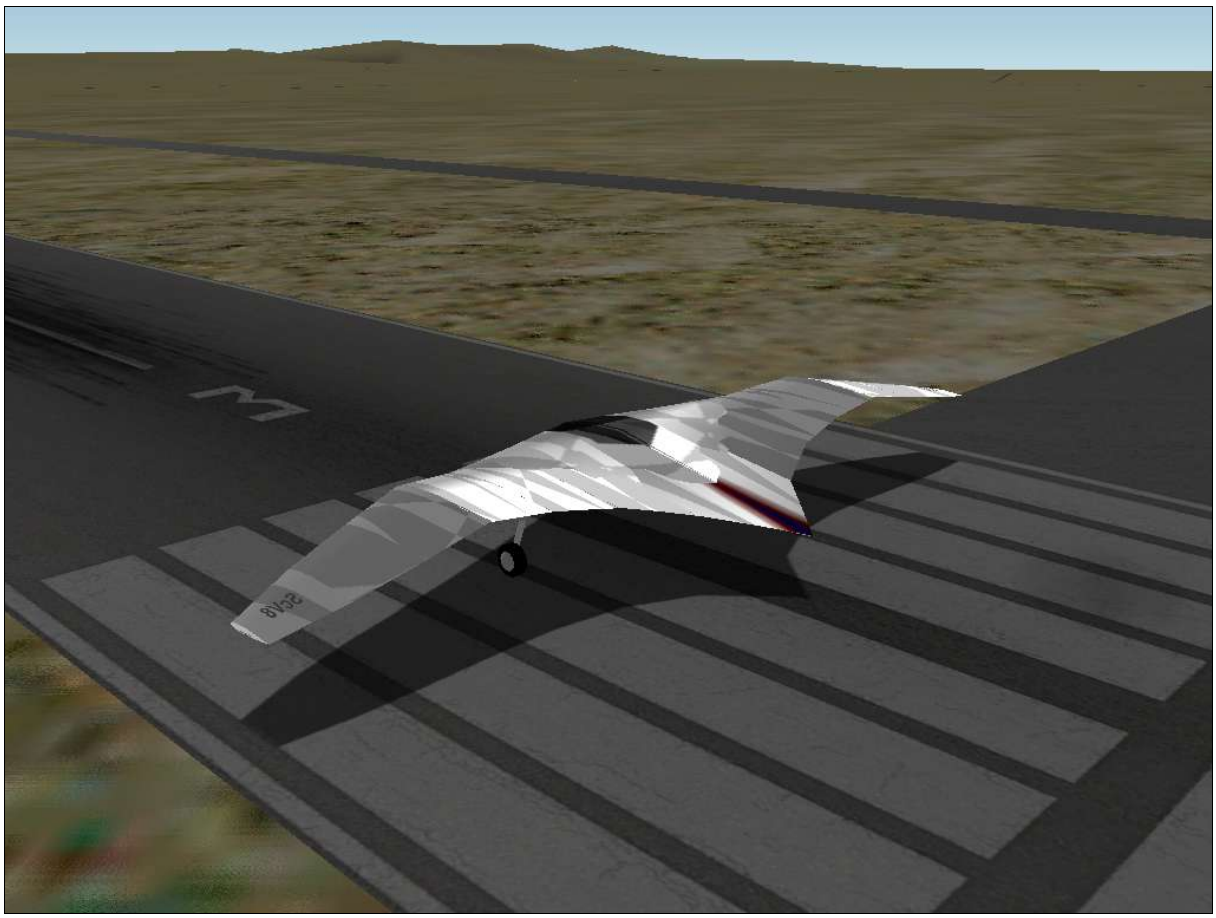
Flying Wing ScV8



Kapt. Wolf Scheuermann, Hamburg Germany

What is it?

It is an engine powered manned flying wing.

What shall it do?

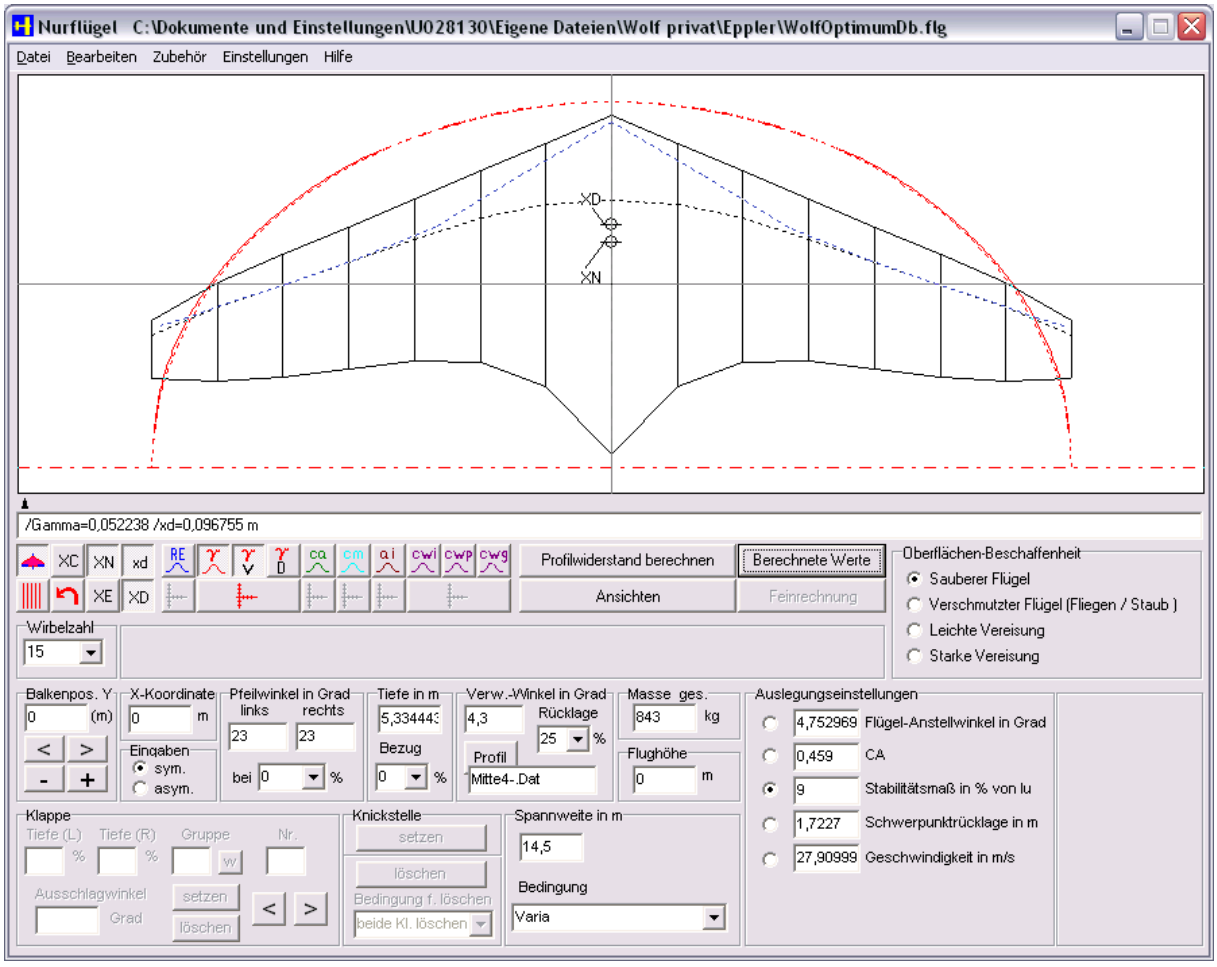
The plane shall be lightweight, easy, simple, and cheap - to fly and to build. It shall have good mannered slow flight characteristics, good performance, and high maximum speed.

Why is it a flying wing?

It's all you need! You don't need more than a wing.

Why is it a swept wing?

To get stability around the pitch axis.

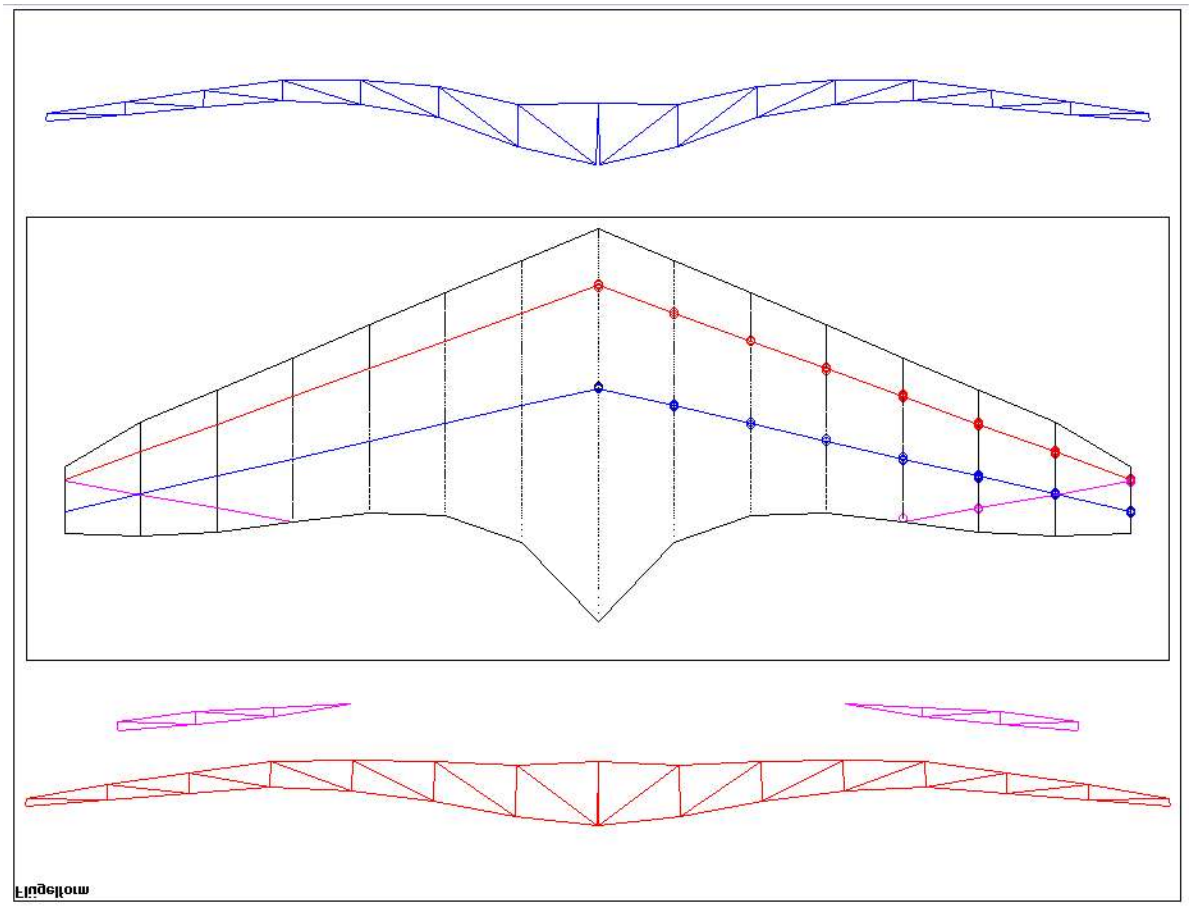


Why does the wings planform have such a stubby aspect ratio?

To keep the wingspan down and the volume large. Even if it shall have glider performance the chosen aspect ratio is sufficient.

Why has it this seagull wing?

Dihedral is good for roll stability but lacks yaw stability (dutch roll). Zero dihedral improves yaw stability but decreases roll stability. First dihedral than anhedral (seagull wing) improves both!

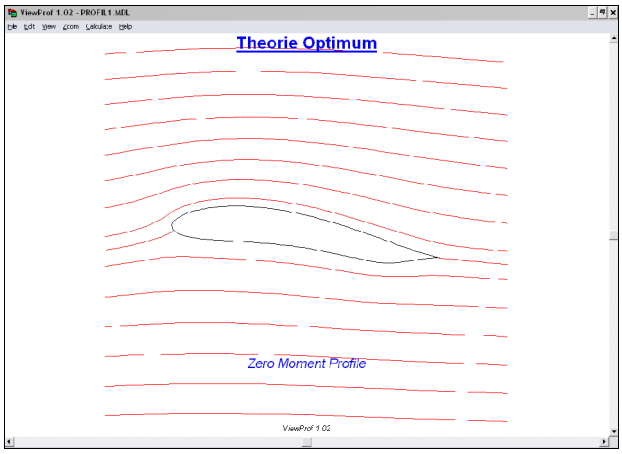


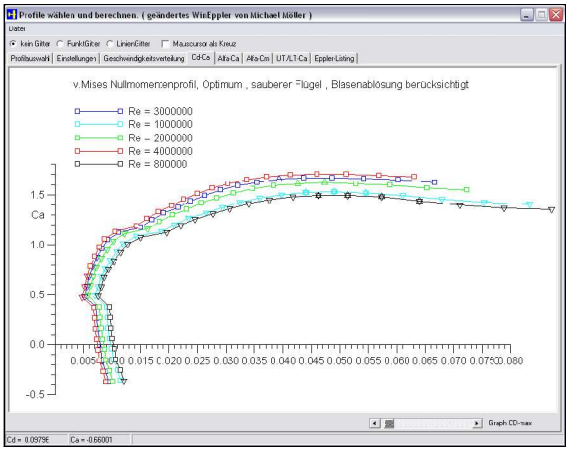
Why is the root airfoil a belly airfoil?

The original idea was to mix a lifting body (with belly but without wings!) with a flying wing (a wing with a humpback but without a fuselage). Some kind of aerodynamic twist. This lets the now no longer plane wing know where is up and down. Improves stability and performance. Every bird knows it!

