

# Basics of Giant Scale Design

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*Andersen  
Designs*

# Are you ready to design?

- Have you mastered; Plan Building or Kit Bashing?
- Are you a good pilot?
- Do you understand basic principles of structure and flight?
- Will you enjoy every step in the process? »

*“I don't have to be an aeronautical engineer. I start with a proven design.”*

*- Wayne Siewert*





*"An airplane is a group  
of compromises flying  
in close formation"*

- Allen Penticoff



# Design Methods

## Analytical

- Accurate and optimal
- Math intensive
- Requires super computer and wind tunnel
- For professional aeronautical engineers only





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## Heuristic

- Derive from accumulated experience.
- Modest change from previous designs.
- Most applicable to modeling.



# Six Steps in Scale Design

- Gather all the documentation that you'll ever need
- Decide on model size & purchase components
- Enlarge 3-views to model size
- Trace the 3-view & fill in structure
- Save the original, build from blue line copies
- Update the drawings as you build & fly »



# Labor Required

- 10% Research
- 30% Design & Draw
- 5% Cut Wooden Parts
- 10% Make F/G, Plastic & Metal Parts
- 20% Build Airframe
- 25% Cover, Paint & Detail





# Build or Buy?

- Wheels
- Vacuum-Formed Canopy
- Struts
- Fiberglass Wheel Pants
- Fiberglass Cowl
- Decals
- Muffler

If you buy, fine tune model  
size to match available  
parts...





# Documentation

- 5-View Drawings w/Cross Sections
- Black & White Photos
- Color Drawings or Photos
- Color Proofs
- Paint Chips
- Plastic Models

Gather all  
documentation you'll  
ever need before  
proceeding ...

**Reconcile Differences!**



# When to Deviate From Scale



## Never!

Well ... except for compelling reason!

Examples:

- Washout – For low speed stability
- Wing thickness at root – to fit retracts
- Stab incidence – if too negative
- Wheel doors/pants – Cut high for grass



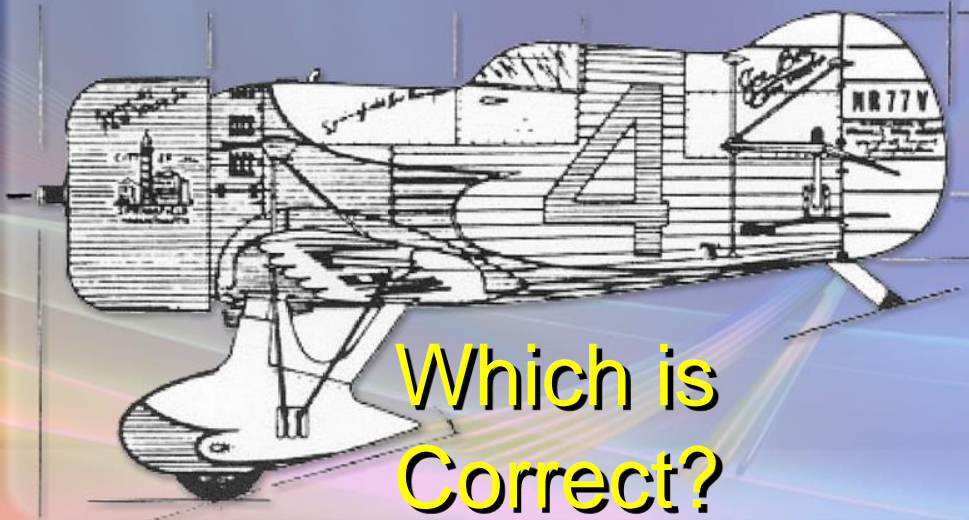
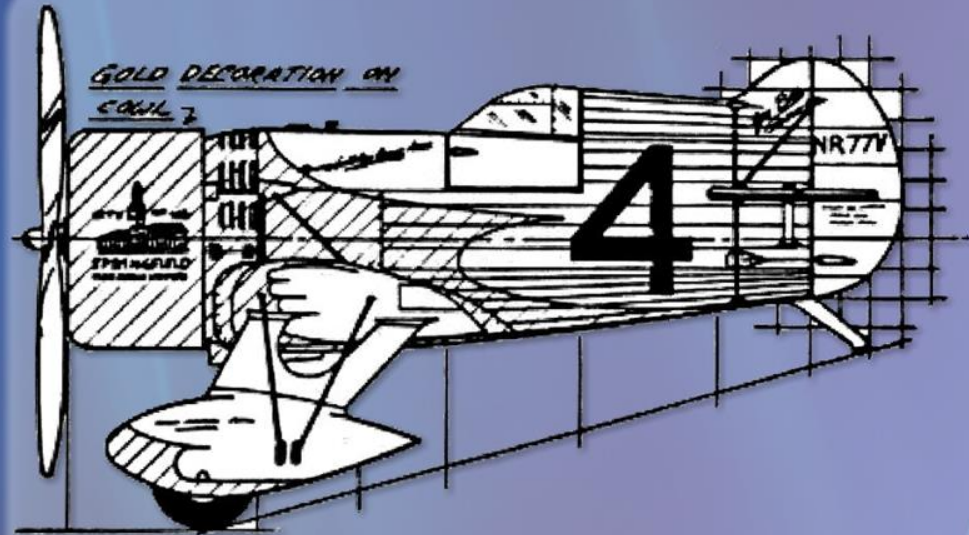


