

# Yoda Development

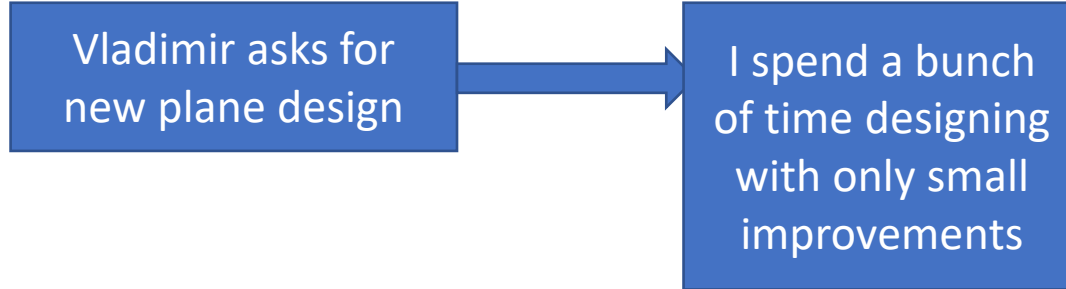
The design process, and some of the technical rationale and benefits for the design

# Design Goals For “Snipe3”

- Improve the usual performance stuff
  - Launch height
  - Thermal capability
  - Wind penetration
  - Minimum sink
  - “Blah, blah, blah”....
- Improve handling qualities
  - Reduce pilot workload while in the air
  - Easier quick turn-around capability
  - Make the plane more “fun” to fly

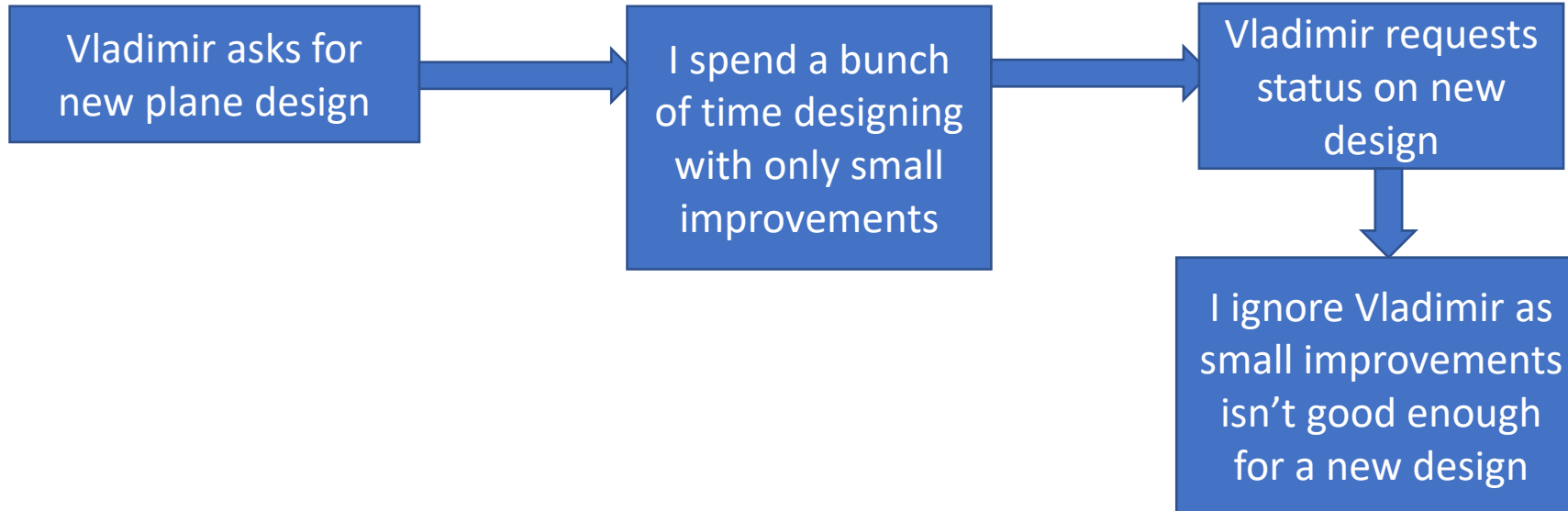
In other words, what all f3k aircraft designers have strived for in the past 20+ years  
The one change was that I increased focus on the handling qualities