What are these strange airfoils in the wing?

It is the optimum solution from complex airfoil theory (Richard von Mises, 1921): A slow speed airfoil that does not stall! Thickness differs between 13% and 17%.



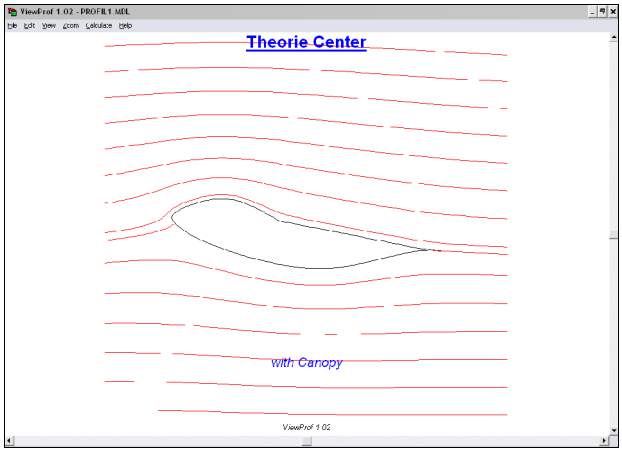


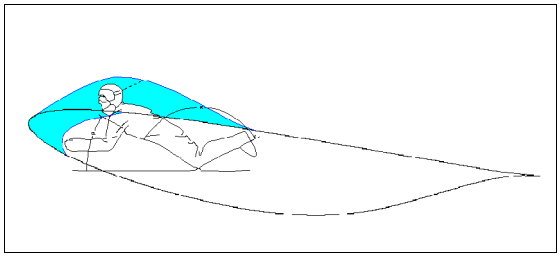
Why is the trailing edge curved and the leading edge straight?

The leading edge is straight to get the sweep. The trailing edge is curved to get an elliptic circulation distribution (minimum induced drag) and provides optimum flap geometry without slits in the wing.

Why does it have a head?

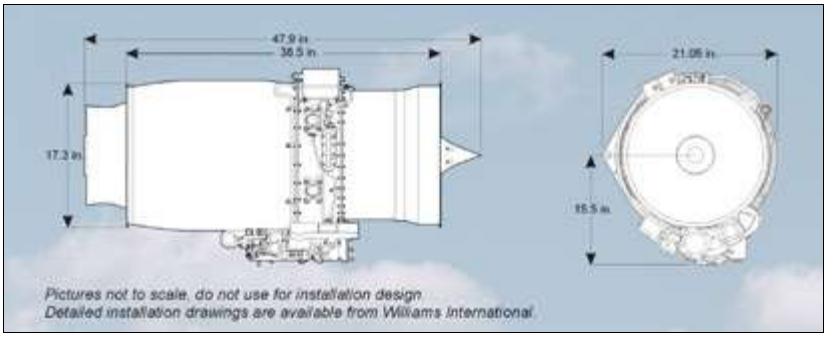
First, I had to stow the pilot in prone position somewhere. Second, it improves the aerodynamic properties of the belly airfoil. Third, it improves the field of vision of the pilot.





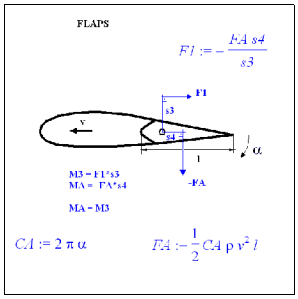
What propulsion should it have?

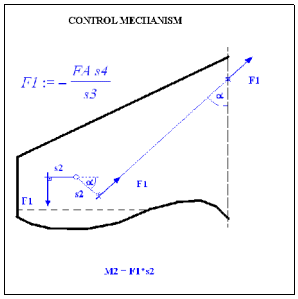
I prefer an internal pusher (jet engine or piston/electric impeller).

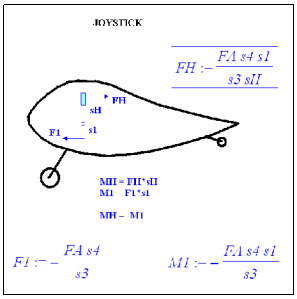


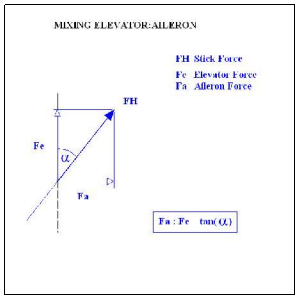
Why has it only one flap?

It is a single-control-flap plane. The flap has aileron and elevator function. Realized with a single joystick and a multilever pushrod mixer.









Why is the flap oblique cut?

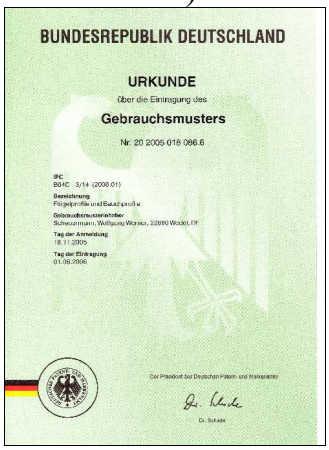
To get also a rudder function of the flap.

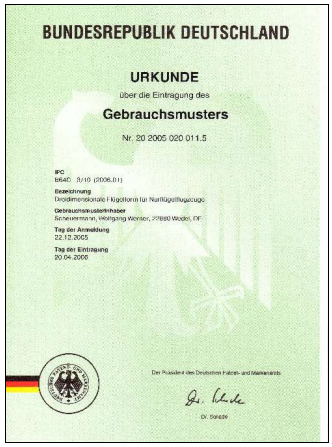
What will I do with it?

Just fly it VFR and have fun!

Are there rights to be observed?

Yes, the airfoils are a German Registered Design (Gebrauchsmuster DE 20 2005 018 086.6) and the shape of the airplane too (Gebrauchsmuster DE 20 2005 020 011.5)!