# Don't!

- Enlarge the tail
- Use flat sheet instead of an airfoil in the tail
- Move the wheels forward
- Increase dihedral
- Thicken the wing
- Shorten the landing gear
- Add down thrust or side thrust
- Use horsepower to overcome excess weight



# Choose 3-Views Carefully!



Which is  
Correct?





- Weight is proportional to  $\text{size}^3$
- Area is proportional to  $\text{size}^2$
- Speed is proportional to  $\sqrt{\text{size}}$

### Example:

70" span 7Lb model scaled up to 100" will weigh 20Lbs, fly 20% faster and require twice the paint...



# Power is Proportional to Size <sup>3.5</sup>

*Note: Small change in size requires large change in power!*

## Example:

60 – sized model of 70” wing span,  
enlarged to 100” span requires 3.45  
times the power

(Saito 180, Moki 2.1, Quadra 35 ...)



Reno 2009 P51's



# Start With The Propeller

*What size propeller and RPM do I need to propel this airplane?*

*Then pick the engine!*



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# Enlarging 3-Views to Model Size

1/3rd scale is 1/3rd bigger than ...



1/4 scale which is 1/4 bigger than ...



1/5th scale which is 1/5th bigger than ...



1/6th scale and so on ...



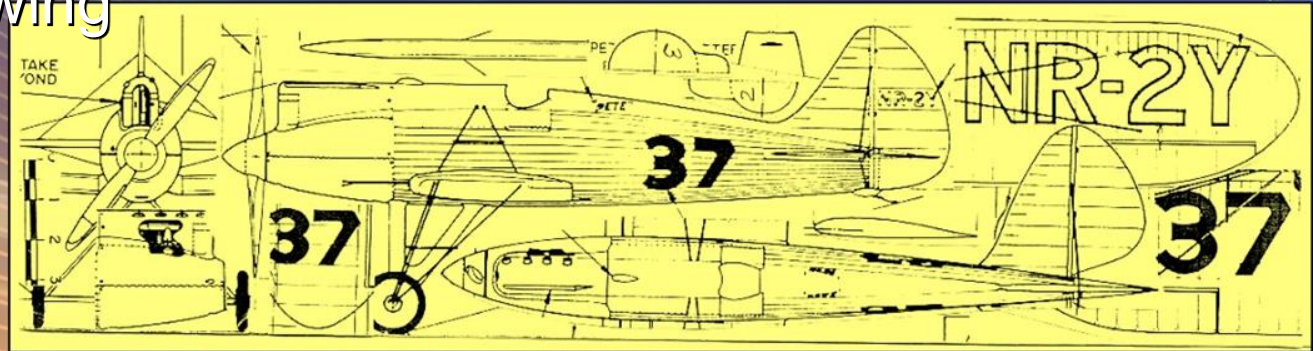
- Copy 3-views, check length & width
- Calculate enlargement factor = model span/3-view span
- Calculate drawing height =  $36''/\text{enlargement factor}$
- Cutup, rearrange 3-views, draw calibration lines
- Enlarge to 36" height max, any length
- Verify correct dimensions – length & width