# Design Process



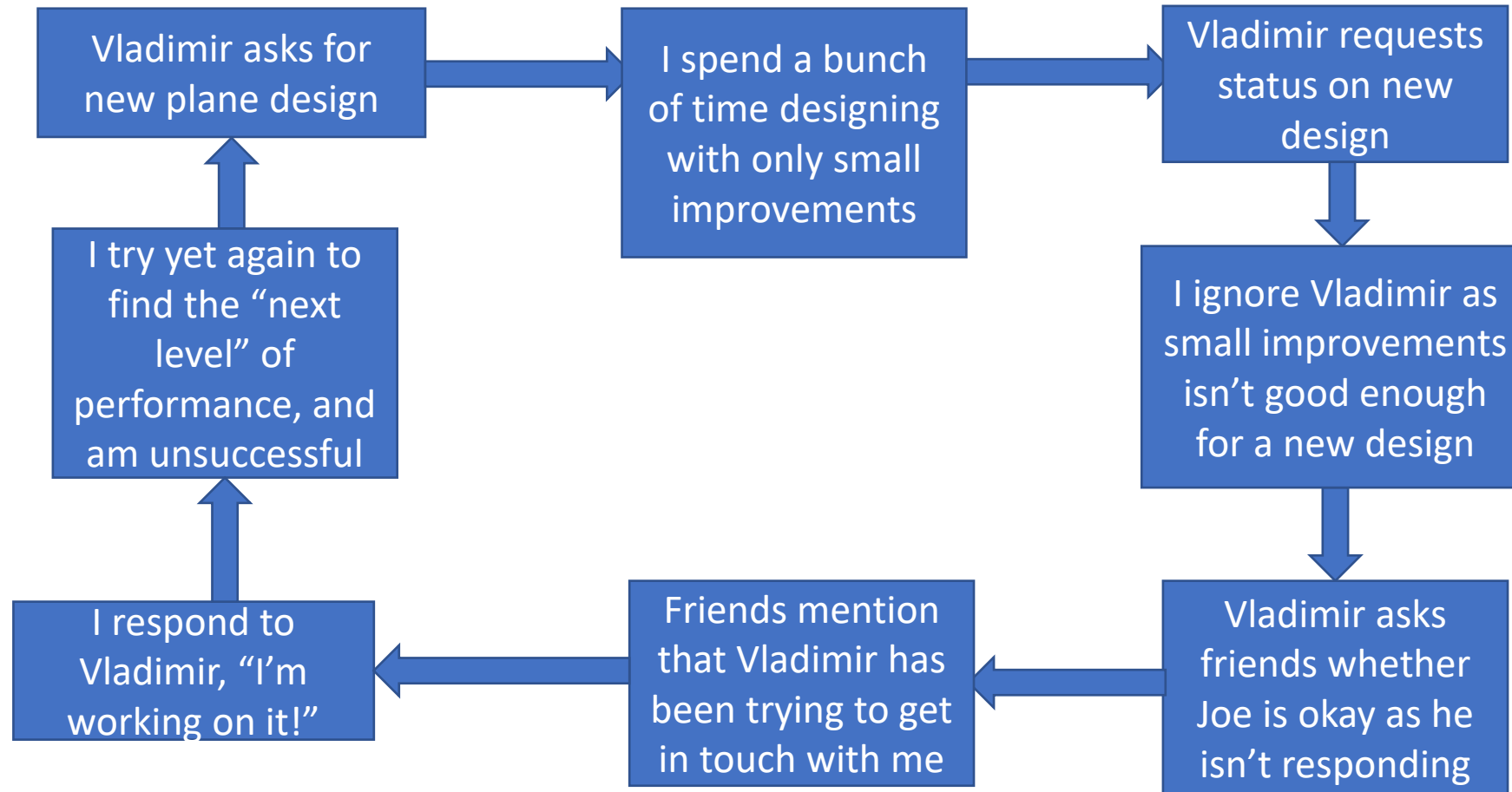
The current design paradigm is rather mature, hard to find anything other than incremental gains  
I would find little elements that can provide a trivial gain, that isn't enough benefit for me to  
commit Vladimir to a new design

# Design Process



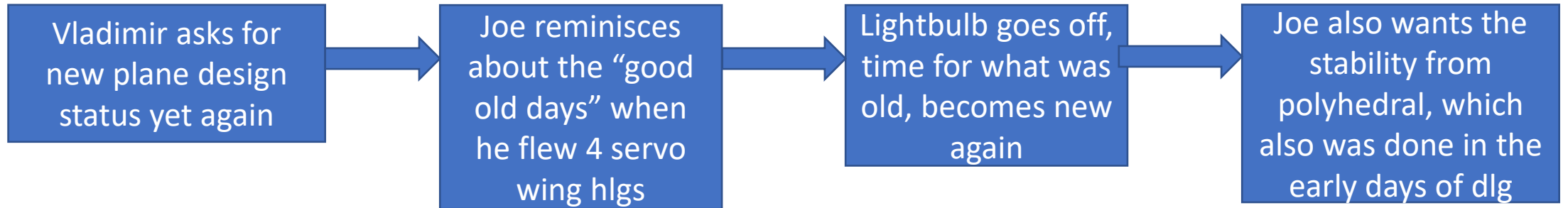
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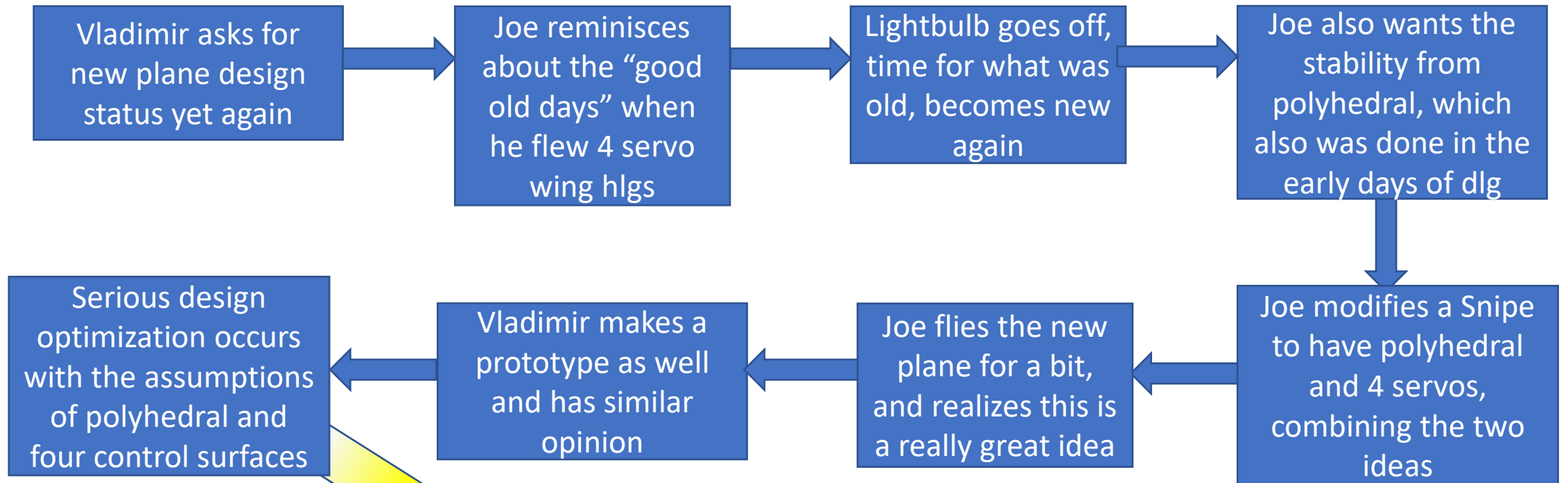
This design loop repeated numerous times in the past couple of years

# Concept Evolution Process



Sometimes the best "new" ideas come from something old

# Concept Evolution Process



The final result was a new plane. People kept asking when the Snipe3 was coming out. This was a new style of plane, and deserved a new name. The name selection process is best provided in person... 😊