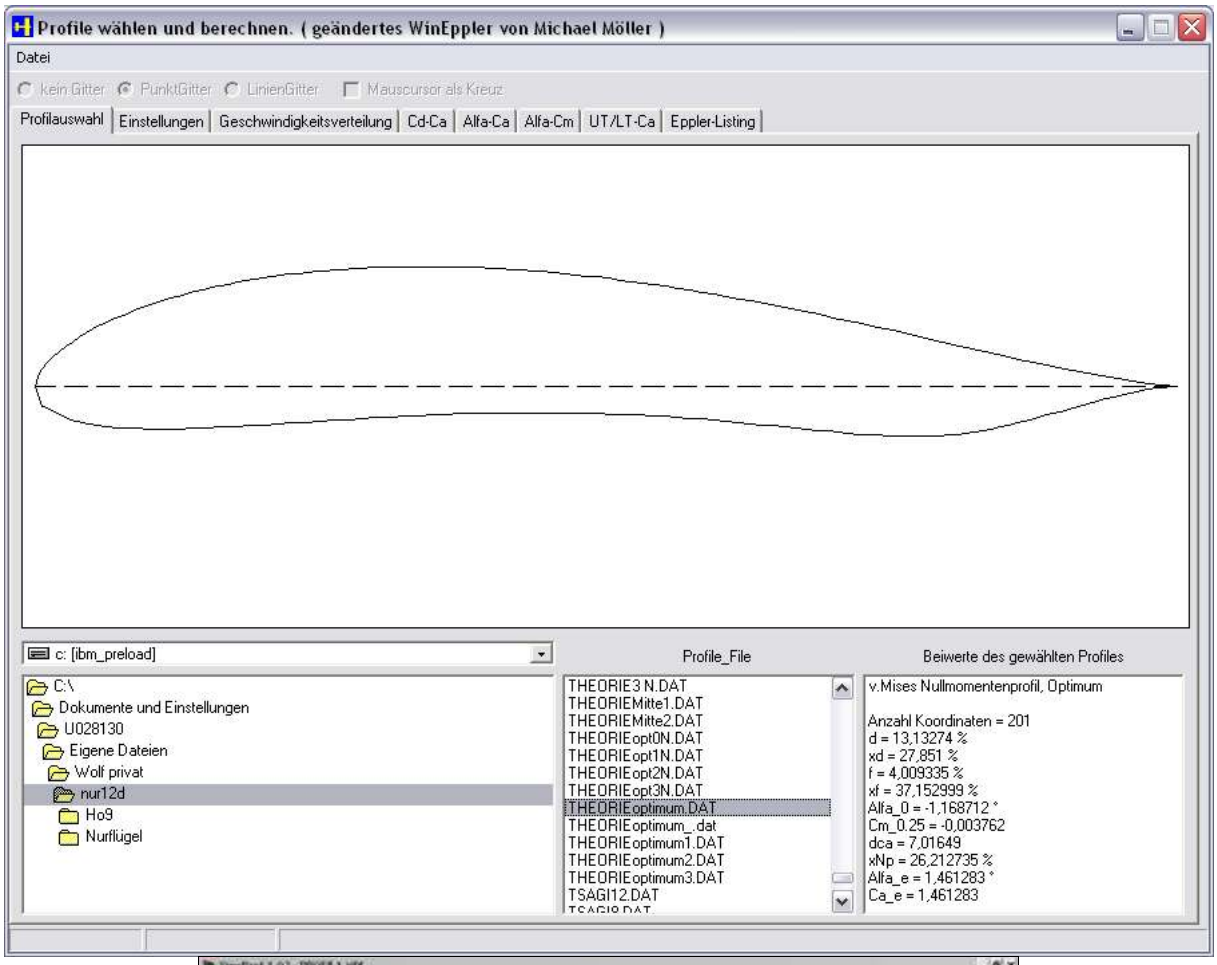


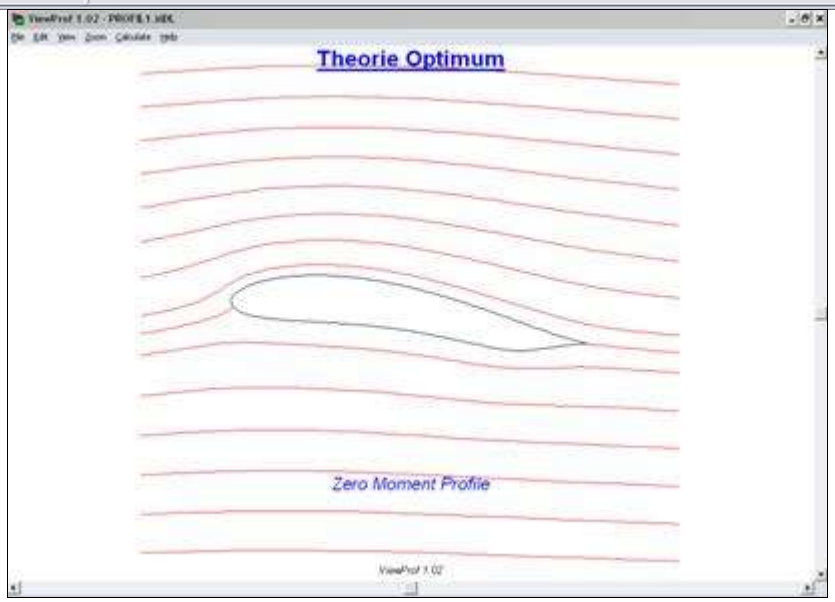


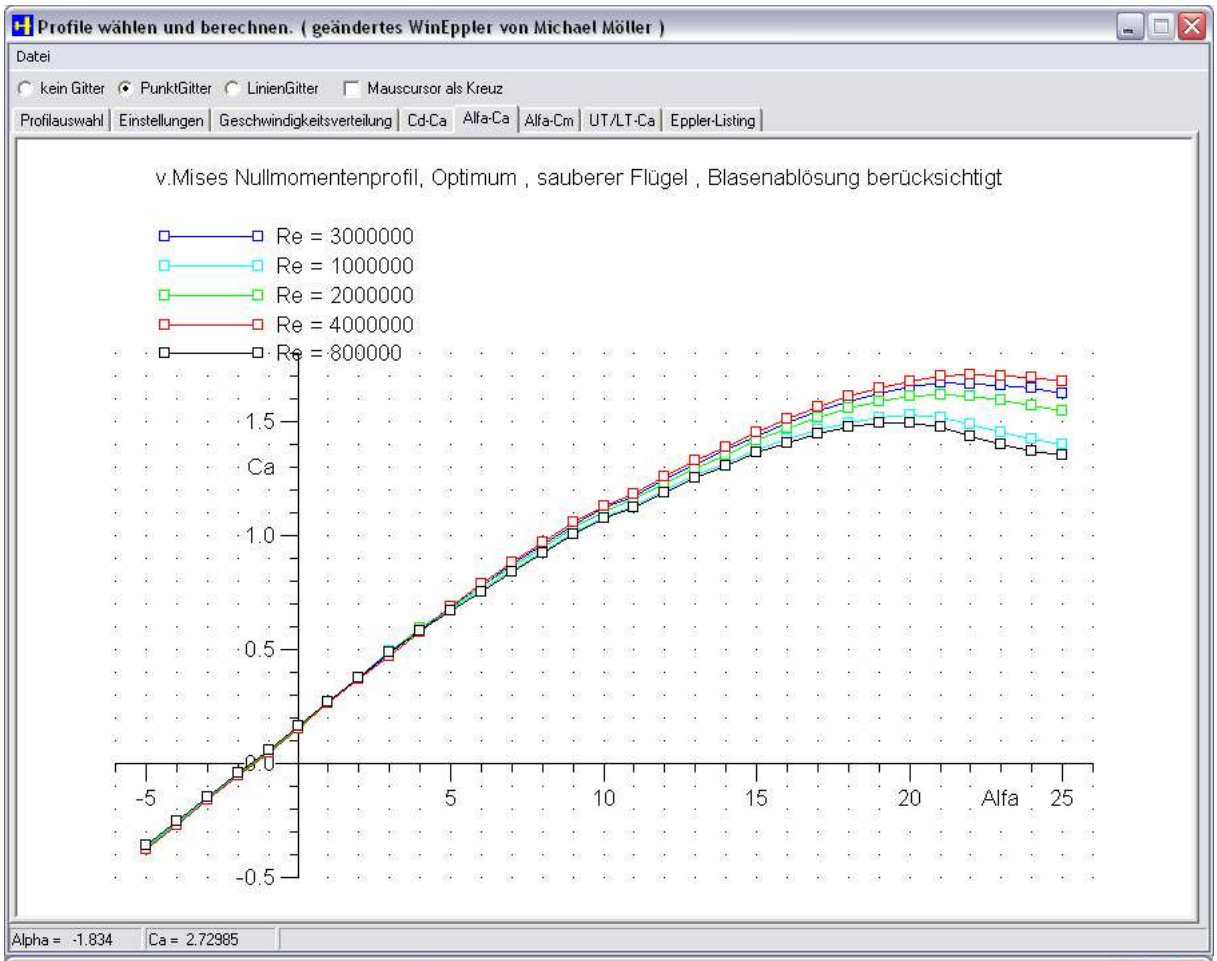
Appendix

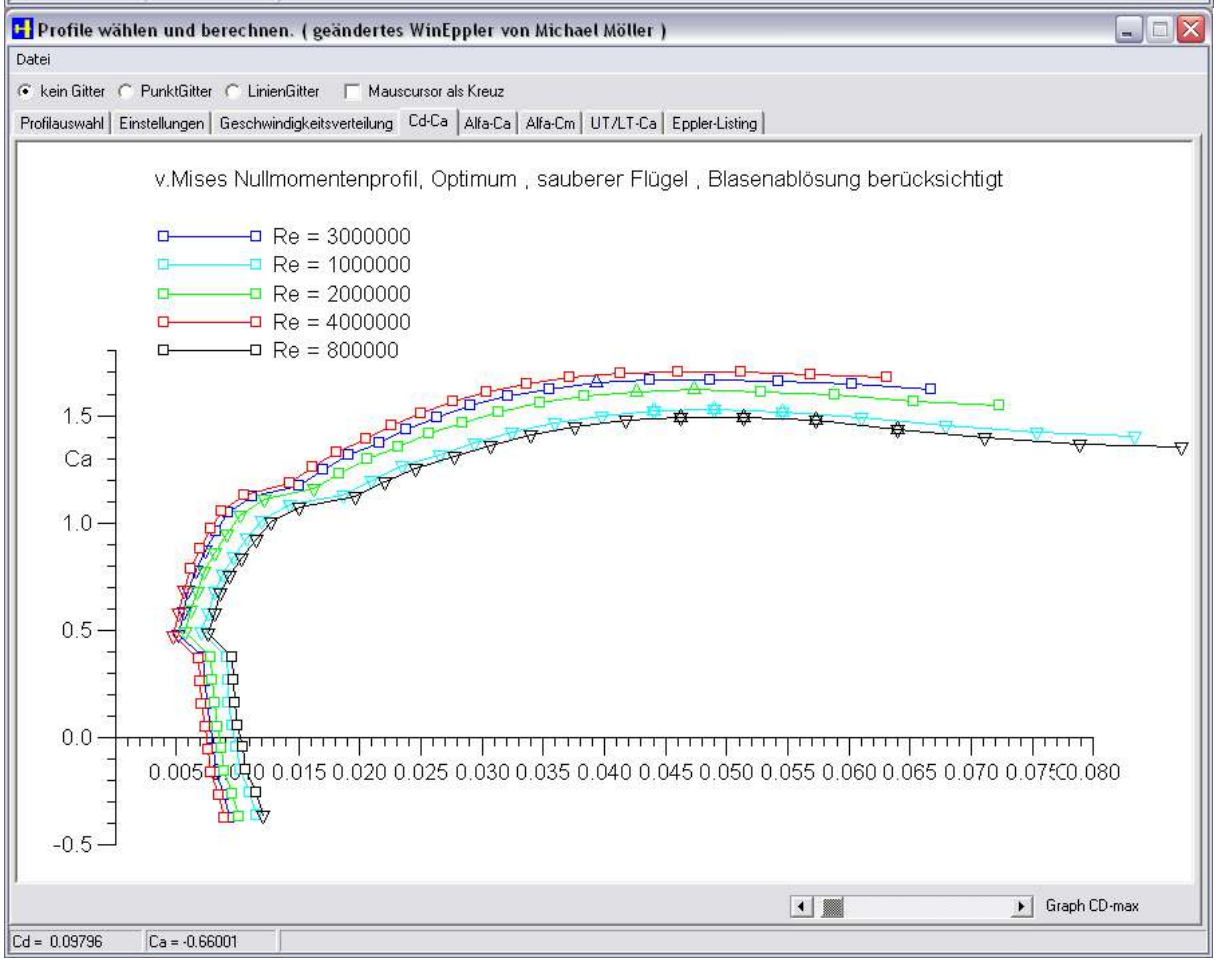
Airfoils for the Flying Wing ScV8