# Enlarging Services

- Look in Yellow Pages for Engineering copying services, OZLID copying, etc... for architects, engineers, surveyors, etc...
- Copy size standard is 36" max height, any length
- Photocopy enlargement cost is about \$40 for one 1/4 scale drawing



36" Max After  
Enlargement



# Copy structural details from a proven design of similar size & construction.

## For Example:

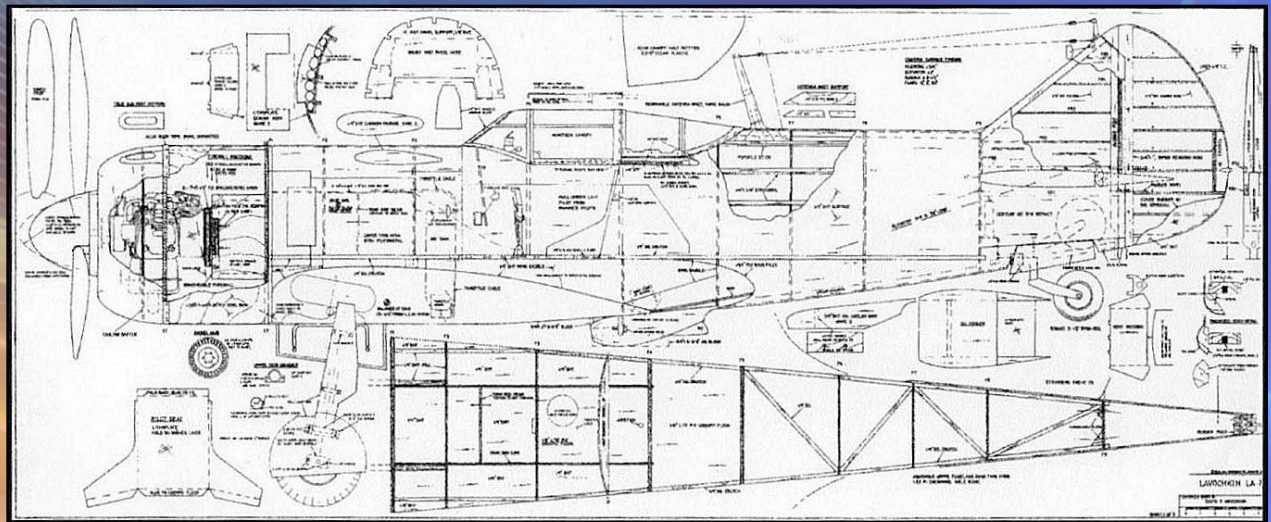
- To design a 95" span Nakajima Ki 27 Nate, refer to plans of a Zivoli P-47
- Same rib spacing, ply thickness, sheeting, stringers, mounts etc
- Same washout, incidence angles, throws, C.G., weight etc...