# Polyhedral 4 Servo Wing Benefits

- Better stability for lower drag penalty than equivalent single dihedral wing
- Lower drag when using ailerons
- Wing and horizontal tail adverse interactions virtually eliminated
- Much better handling qualities, especially when thermal camber is used
- Much easier control mix optimization
  - Use flap differential to eliminate aileron to pitch cross-talk
  - Use aileron differential to minimize adverse yaw effects
- Very good handling when full flaps are deployed
- Lower risk of control surface flutter due to smaller span control surfaces

I will quantify the drag improvements in more detail later



# Design Incremental Improvements

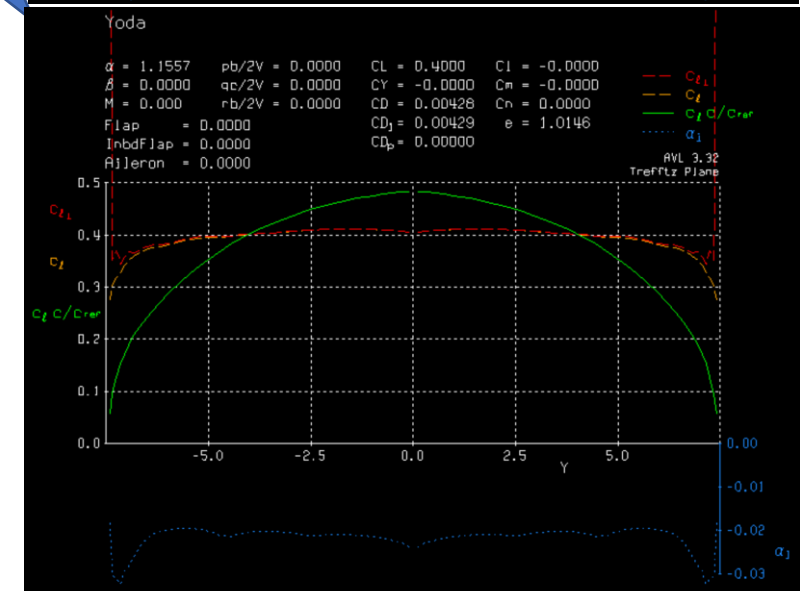
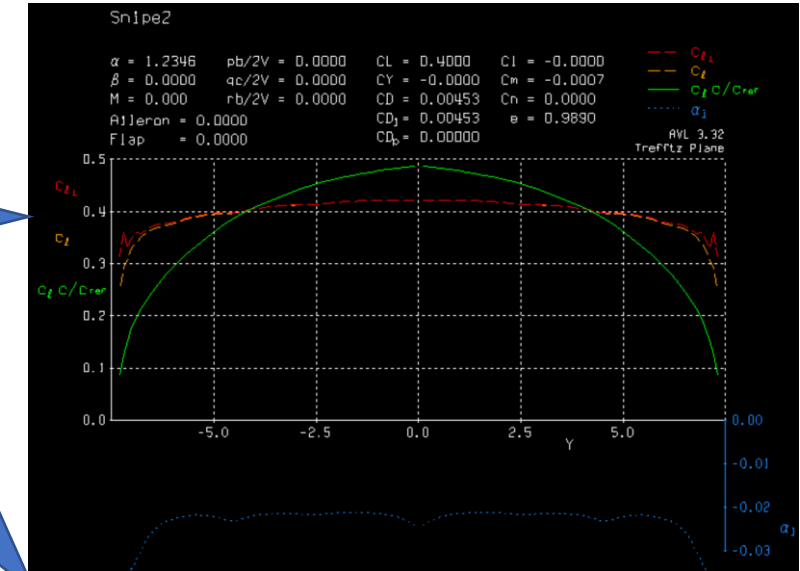
- Easily removable and replaceable fin
  - Improved structural integrity of the fin
- Integrated wing fillets, placed on the fuselage
  - Best to have the interface on the surface with a thicker boundary layer
  - Provides positive lock on the wing mount to fuselage
- 30 mm shorter nose as compared to Snipe2
  - Reduces wetted area, reducing drag
- Fin planform updated for lower drag and lighter weight