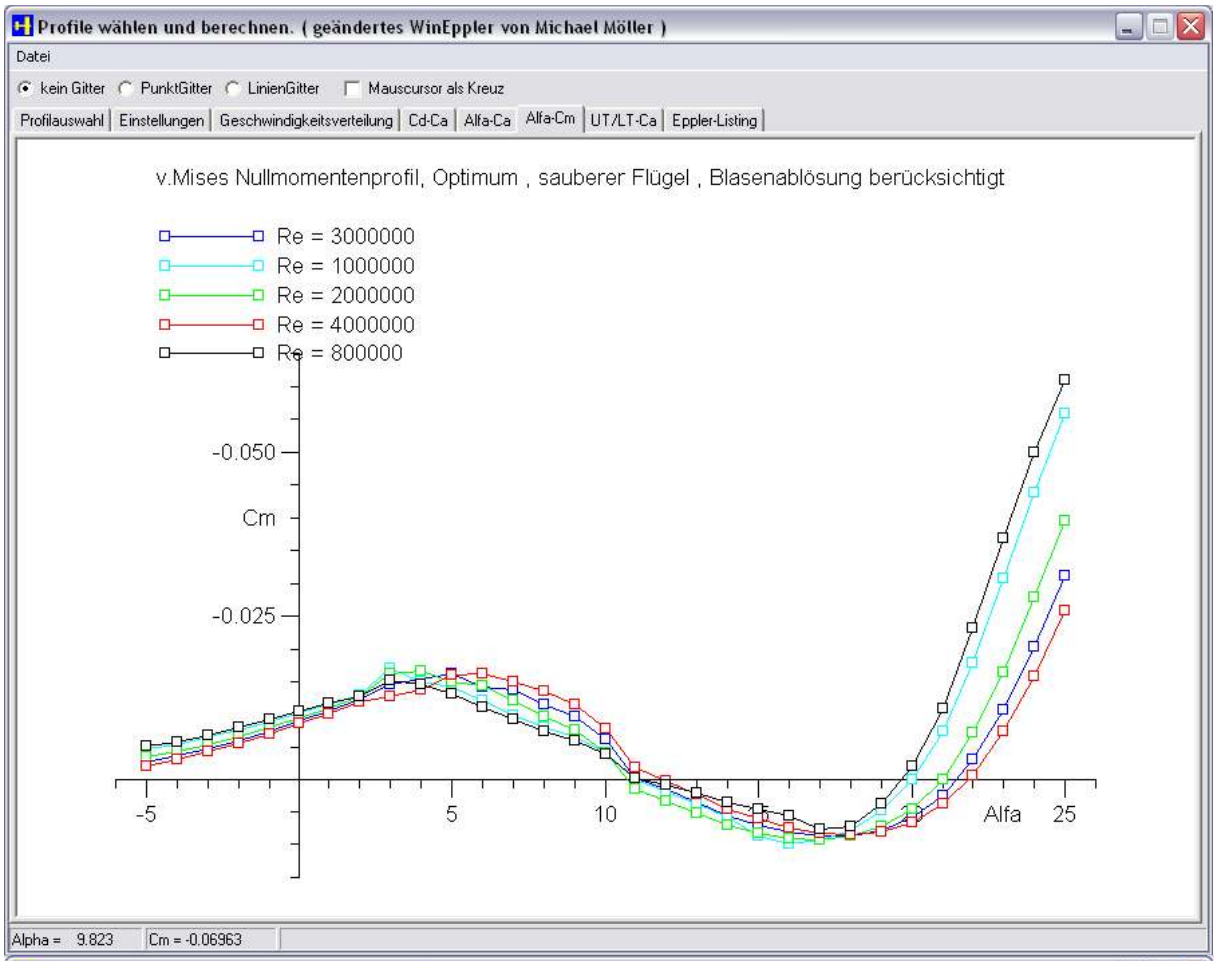
Theoretical Optimum, thin

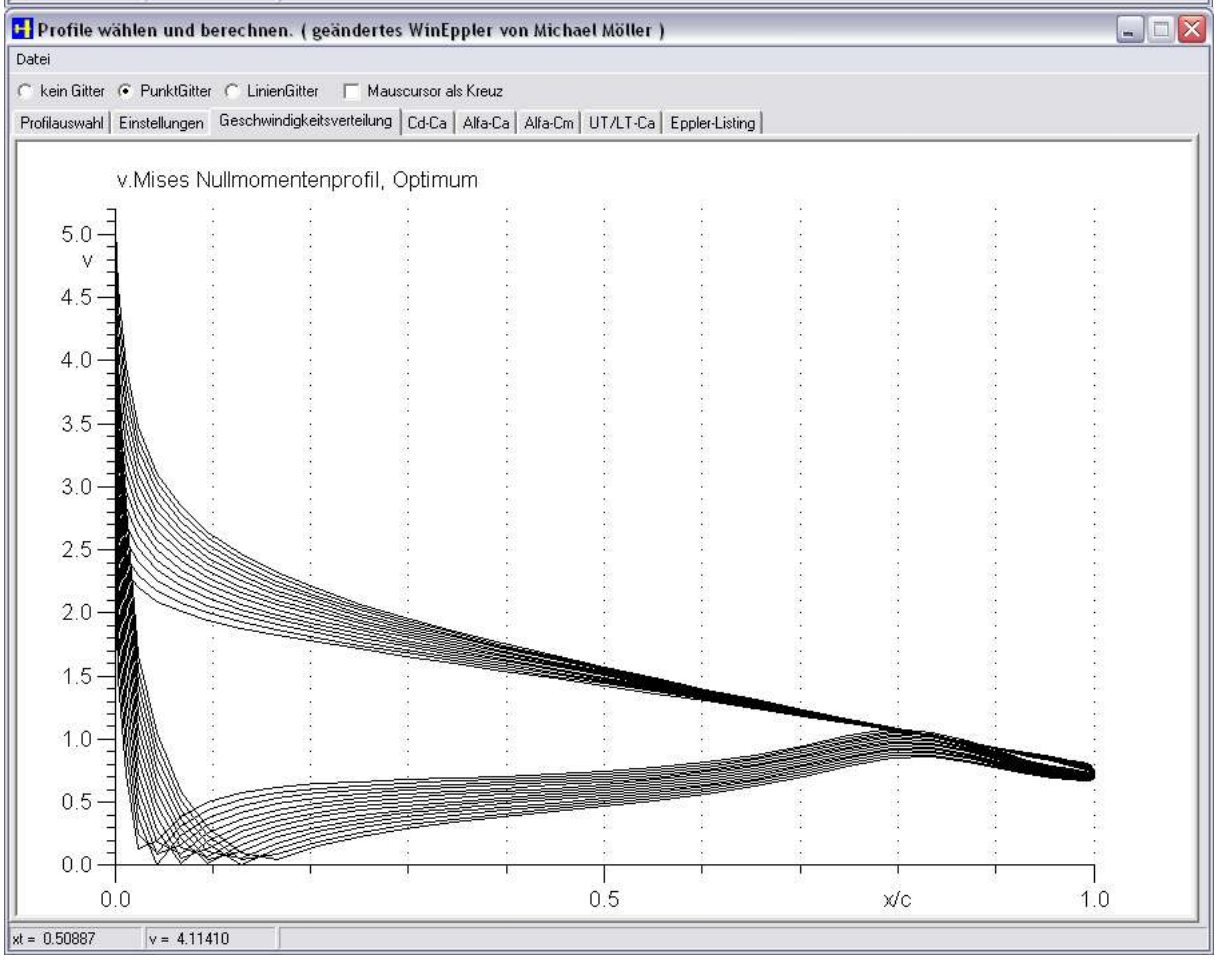




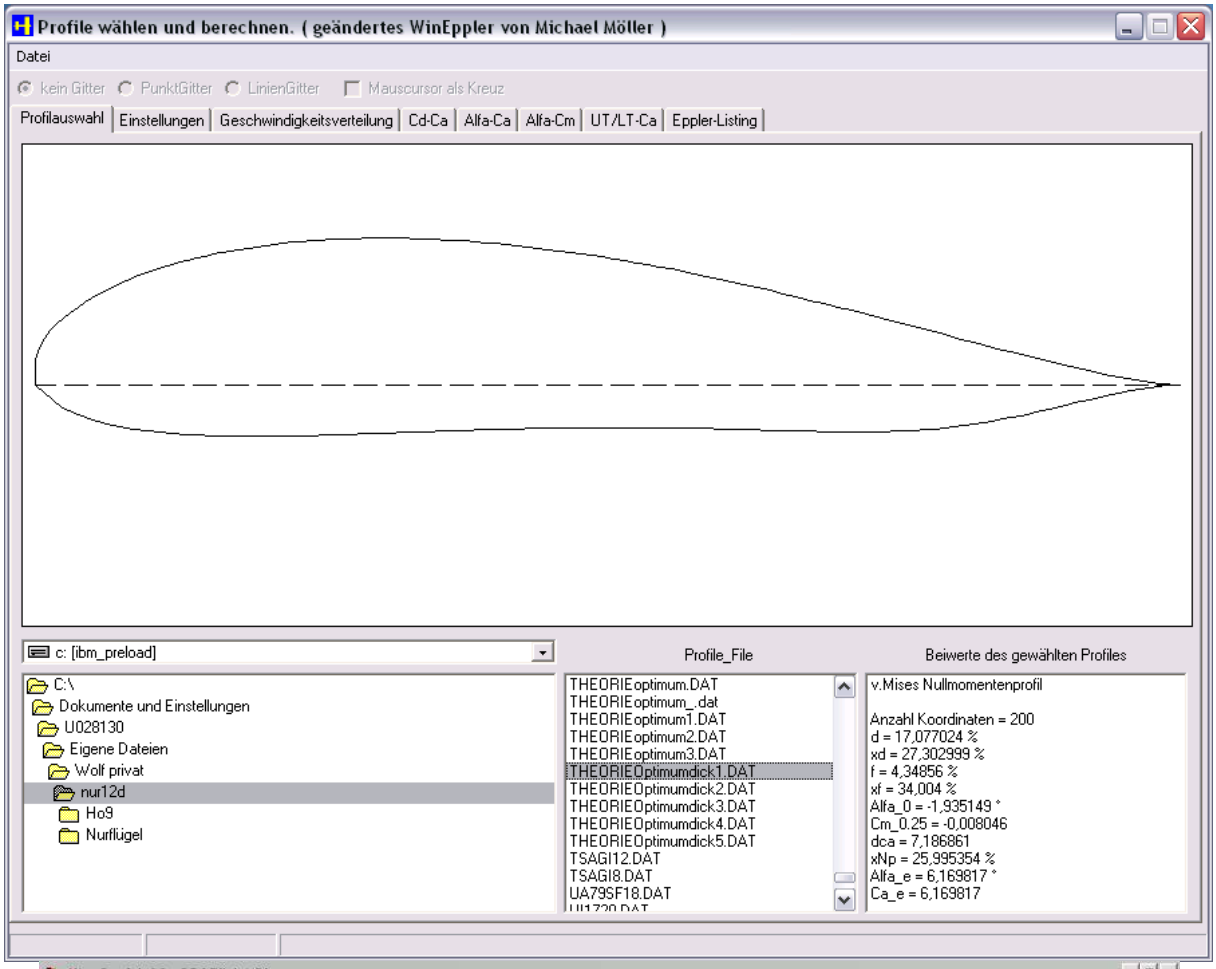


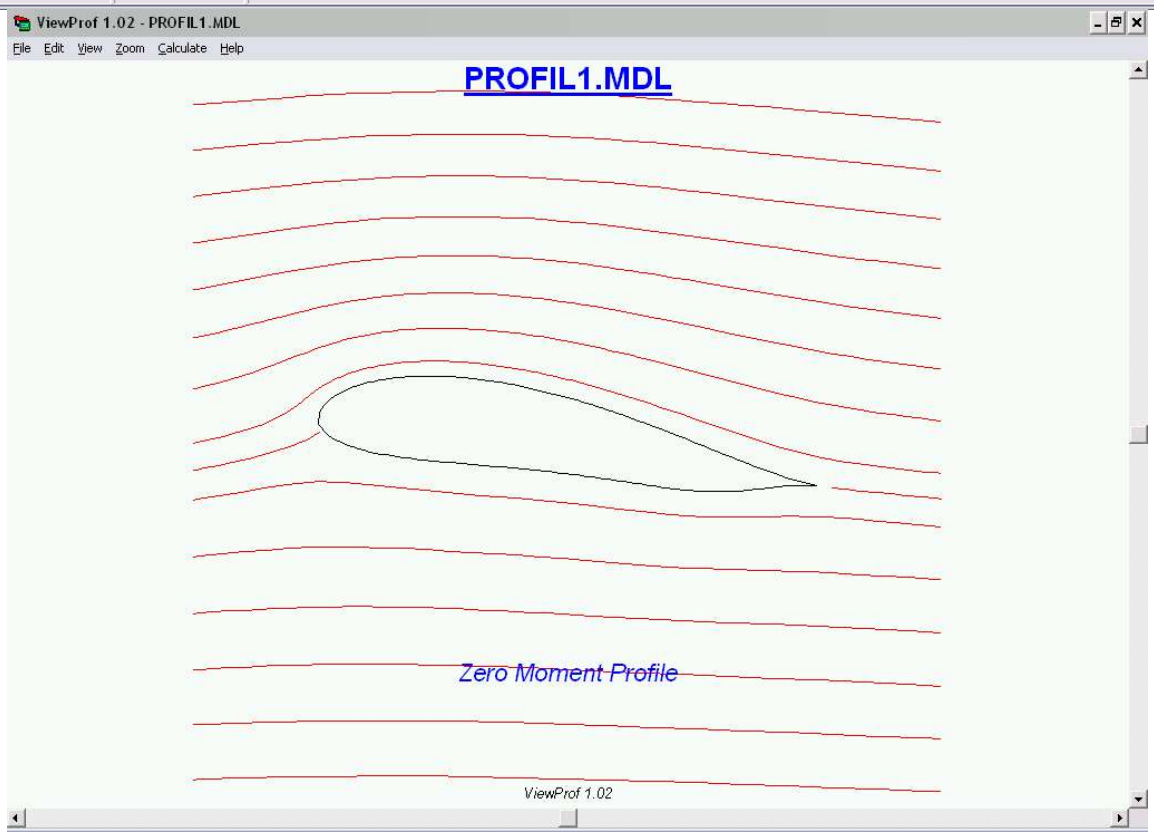