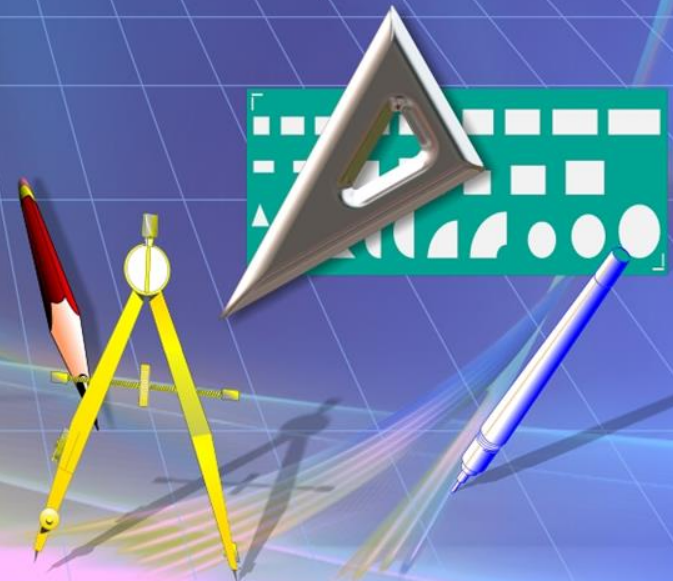
# Drawing the Plans

- Draw master w/0.5 HB pencil on 1/8" quadrille-rule vellum
- Let wide paper hang over left & right edges of table
- White table works better for tracing
- Build from copy of master drawing
- Update the master as you build! »