# Performance Comparison at Cruise

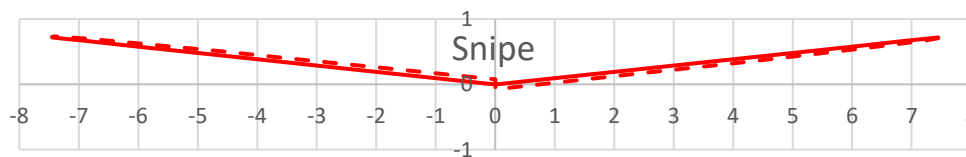
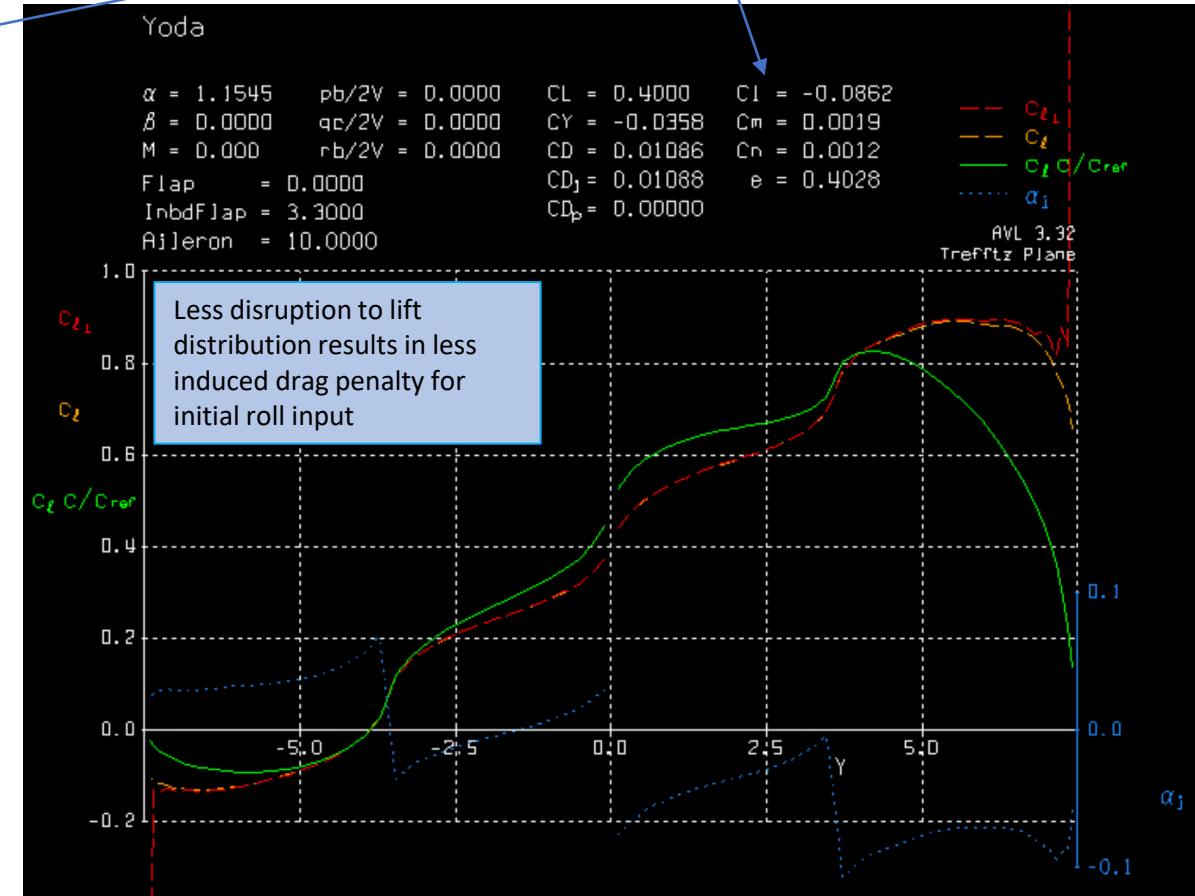
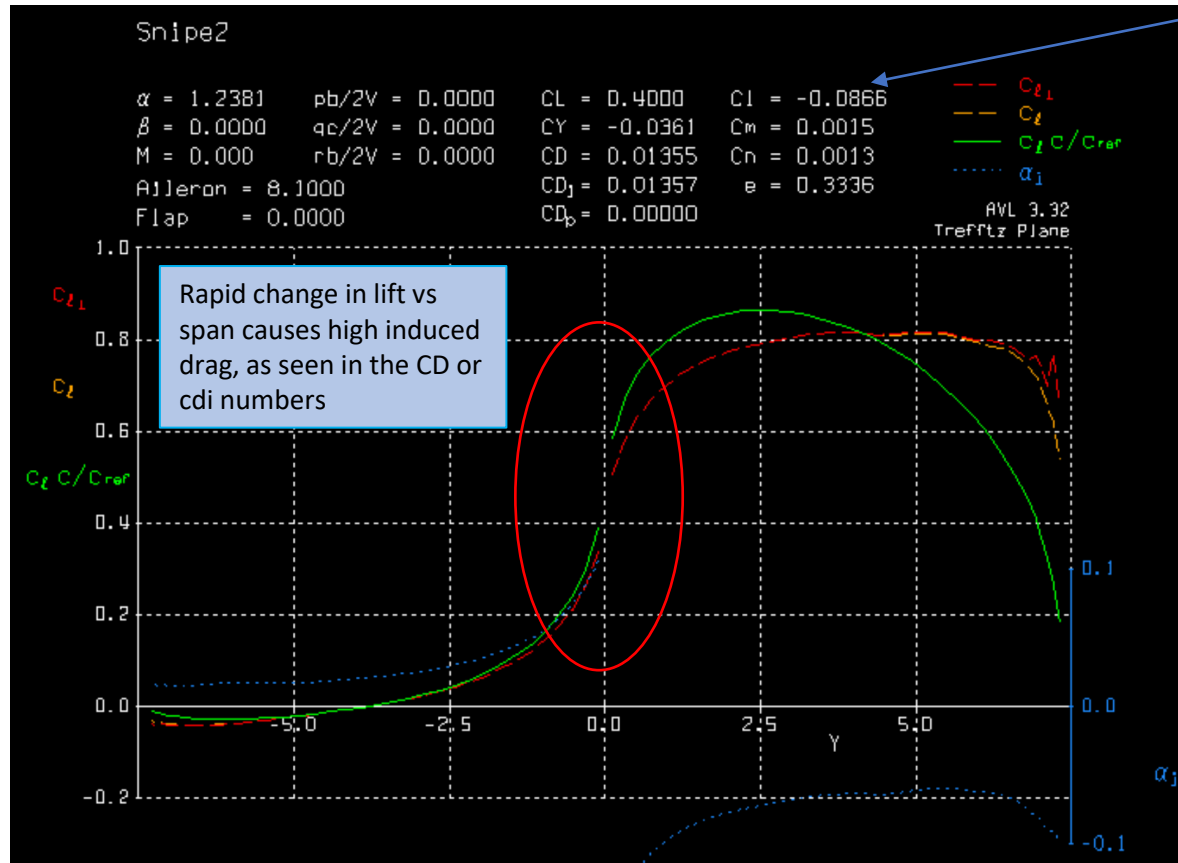
- Data from AVL for cruise condition with no control deflections
- The comparison will be for the drag difference for a flaperon deflection vs a separated flap and aileron control system to get the same roll response
- Note, comparing wing alone performance, not capturing gains from fuselage and tail improvements
- Note2, I show both aileron deflection data assuming wing is fixed, as well as data for when wing is rolling. The data that matters is between the two, likely closer to the constant roll rate data due to the very low wing roll inertia

	Snipe	Yoda
cdf	0.0167	0.0170
cdi	0.0045	0.0043
total	0.0212	0.0212
Gain		0%

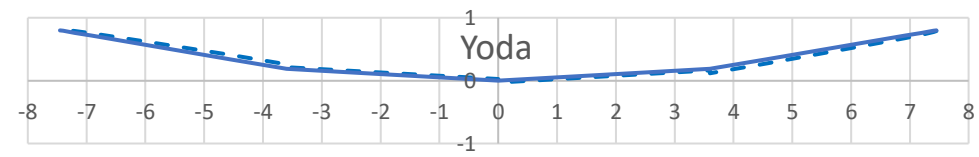


Gains for cruise are due to fuselage wetted area reduction, better wing/fuselage integration, and better vertical tail rather than wing