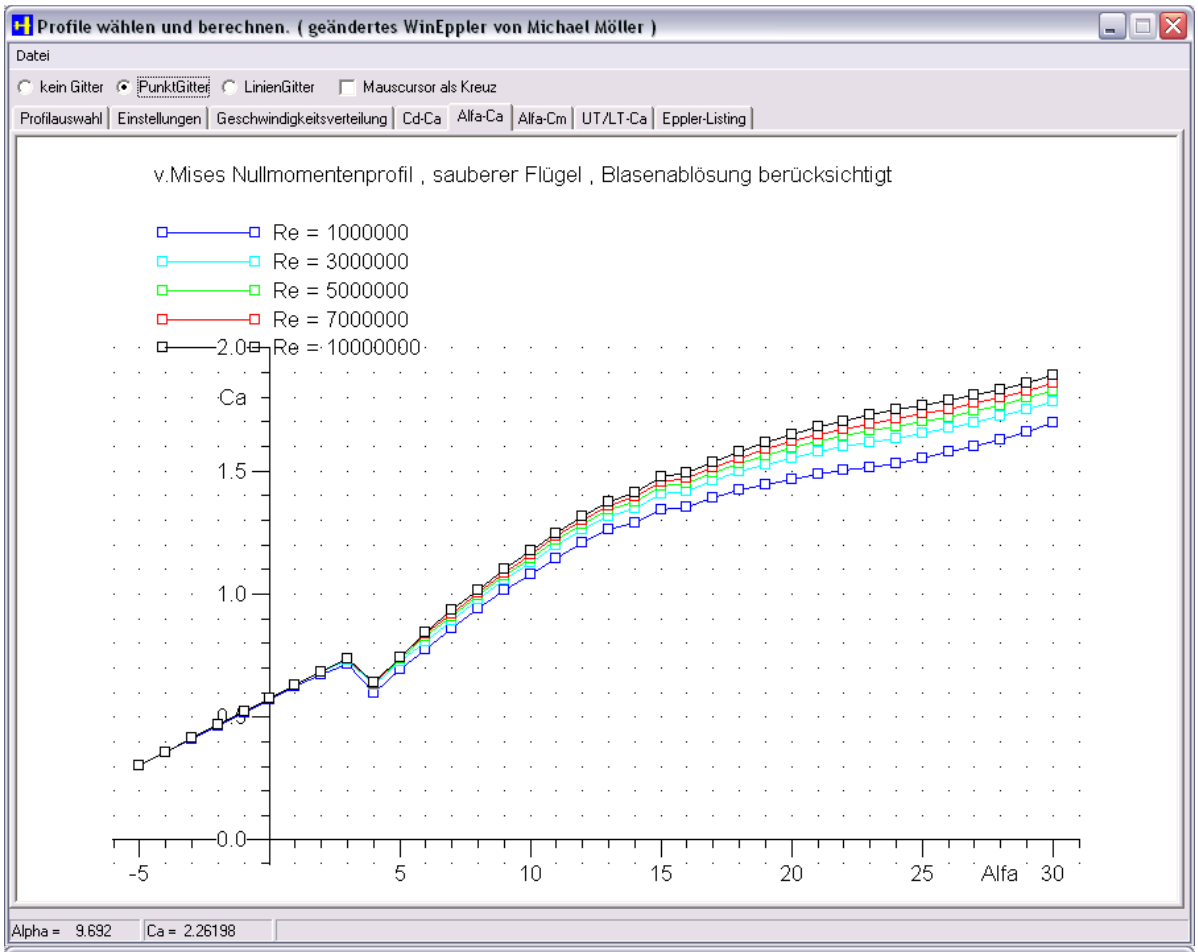


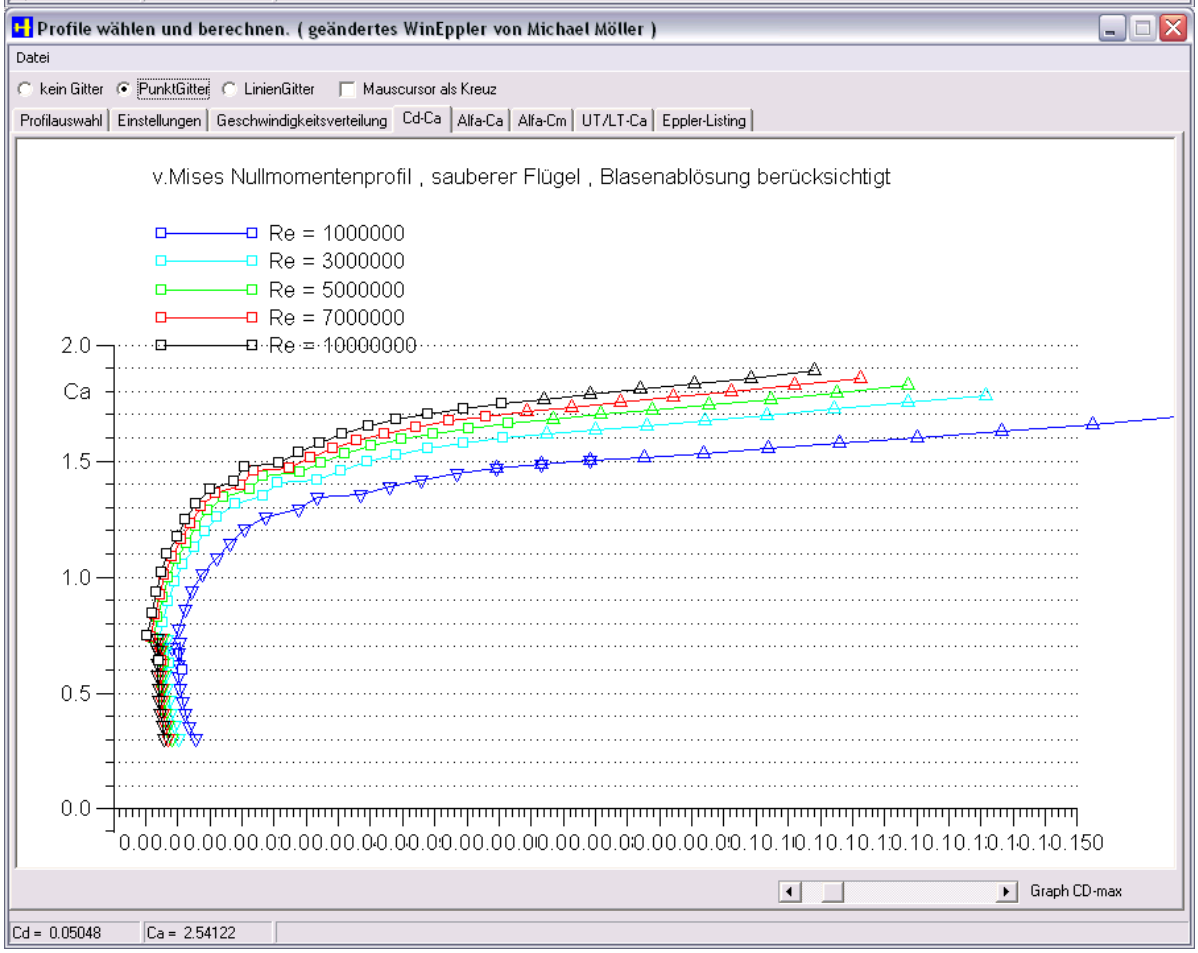


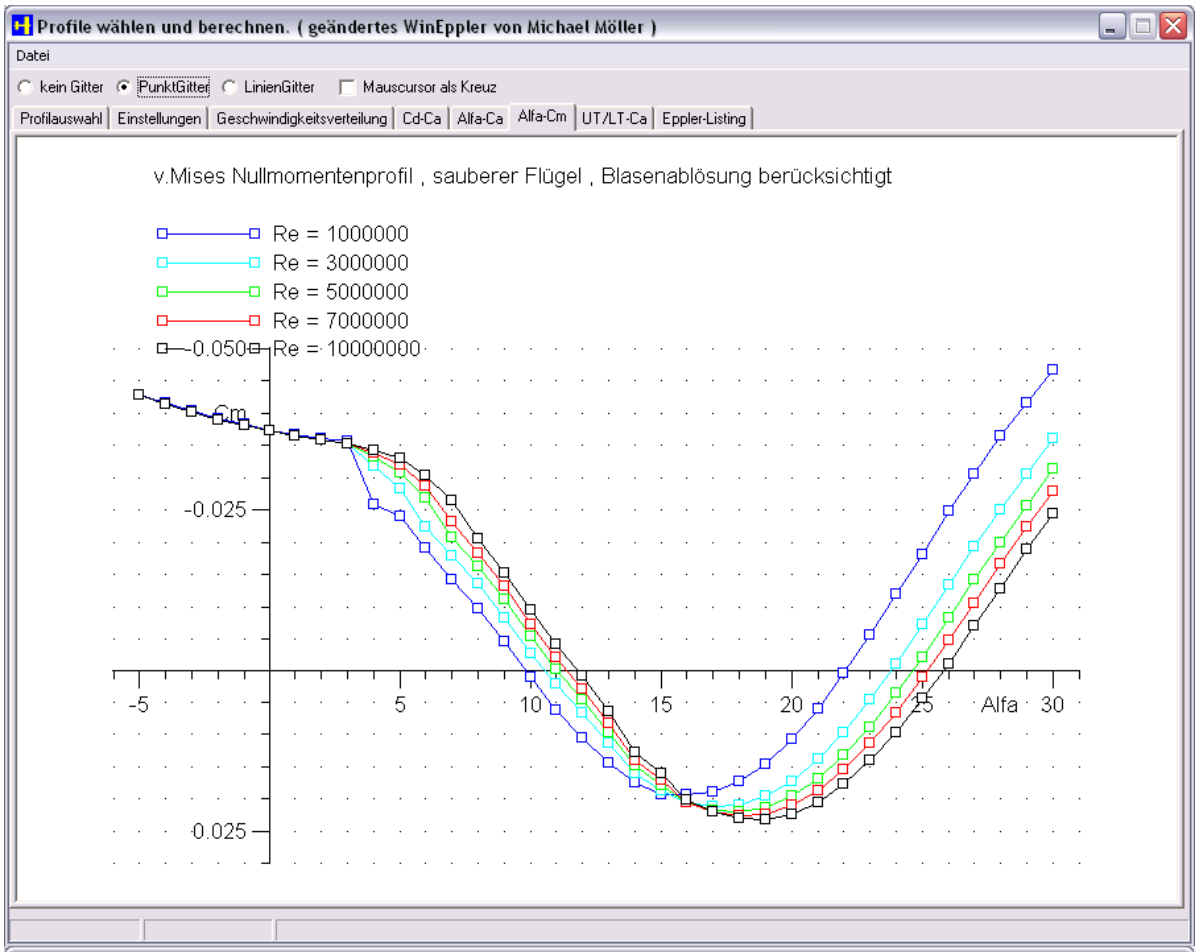
Theoretical Optimum, thick

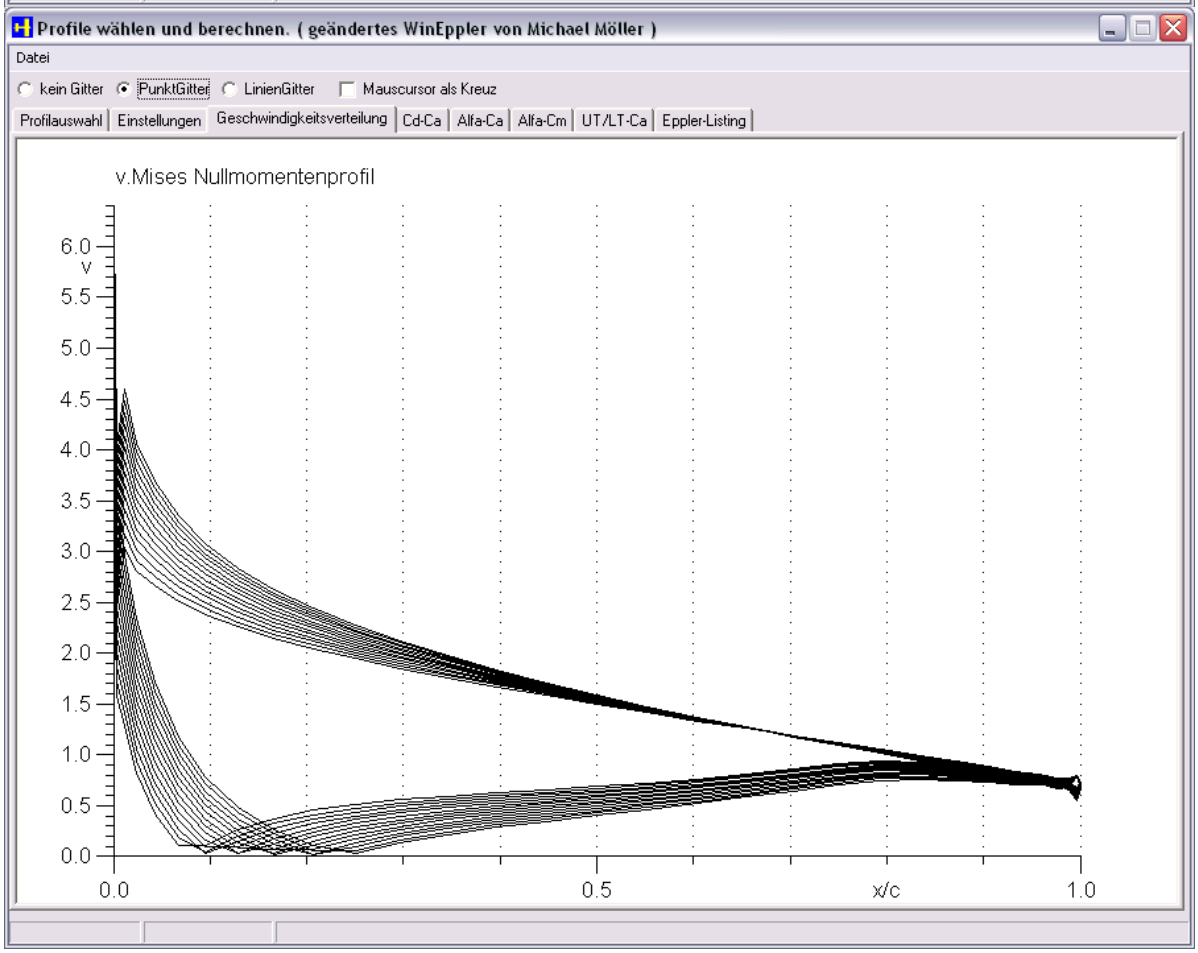