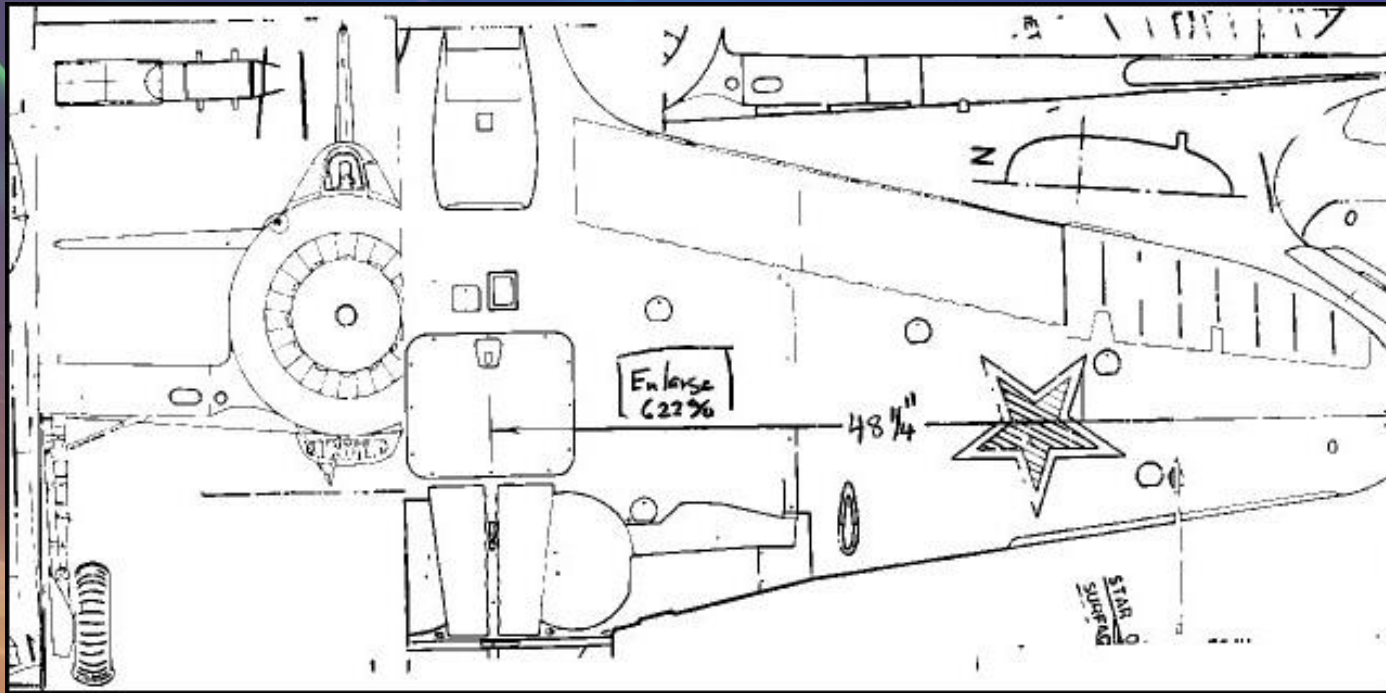
# Drawing Tools

- 0.5mm HB Mechanical Pencil
- Eraser & Thin Metal Shield
- 45°-90° Plastic Triangle
- 30°-60°-90° Plastic Triangle
- 12" Ruler
- Long Straight Edge
- Compass
- Circle Template
- French Curve
- Ships Curve
- 36" White Drawing Table
- Bright Shadow-Less Lighting

