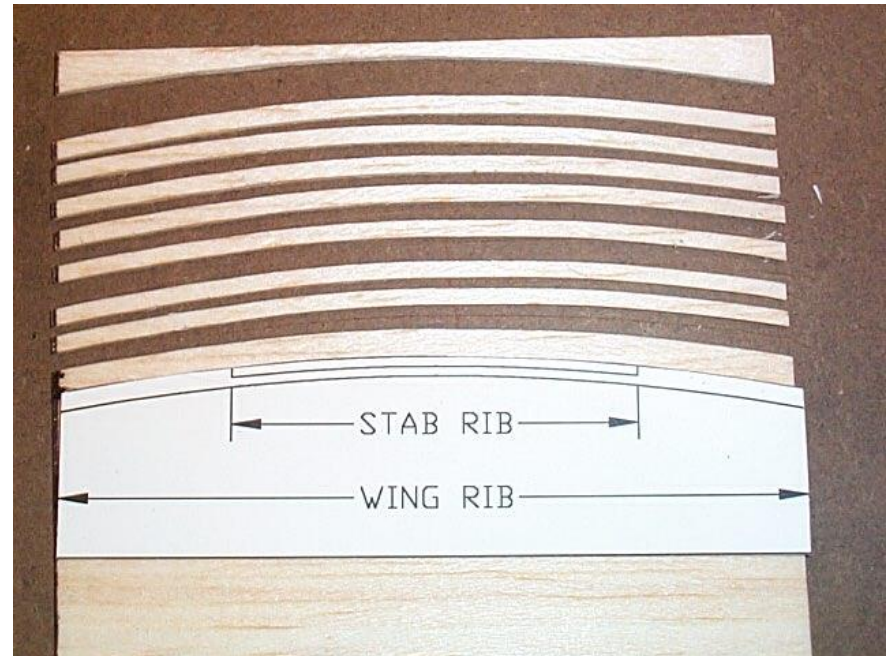
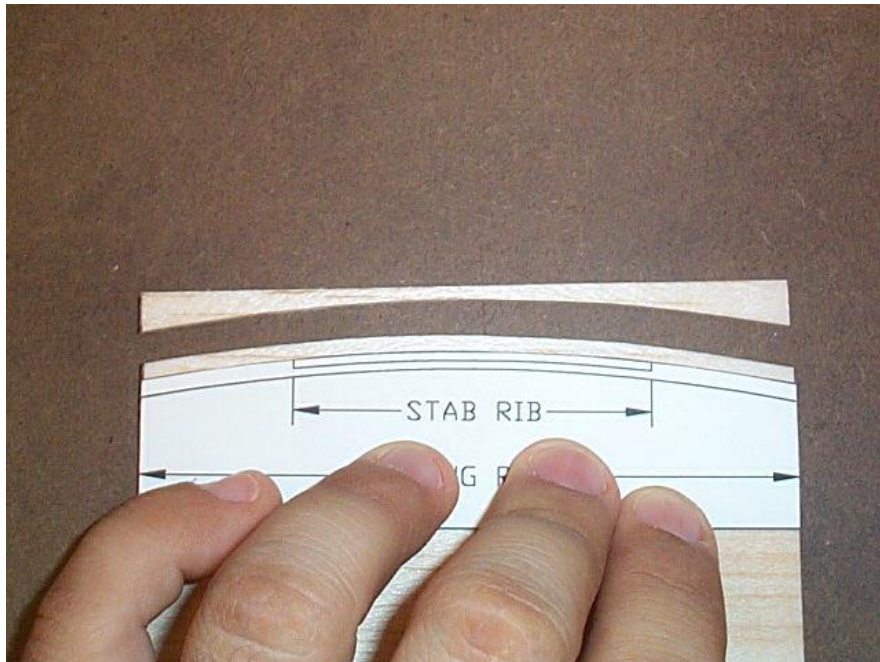
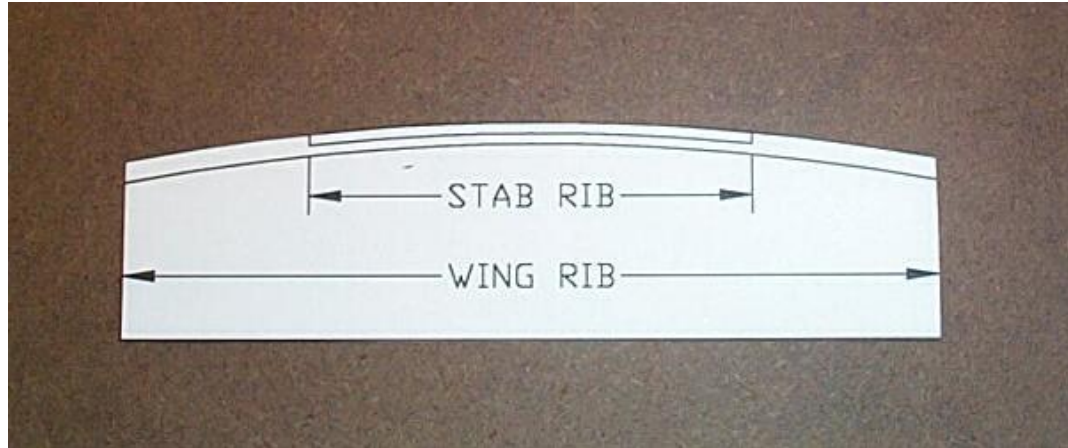
Prepare materials