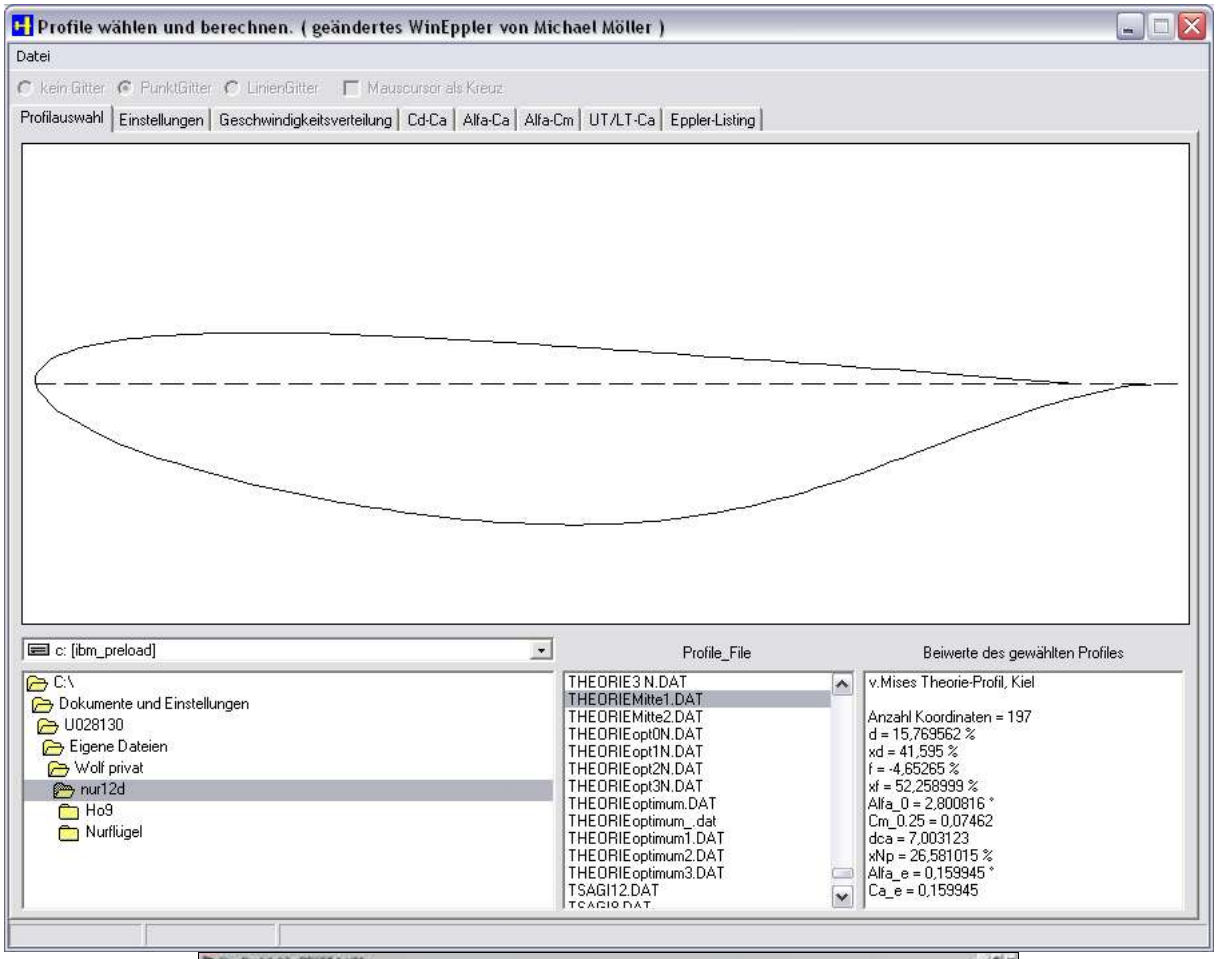


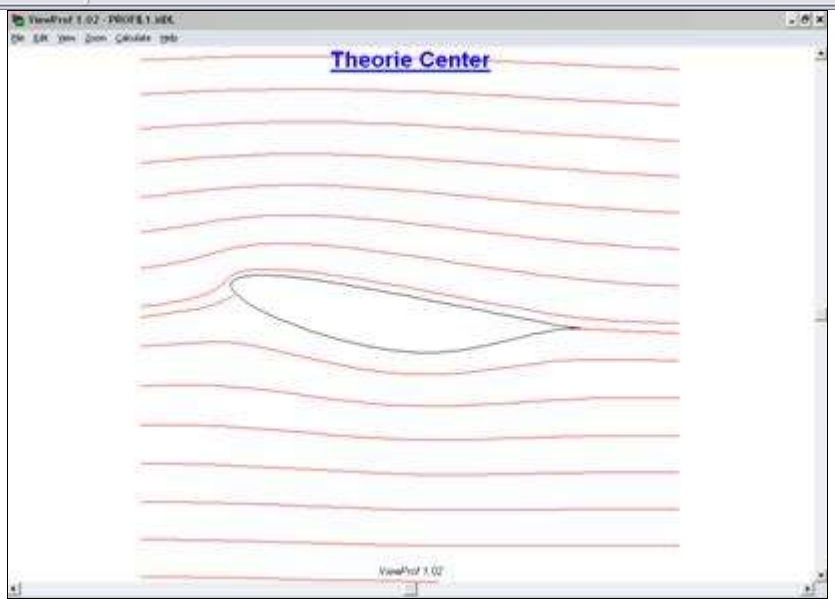


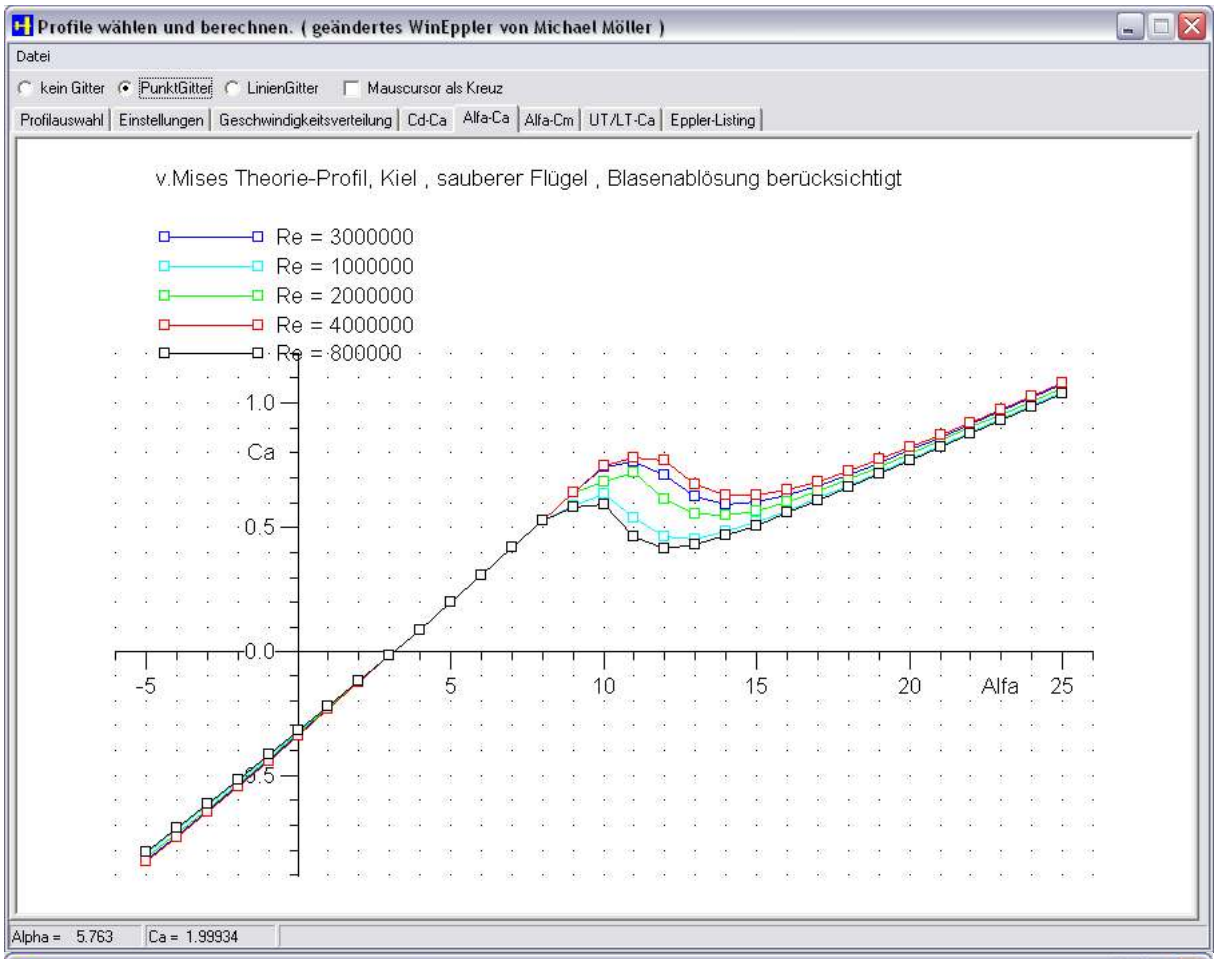


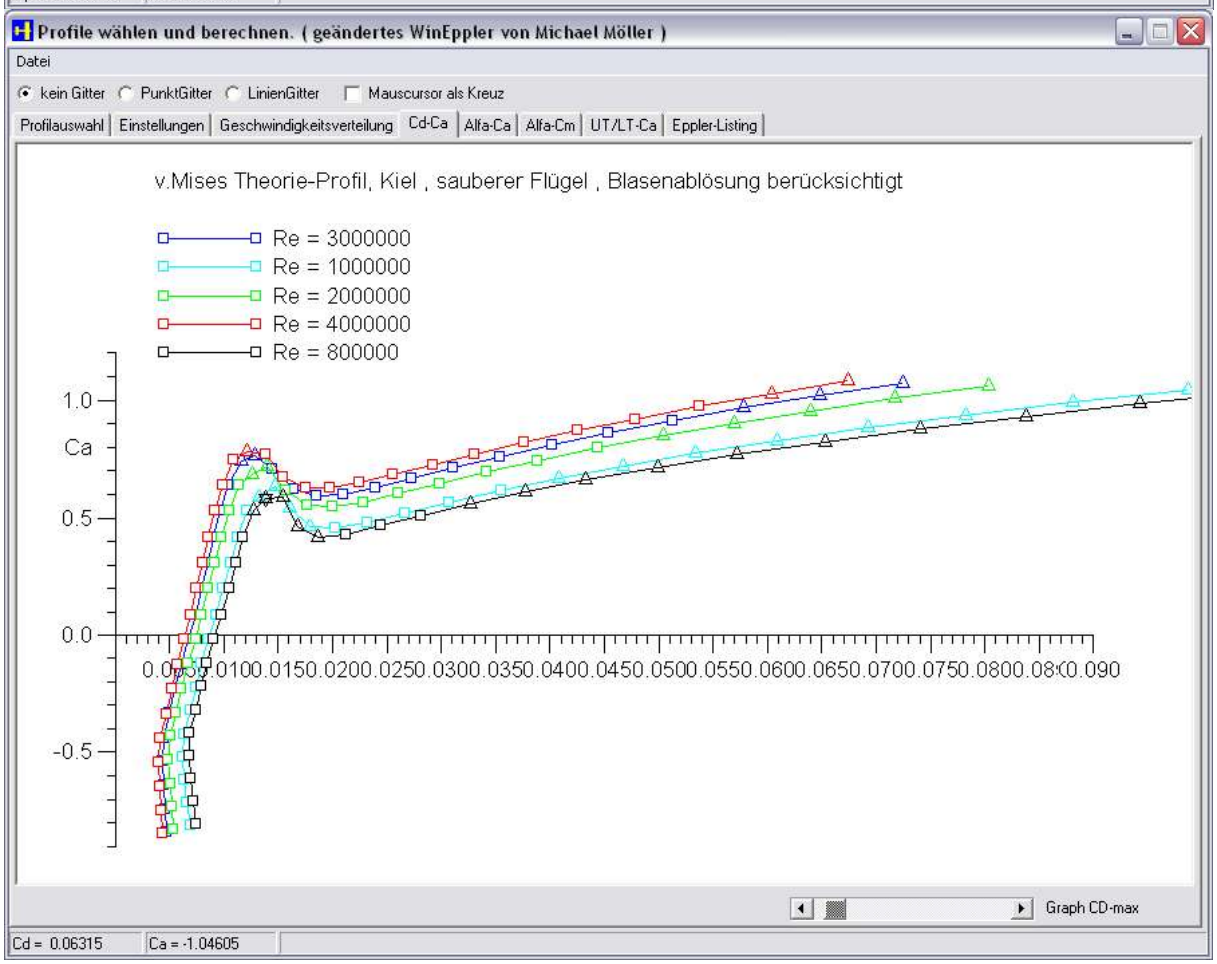


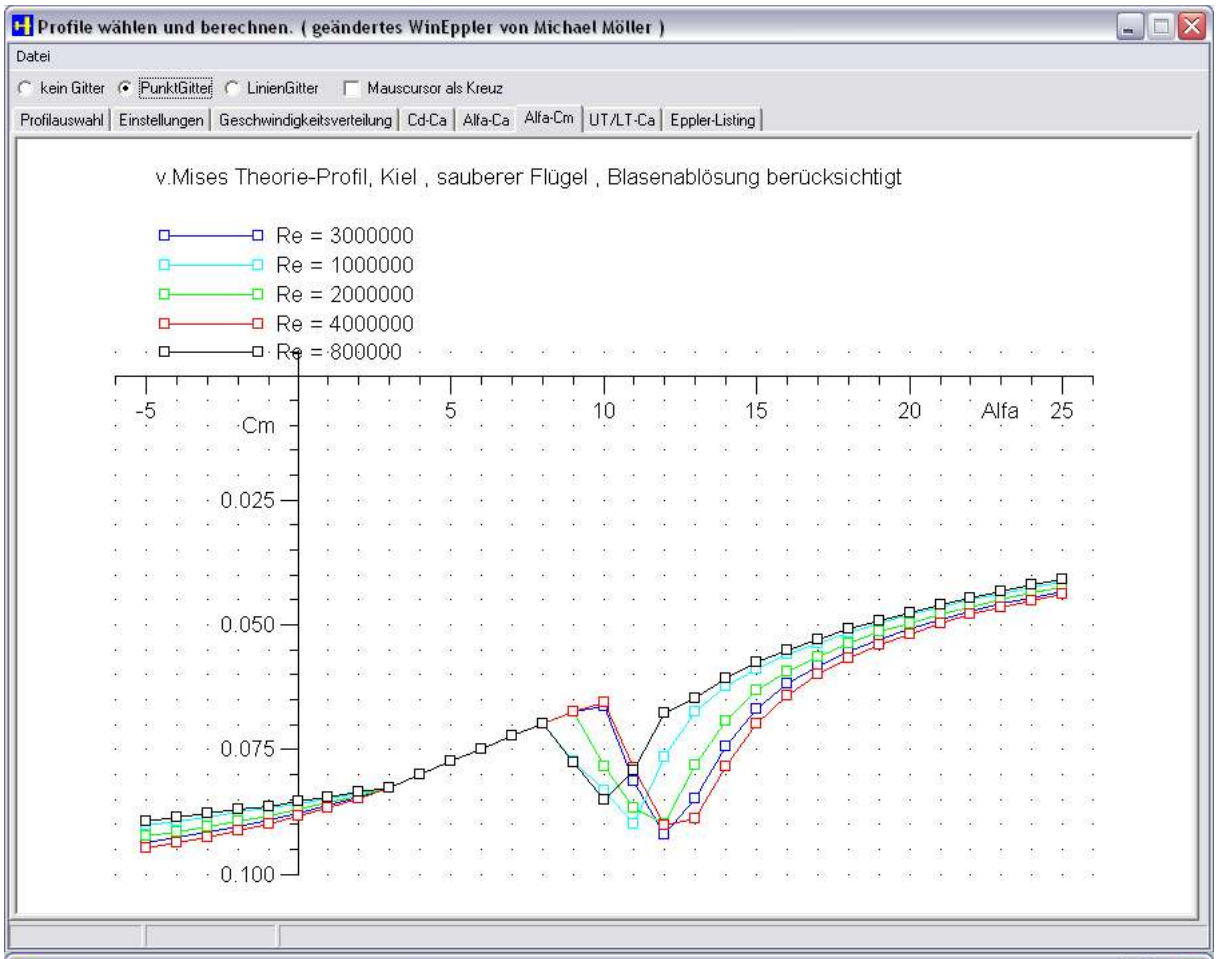
Root Airfoil