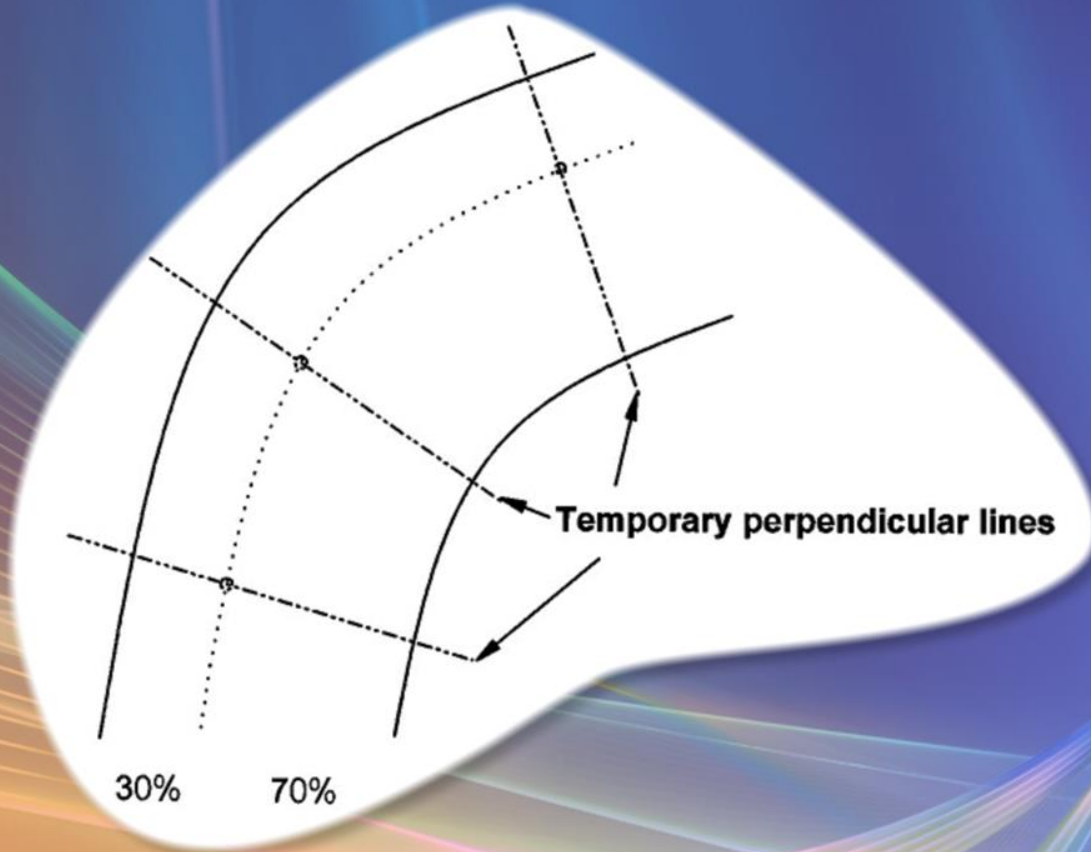




# Enlarged Wing View Ready For Tracing



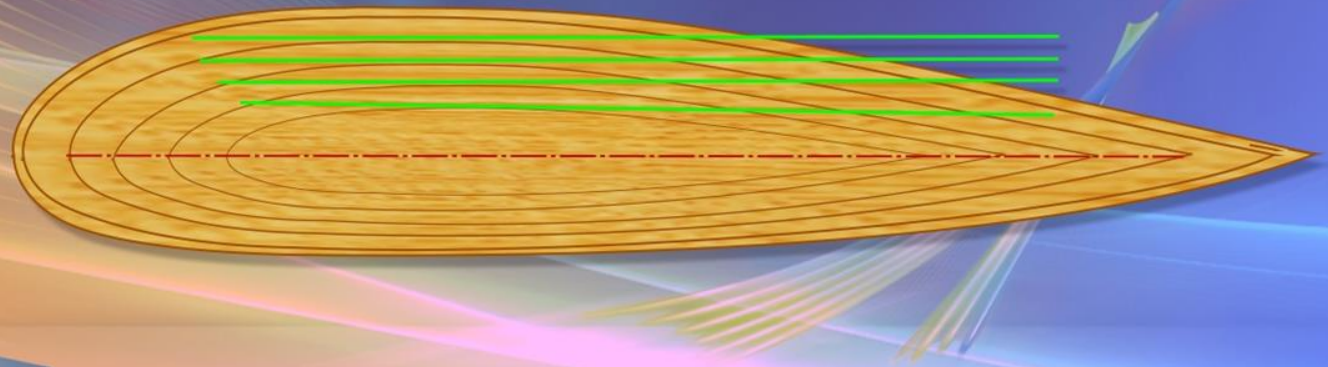
# Lofting a Line Between Two Other Lines



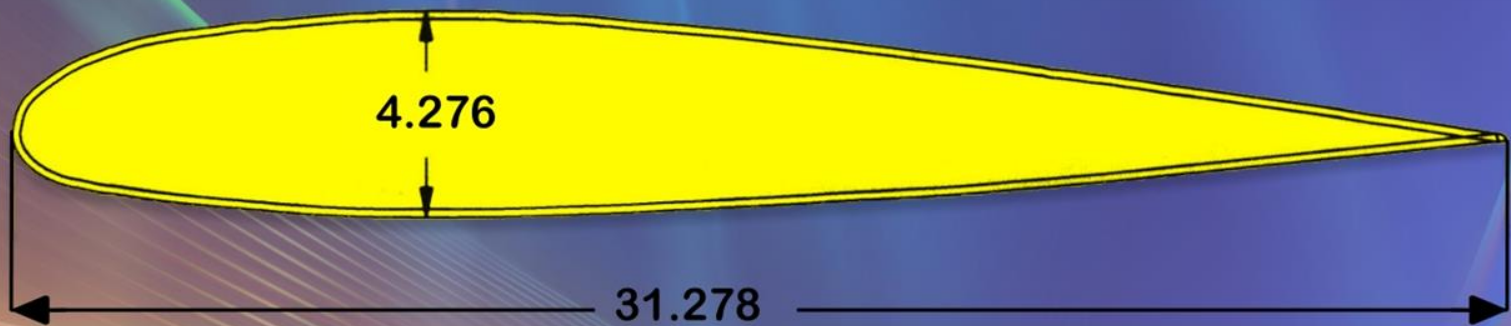


# Lofting Wing Ribs

- Draw wing top-view & front view w/rib positions
- Superimpose root, mid & tip airfoils ... no washout yet!
- Adjust chords & thickness per wing top & front views
- Mark L.E., T.E., top, bottom of airfoils
- Interpolate curves of remaining airfoils
- Trace each airfoil, subtracting sheeting & add spar notches
- Rotate rib for washout, add alignment tabs
- Add details to each rib for ailerons, flaps, retracts, etc...