# Initial Roll Command



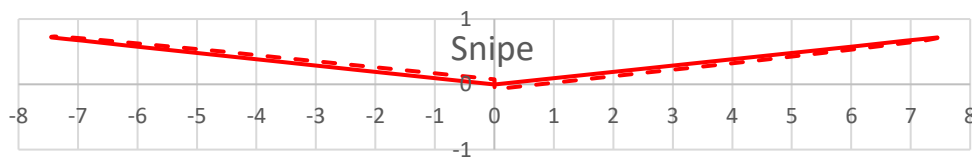
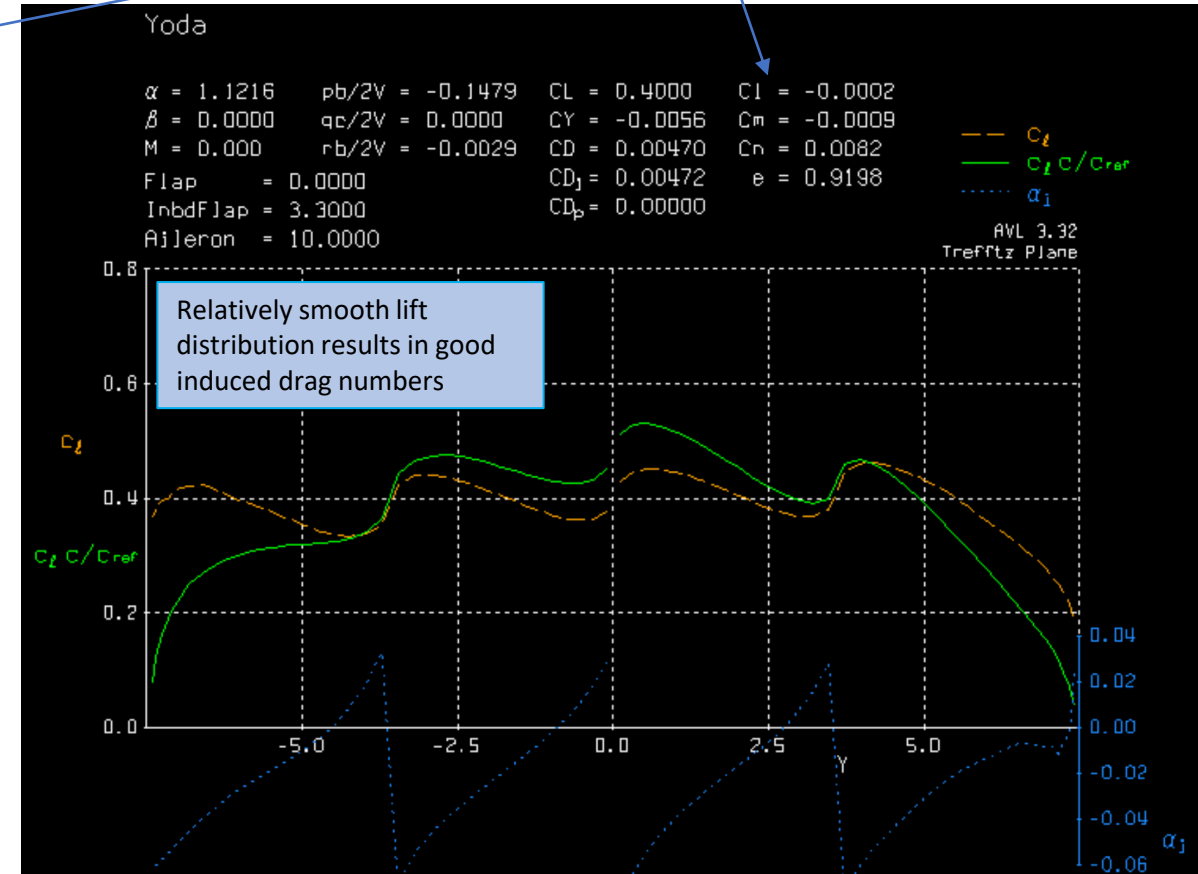
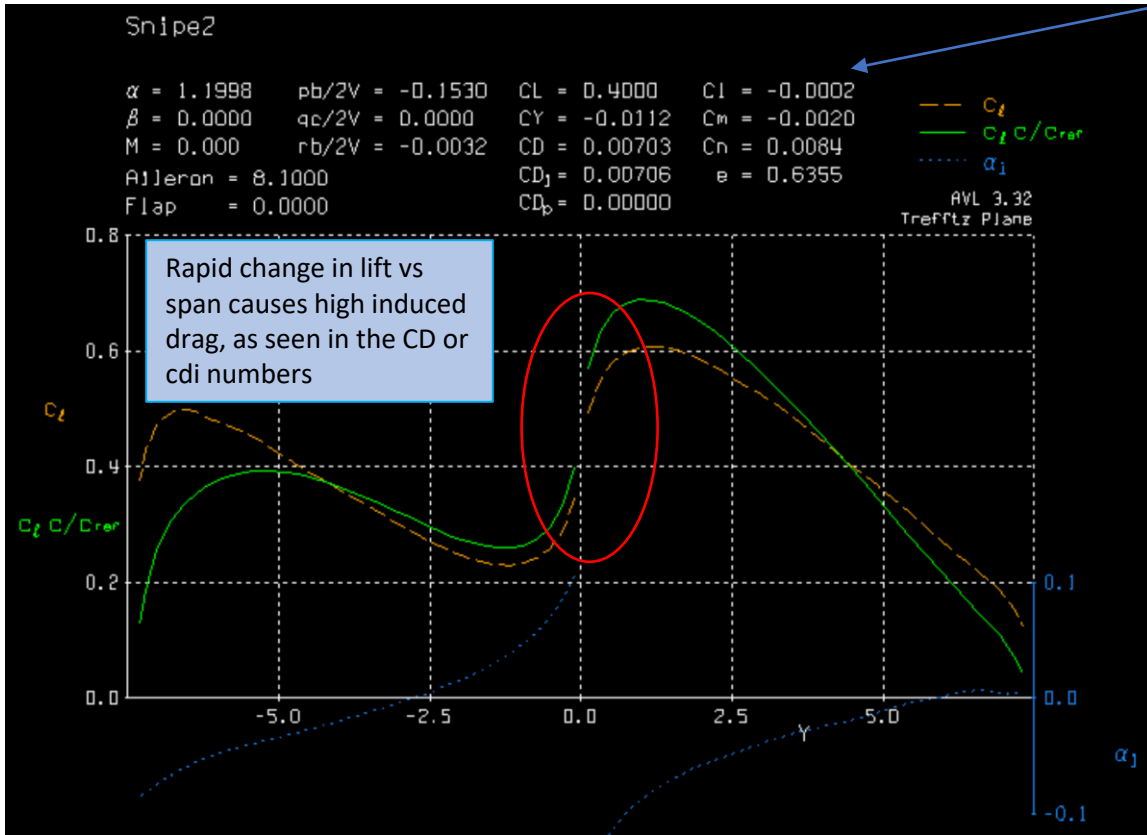
	Snipe	Yoda
cdf	0.0163	0.0164
cdi	0.0136	0.0109
total	0.0299	0.0273
<b>Gain</b>		<b>9.6%</b>