- Select straight sheets for your components to match plan. Make sure you check weight against the bill of materials, stiff and straight, cut slightly long
- Cut ribs, lots, select the best that weigh the bill of materials amount
- Cut covering (if used) with a one inch margin
- If building on plan, tape to building board, cover with wax paper, otherwise just cover board with wax paper.
- Have glue, pins, scrap blocks to hand

Wing Construction

- Gliders wings vary in complexity from the simple like we're going to build to the complex
- Wood selection is CRITICAL, straight, correct weight, stiff, typically light C-grain
- Select pieces, cut to outline, assemble if called for.
- SAND to shape
 - <http://www.amaglider.com/?p=view&a=basic-sanding-techniques>
- Assemble
 - http://legacy.amaglider.com/assets/outdoor-gliders/handlaunch_gliders/building-instructions-for-stan-catapult-gliders.html
 - <http://www.amaflightschool.org/diy/how-build-indoor-catapult-launch-glider-science-olympiad>
 - <https://www.youtube.com/watch?v=HkWy97xe3f4>

Cutting Ribs

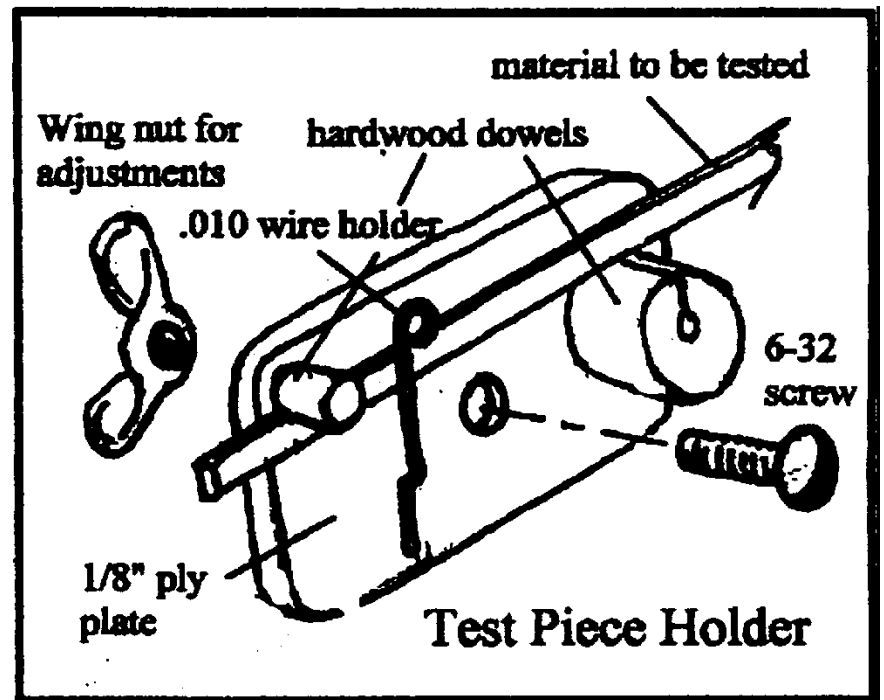
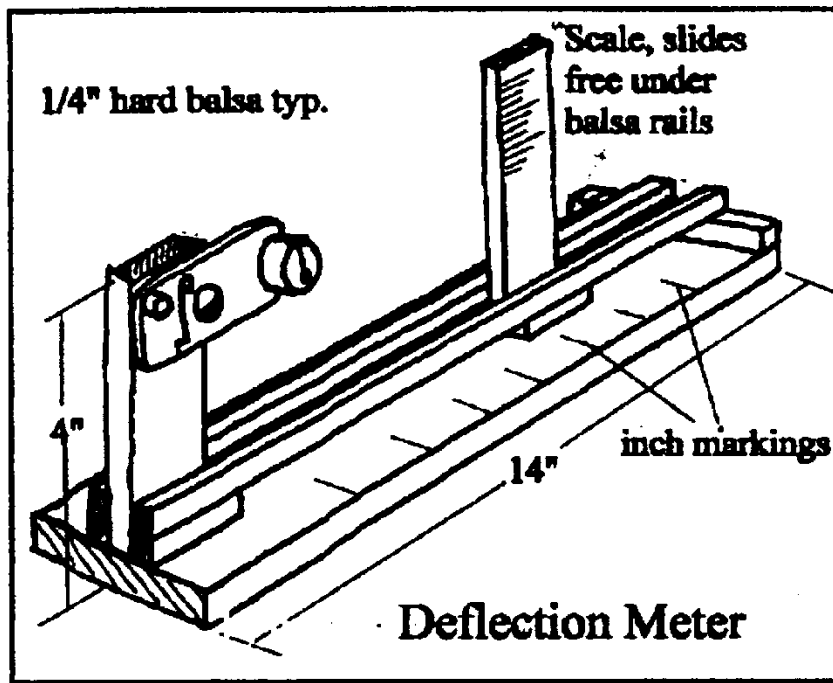


Prepare Jigs

- You can build without jigs, just not as well or as fast.
- Spending time on accurate jigs greatly speeds building good planes

Prepare Jigs

Prepare Jigs



Trials and Record Keeping

- I can show you how to build a Glider, even hand you one of mine, but without practice and data collection you won't be able to fly it! Plan LOTS of practice time
- This event is PRIMARILY about data collection and evaluation. Minimal flight logs pass the requirement, but miss the point!

2009 Wright Stuff Div B

Flight Log

Flying Session Date:													
Room Size:		Ceiling Ht:			Temperature:				Air:				