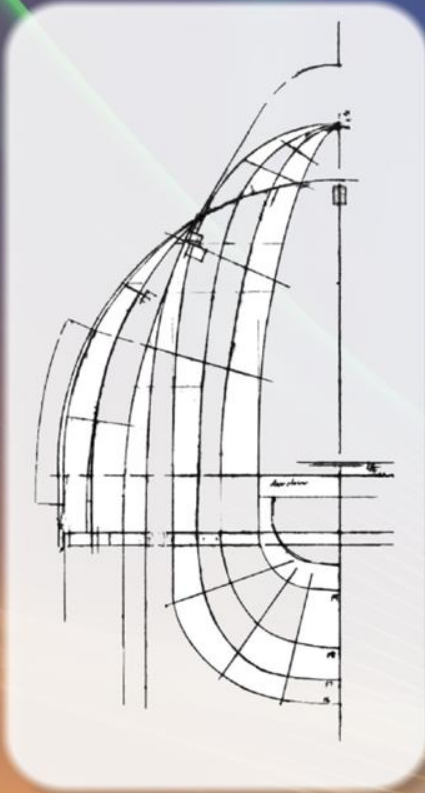


# ModelCAD Intermediate Drawing of a Wing Rib





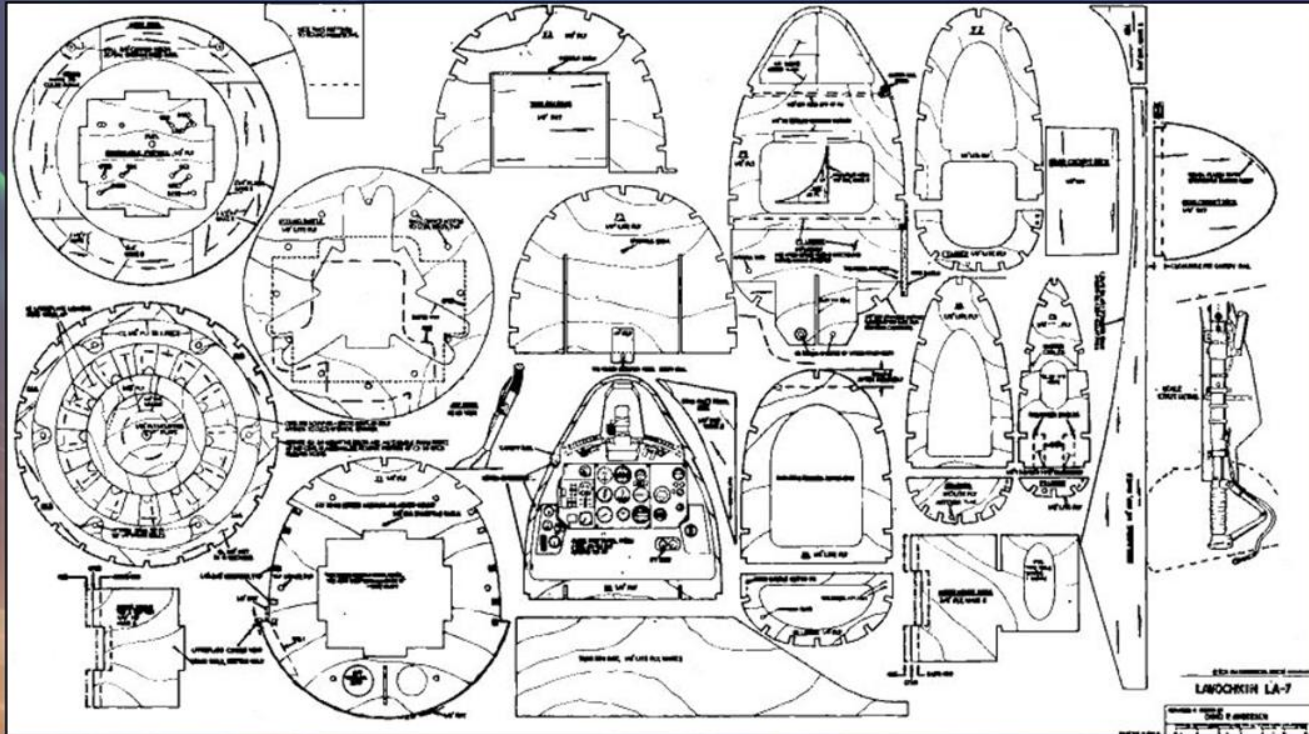
# Lofting Fuselage Formers



- Draw fuselage top view & side views w/ former positions
- Superimpose known former halves
- Adjust height and width per fuselage top & side views
- Mark width & height of remaining formers
- Interpolate curves of remaining formers
- Trace each former half, subtract sheeting, add stringer notches
- Reverse the drawing, trace the other half