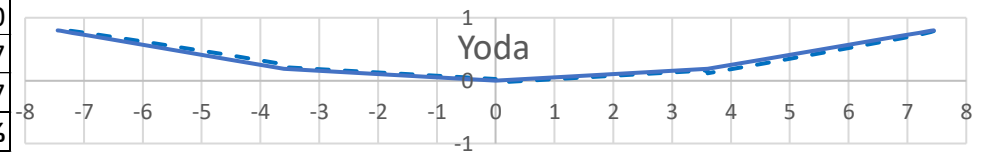
Induced drag is reduced considerably with four wing control surfaces

CI is rolling moment, the control deflection for the flaperon and aileron/flap is set to have the same rolling moment

# Constant Roll Rate



	Snipe	Yoda
cdf	0.0217	0.0210
cdi	0.0070	0.0047
total	0.0287	0.0257
Gain		12.0%



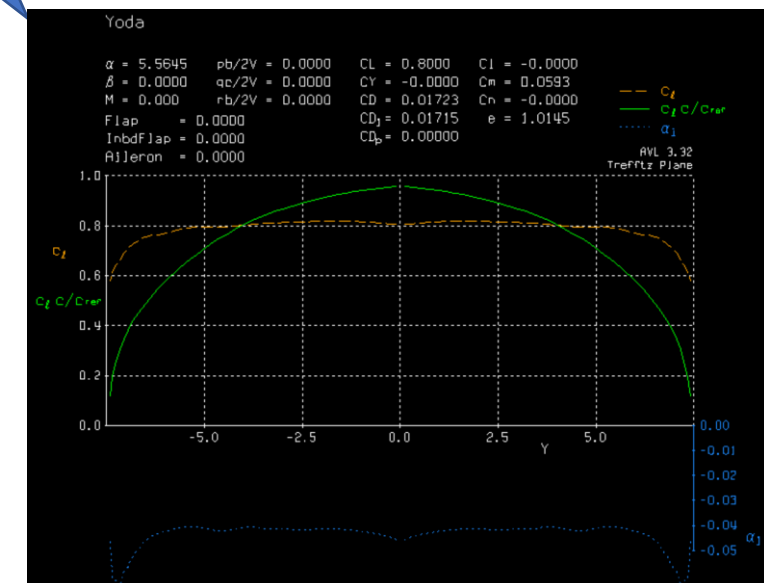
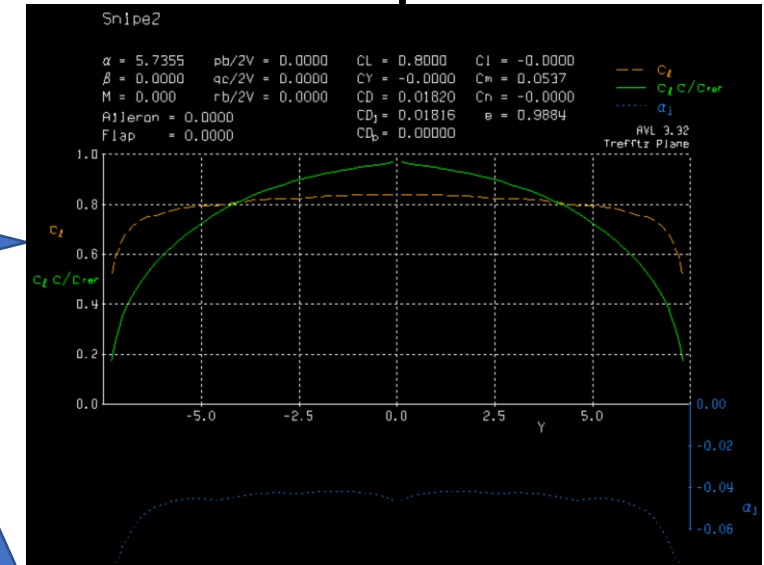
Induced (and viscous) drag is reduced considerably with four wing control surfaces

# Performance Comparison at Thermal Speed

- Data from AVL for cruise condition with no control deflections
- The comparison will be for the drag difference for a flaperon deflection vs a separated flap and aileron control system to get the same roll response