Airplane being tested, brief description													
Flight Number	Wing setting	Tail setting	Propellor Pitch	Motor Size	Max Turns	Backoff Turns	Max Torque	Backoff Torque	Max Height	Turn Diameter	Flight Time	Flight Behavior	Other comments
1													
2													
3													
4													
5													
6													
7													
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10													
11													
12													
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Students: Orville Wright
Wilbur Wright

Thoughts on optimizing the design

- Be organized, collect data carefully, DOCUMENT it.
- Select variables you plan to explore
- Organize your experiment to test alternatives effectively.
- Measure and analyze results. Multiple trials to minimize errors.
- If the students ready (if they can do Algebra, they are), use Design of Experiments!!
- Repeat as necessary.

Flying, misc hints/tips

- Catapult
 - NOTE, the AMA rules on catapult handles DO NOT apply to SO event. They are certainly a good starting point, but not a restriction. There MAY be solutions that prove useful in significant ways.
 - <https://www.youtube.com/watch?v=o8iDG7VDhz4>
- Launch
 - <http://amaflightschool.org/video/how-fly-indoor-catapult-launch-glider>
 - <https://www.youtube.com/watch?v=-q-35REUmGQ>
 - <https://www.youtube.com/watch?v=8SmWT-5Ypbs>
 - <https://www.youtube.com/watch?v=8hvedT8JkYw>

Flying, misc hints/tips

- Pre Flight (develop a checklist, use it every flight)
 - Check settings, use plan recommendation as start point.
 - Check for anything broken, fix it.
 - Set glider in stooage when not flying.
- Broken fuselages while learning transition – practice outside (CALM day) over long grass!