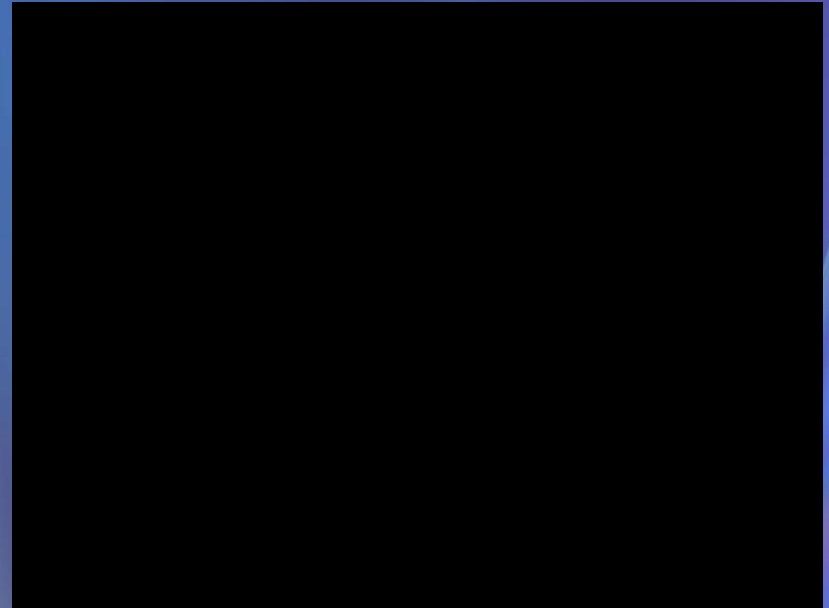
# Fuselage Formers





# Draw The Master

- Draw the master copy on vellum or Mylar ®
- Build the airplane from copies of the *Master!*
- Update the Master as you build & fly, not later!



# *Thanks for your time!*

# *Enjoy Your Next Scale Project!*

## *Resources ...*

### *HighFlight Spring 2010*

*Simplified Scale Design - Article*

### *MNBigBirds.com*

- *Free!* Scale Plan Downloads, 3-Views, Documentation, Fiberglass Parts, Scale Wheels, Retracts etc ...
- Scale Flyers of Minnesota – News Letters, Events, Meetings Info etc ...
- *Contact Information;* Andersen Designs, Micko Aircraft & Accessories and Equinox Giant Scale R/C
- Additional Resources & Building Tools!



### *Additional Resources*

- Shindin Machine - Custom Landing Gear, Shindinmachine.com
- SAC Midwest - Custom Instrument Panels, Sacmidwest.com
- Axel's Pilots - Custom Pilot Figures, Axels-scale-pilots.de
- Pro-Mark – Dry-Transfer Decals & paint masks, Pro-Mark.com
- TnT Landing Gear - Struts, TnTLandingGear.com
- Abell Hobbies - Sheet Metal Struts, AbellRC.com
- Bisson Custom Mufflers - BissonMufflers.com
- Bob Banka's Aircraft Documentation – Photos & 3Views, Bobsairdoc.com
- "Vacuum Forming for the Hobbyist" - Book on Home Vacuum Forming, RCM Plans, RCMPlans.com
- ModelCAD 3000 - Free Download; Modelcad-3000.uptodown.com/en/
- Clearprint Drafting & Design Fade-Out Vellum, 1000H-8, 36" x 20 yds