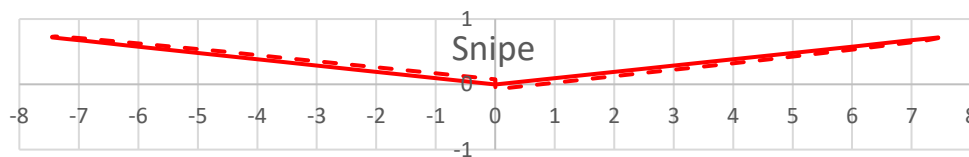
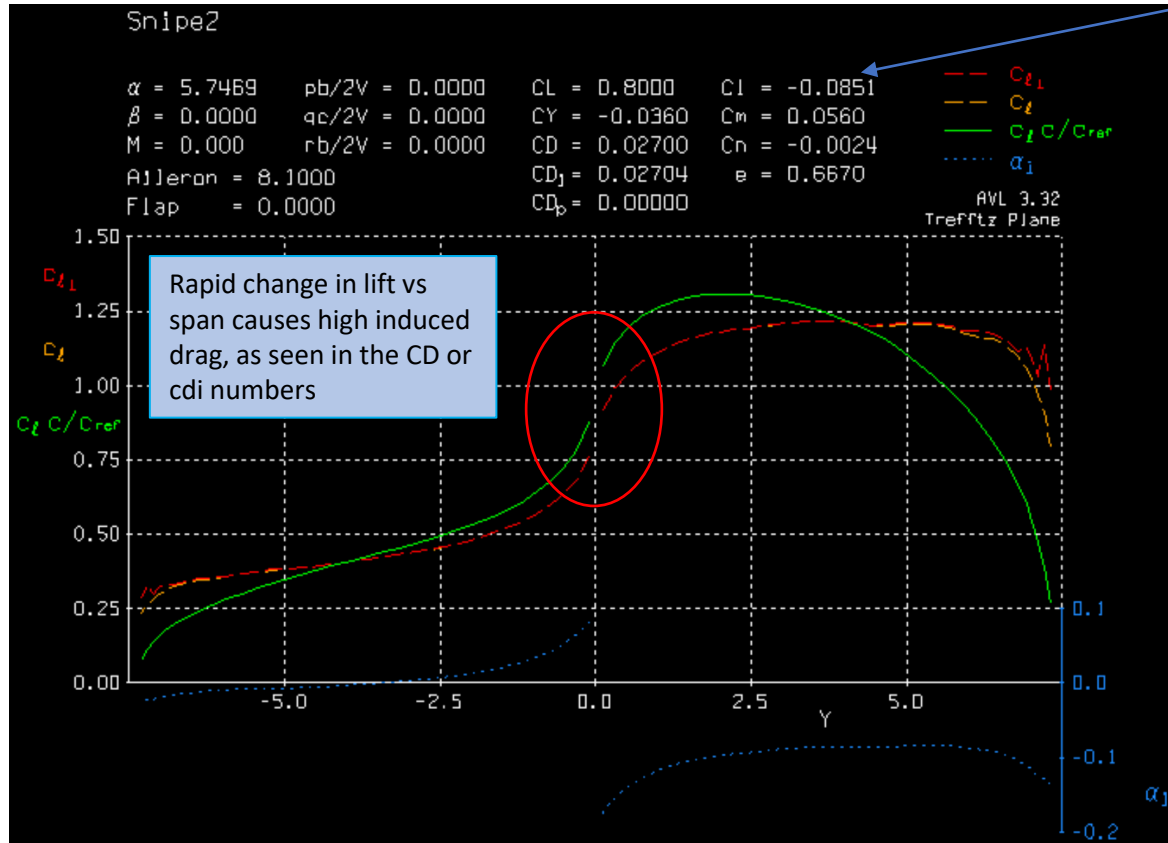
	Snipe	Yoda
cdf	0.0283	0.0277
cdi	0.0182	0.0172
total	0.0465	0.0449
<b>Gain</b>		<b>3.4%</b>