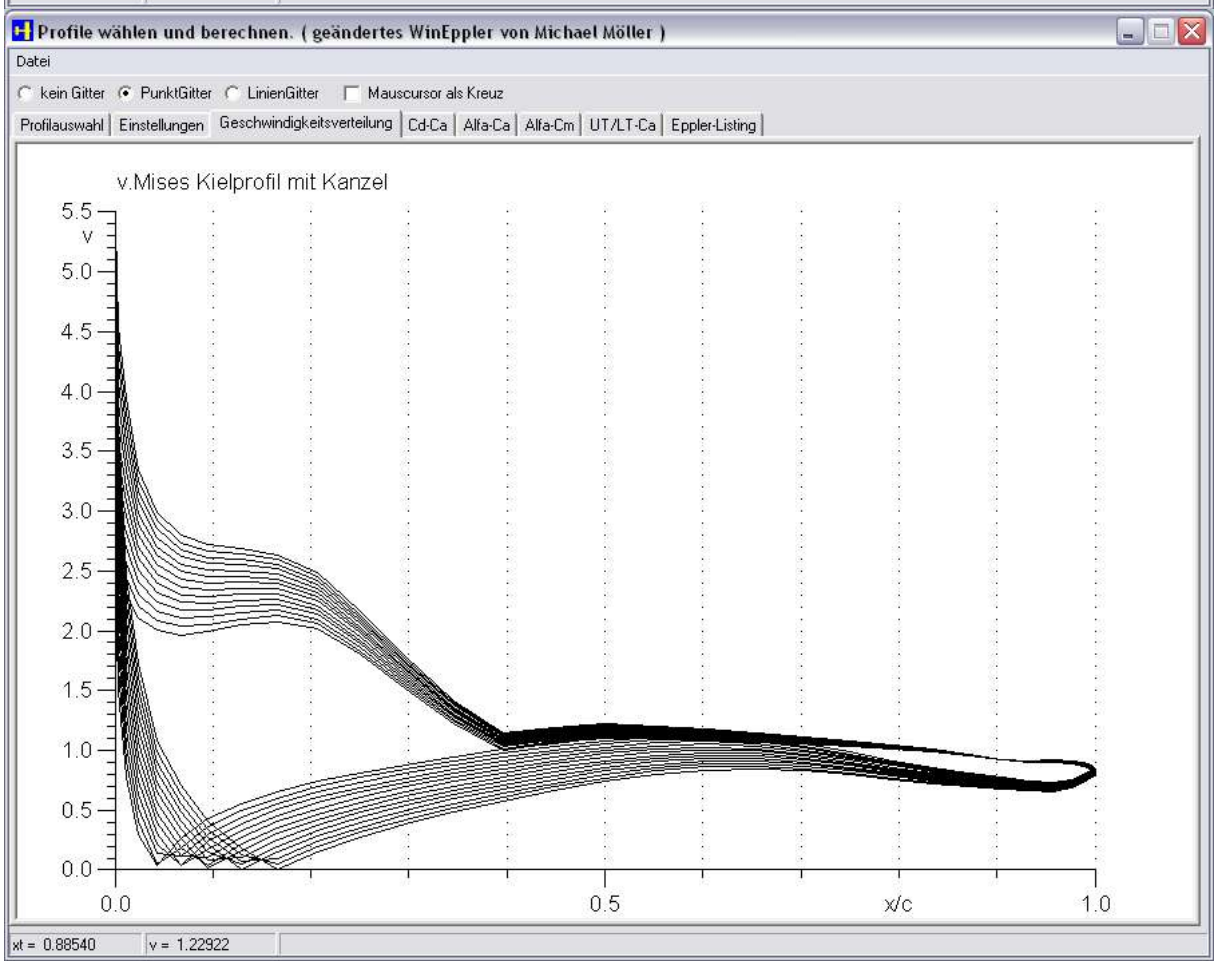




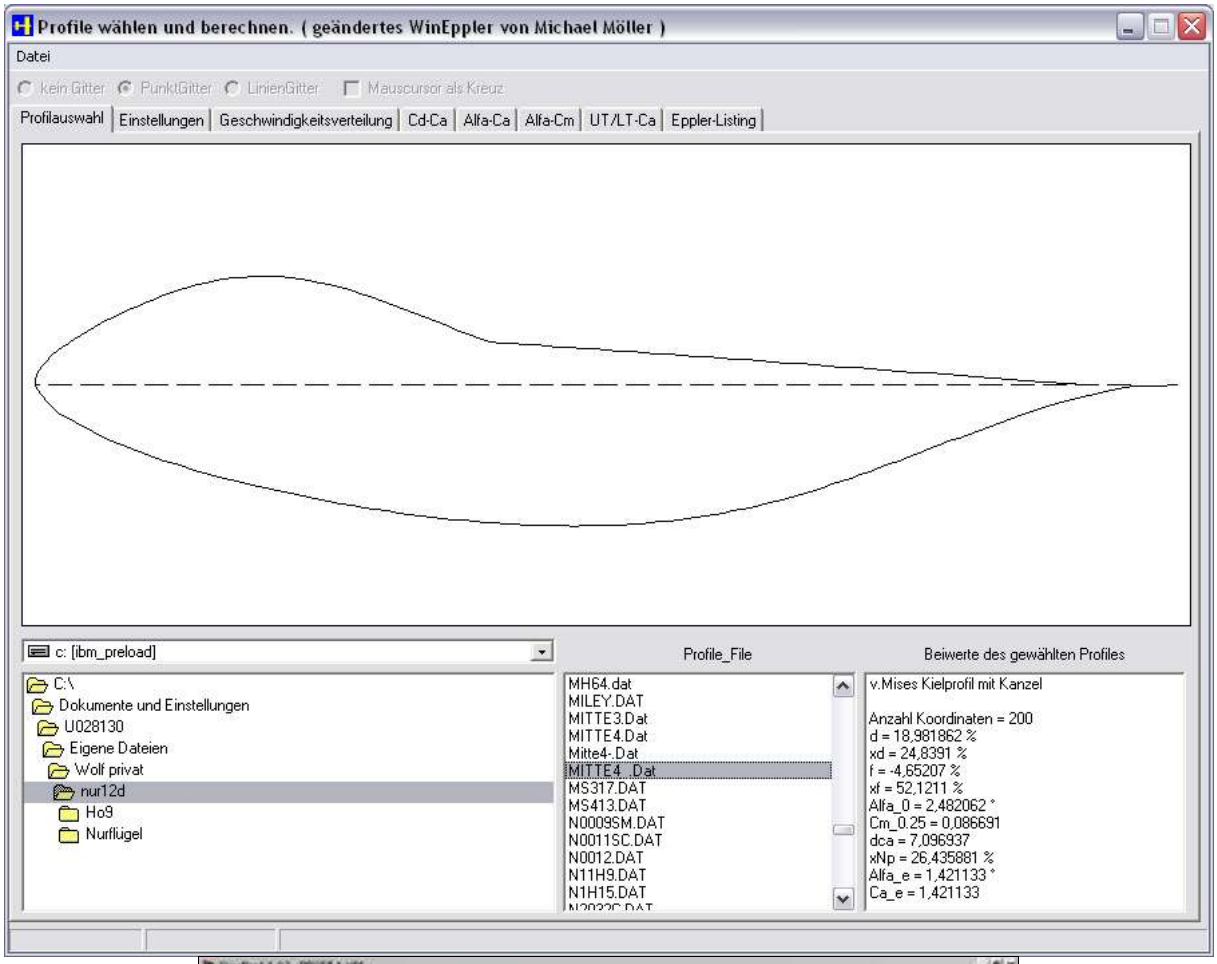


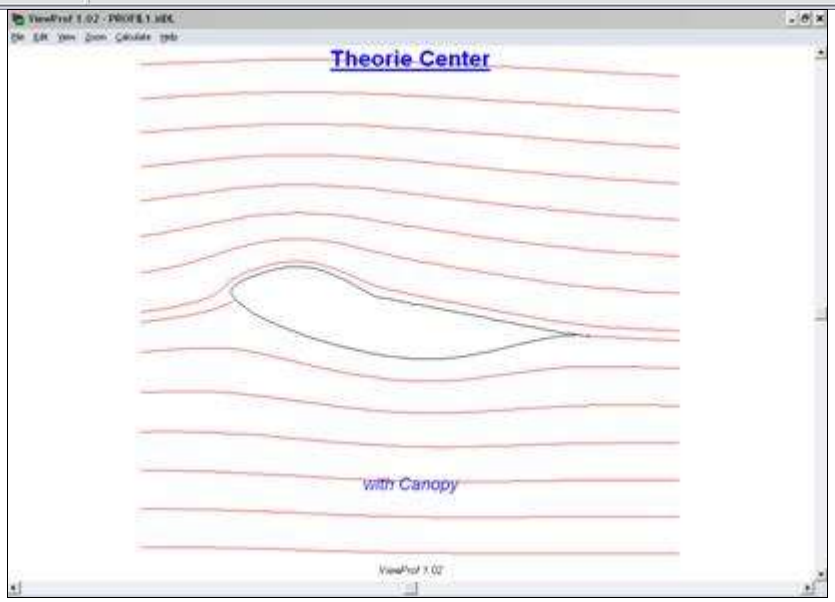


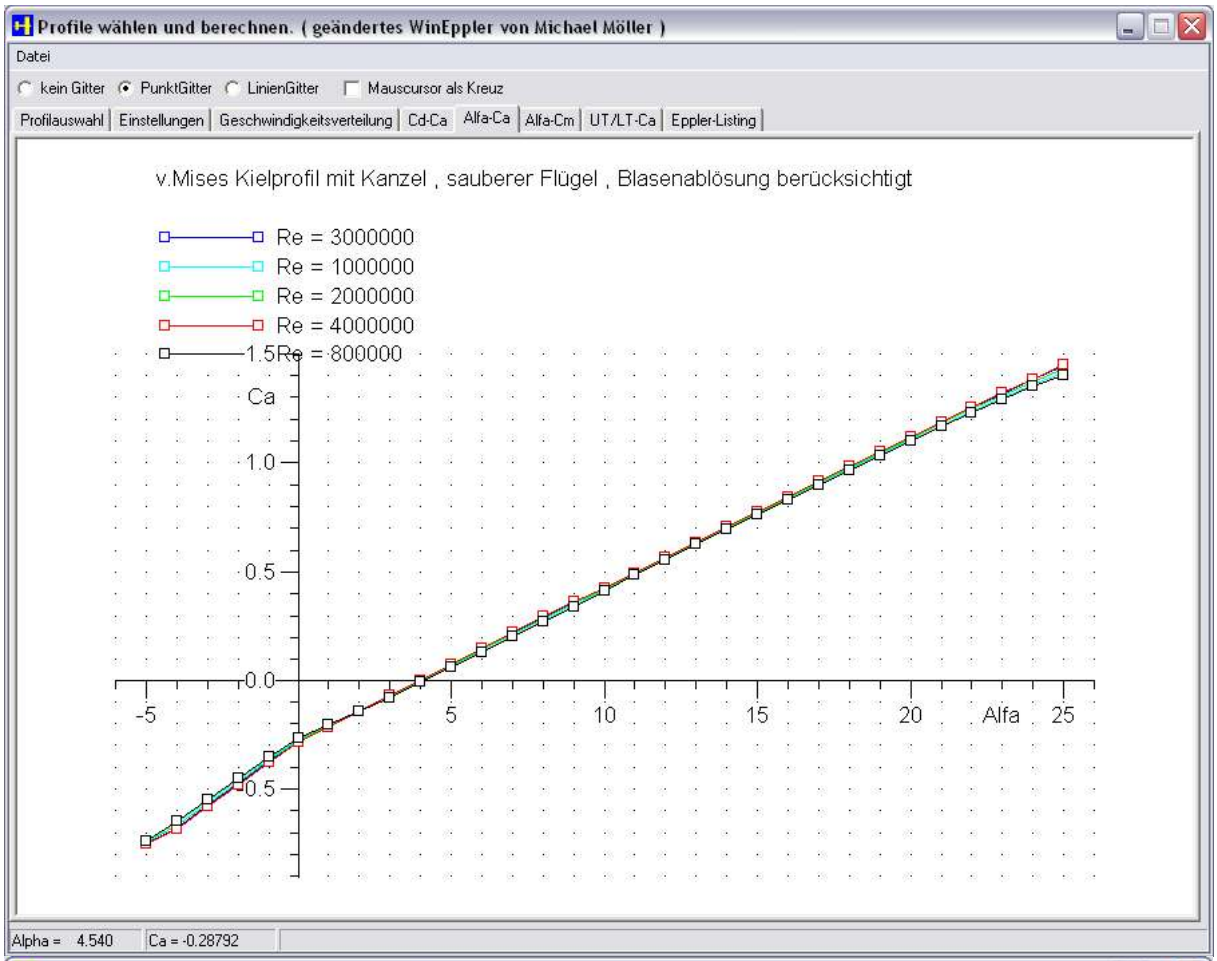


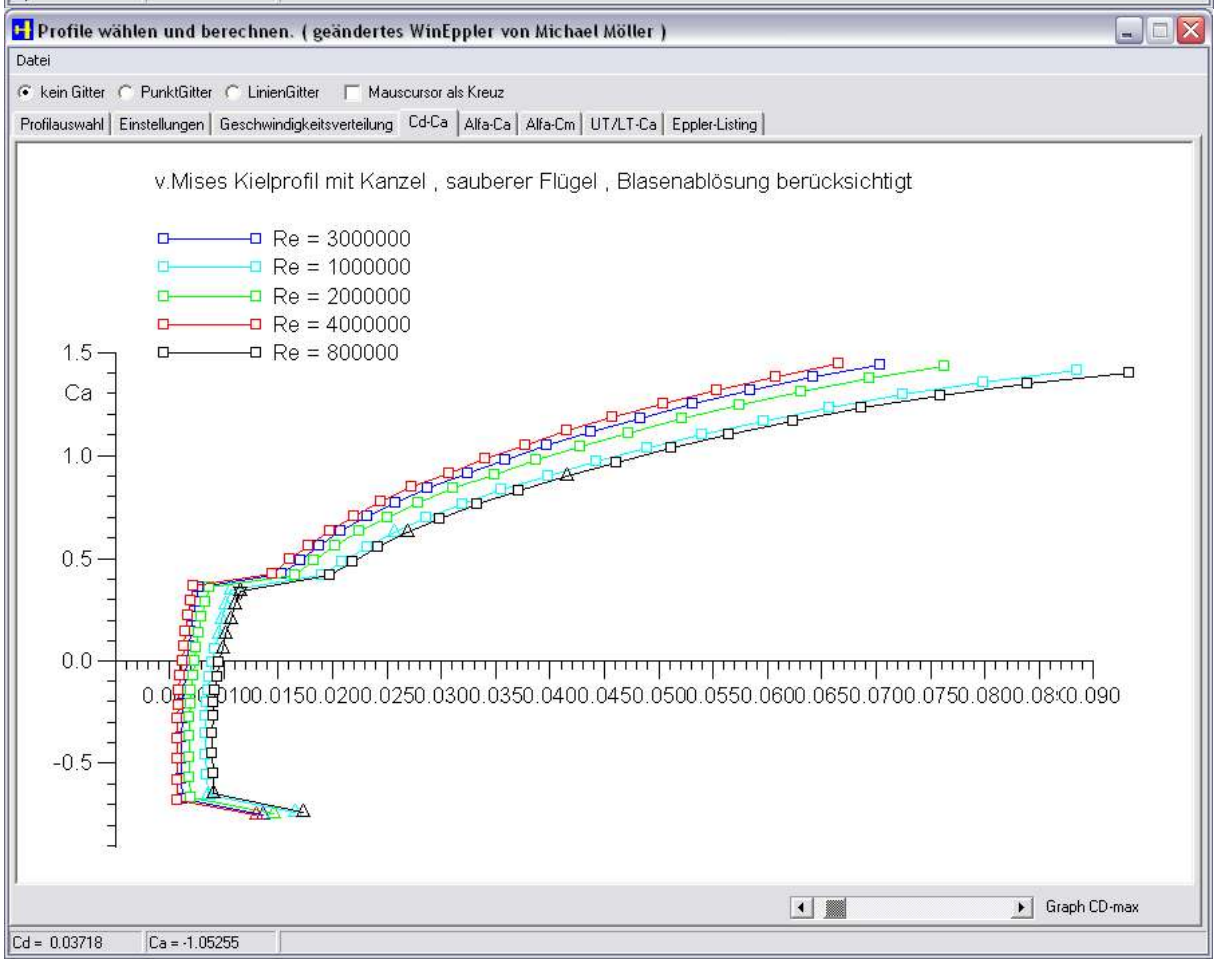