Modest wing performance gains at thermal speed even without adding camber

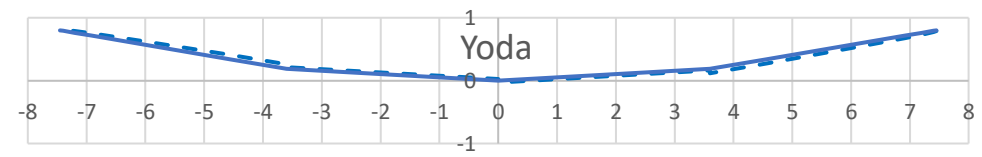




# Initial Roll Command



	Snipe	Yoda
cdf	0.0290	0.0284
cdi	0.0270	0.0237
total	0.0560	0.0521
Gain		7.6%

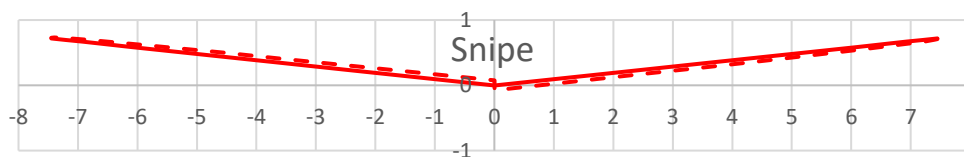
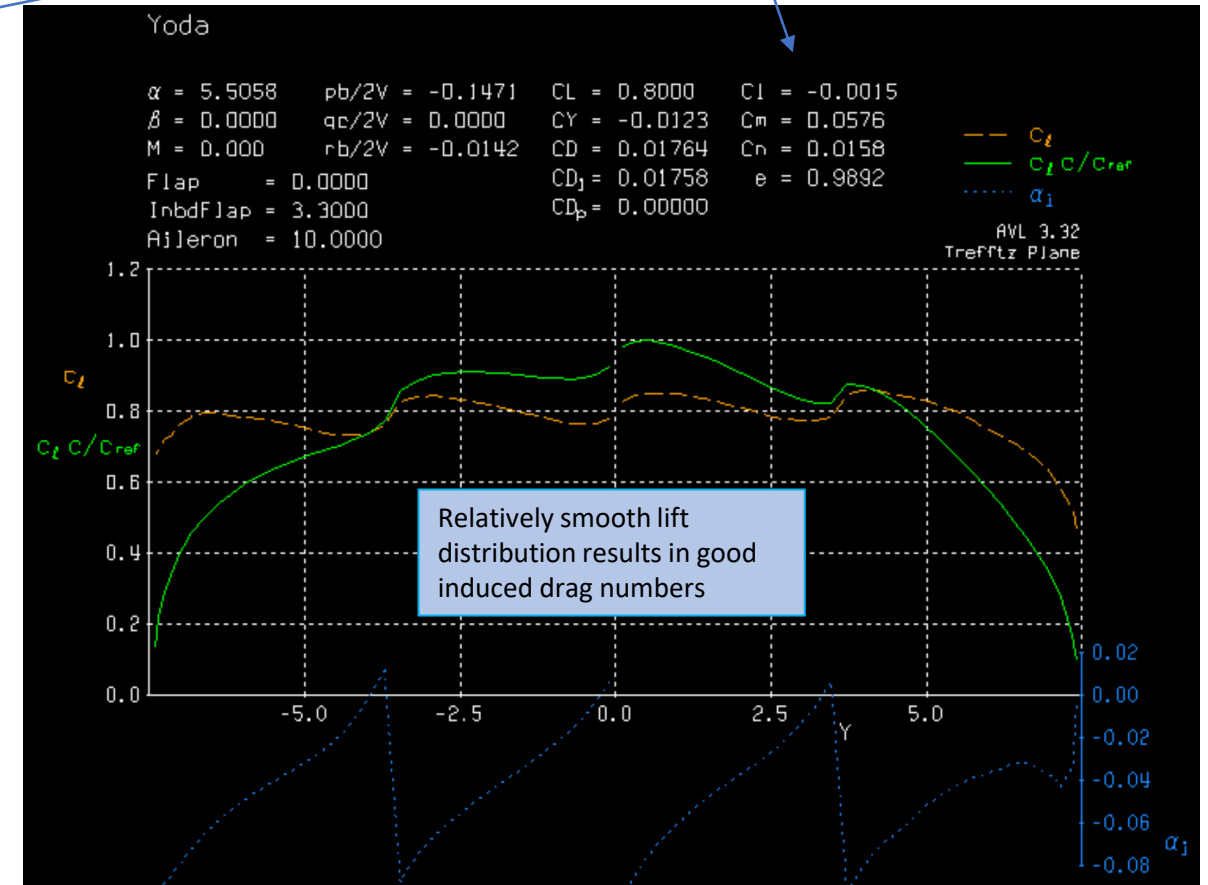
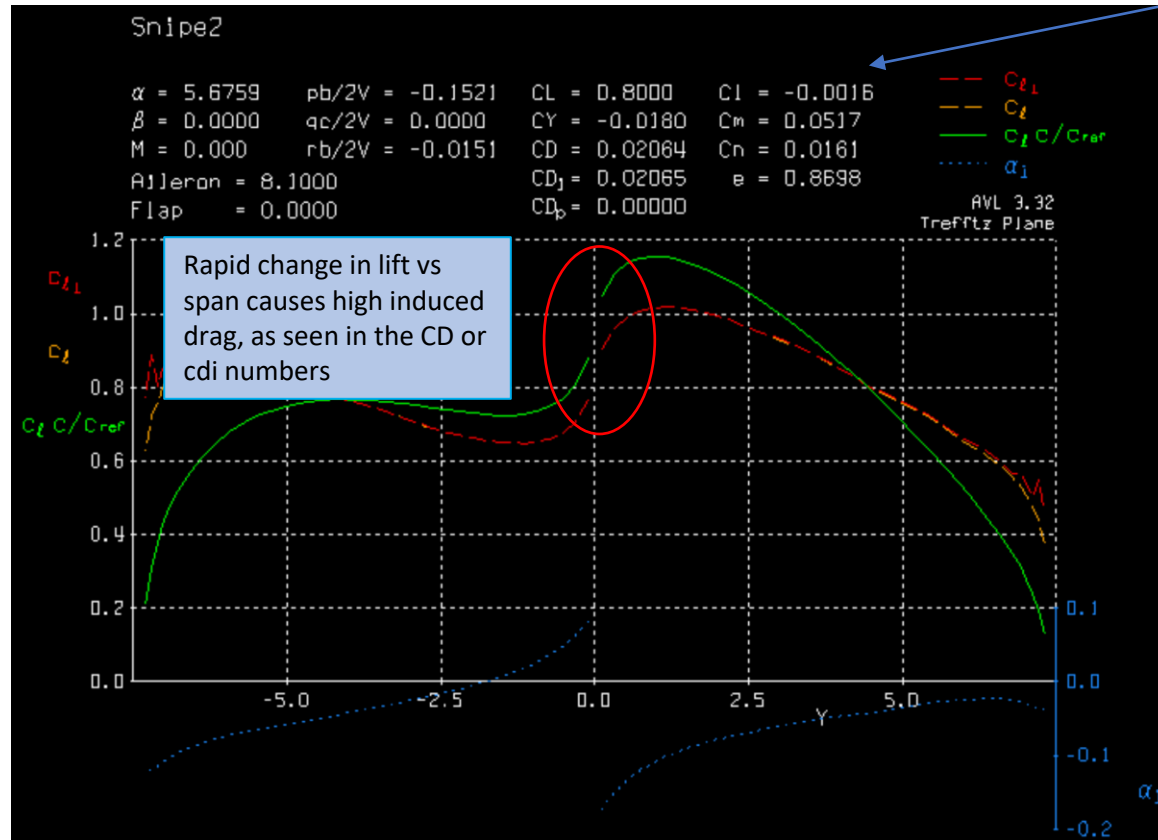


Induced drag is reduced considerably with four wing control surfaces

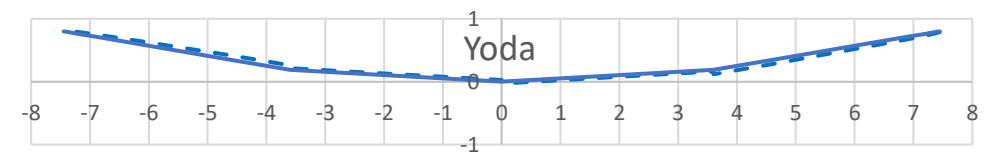
CI is rolling moment, the control deflection for the flaperon and aileron/flap is set to have the same rolling moment

# Constant Roll Rate

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	Snipe	Yoda
cdf	0.0702	0.0621
cdi	0.0206	0.0176
total	0.0908	0.0796
Gain		14.1%



Induced (and viscous) drag is reduced considerably with four wing control surfaces

# Conclusions

- The plane is subjectively a joy to fly, handling qualities are like a small F5J plane
- There are definite measurable performance gains that result from the combination of polyhedral as well as four servo wing. Each provide a gain the combination is more than additive.
- The design refinements are quite welcome, as usual Vladimir has put in many long hours refining the engineering that goes into the design
- My personal opinion is that this design will change the market, and the greatest benefactors will be the typical pilot rather than the very top end competitor. It is so easy to fly, and easy to fly well.