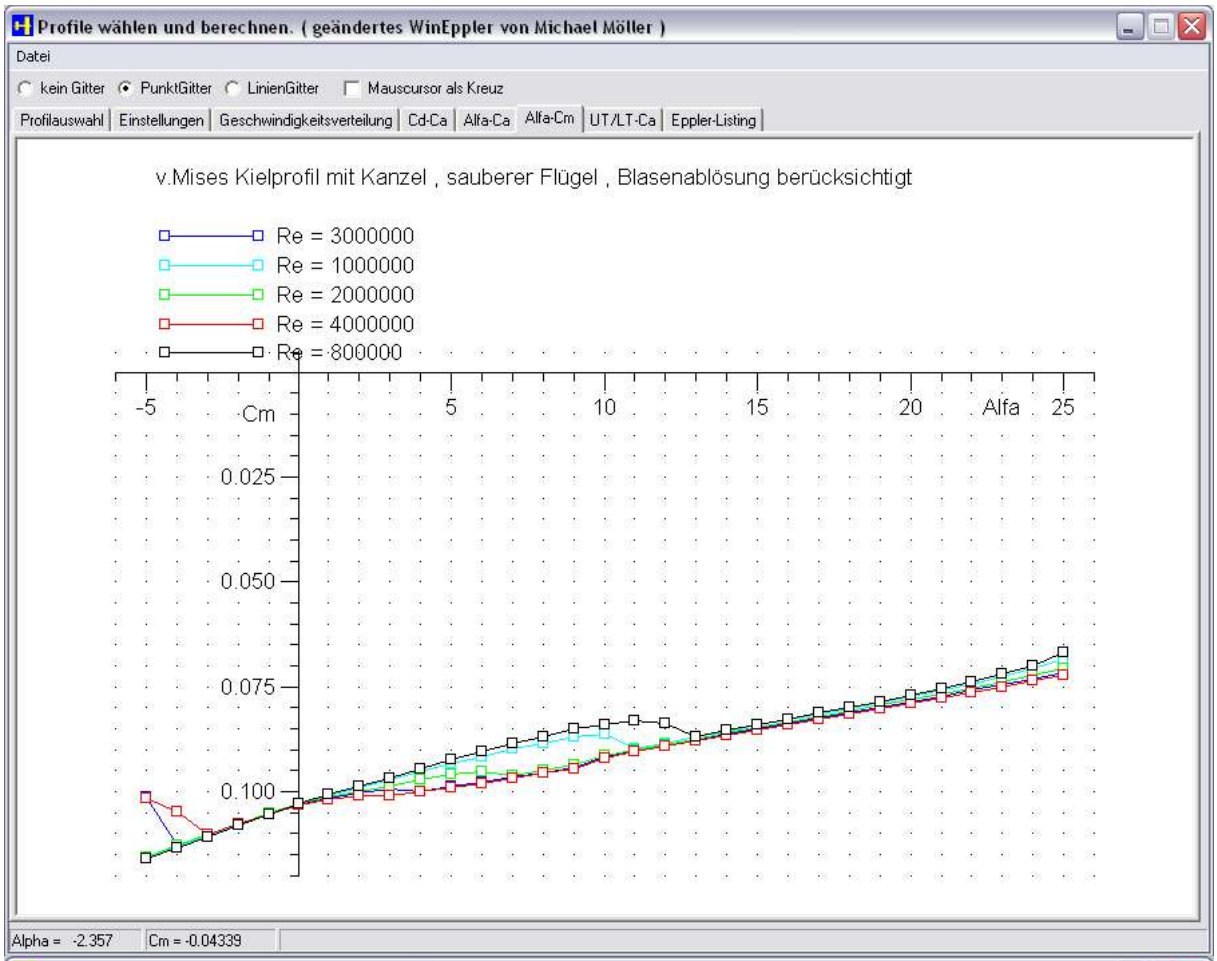
Root Airfoil with Canopy

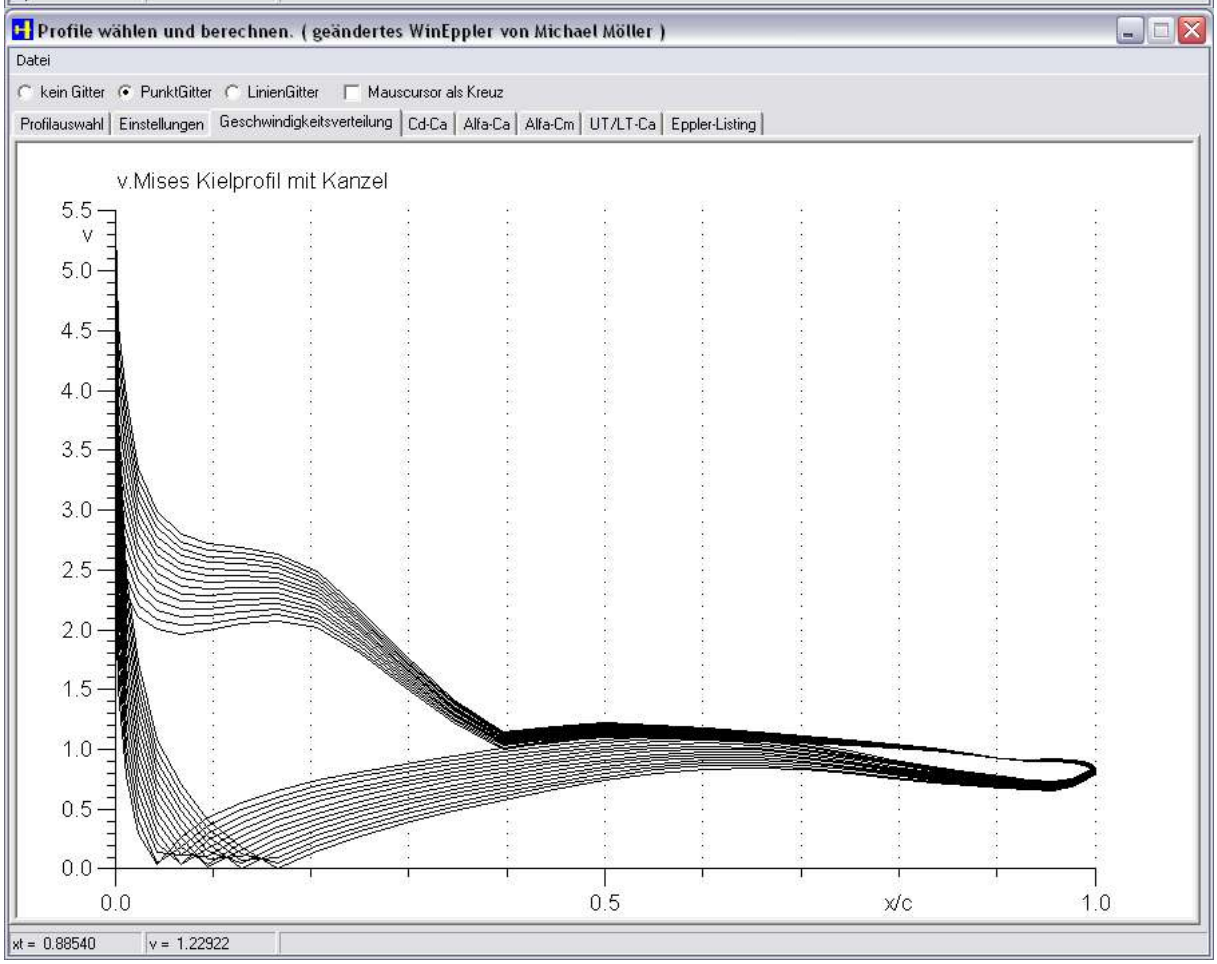




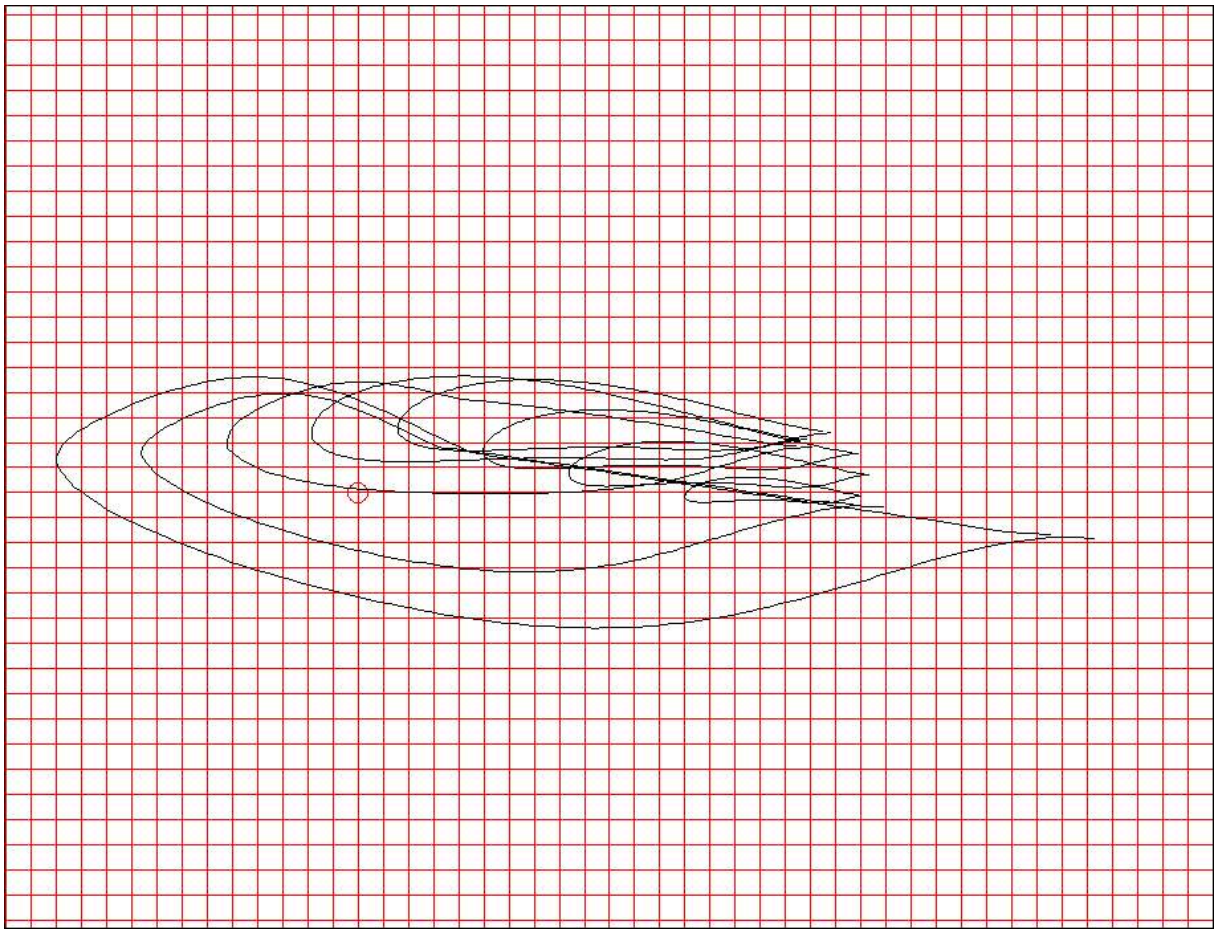


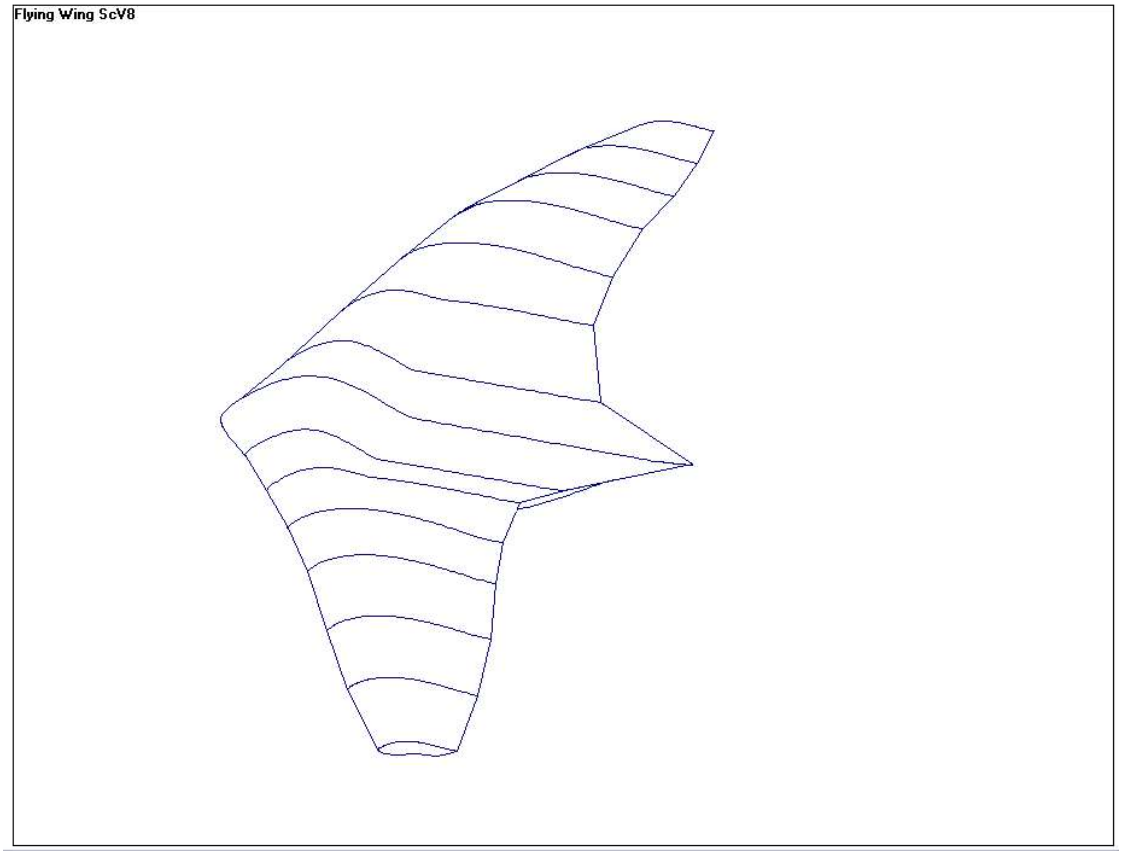


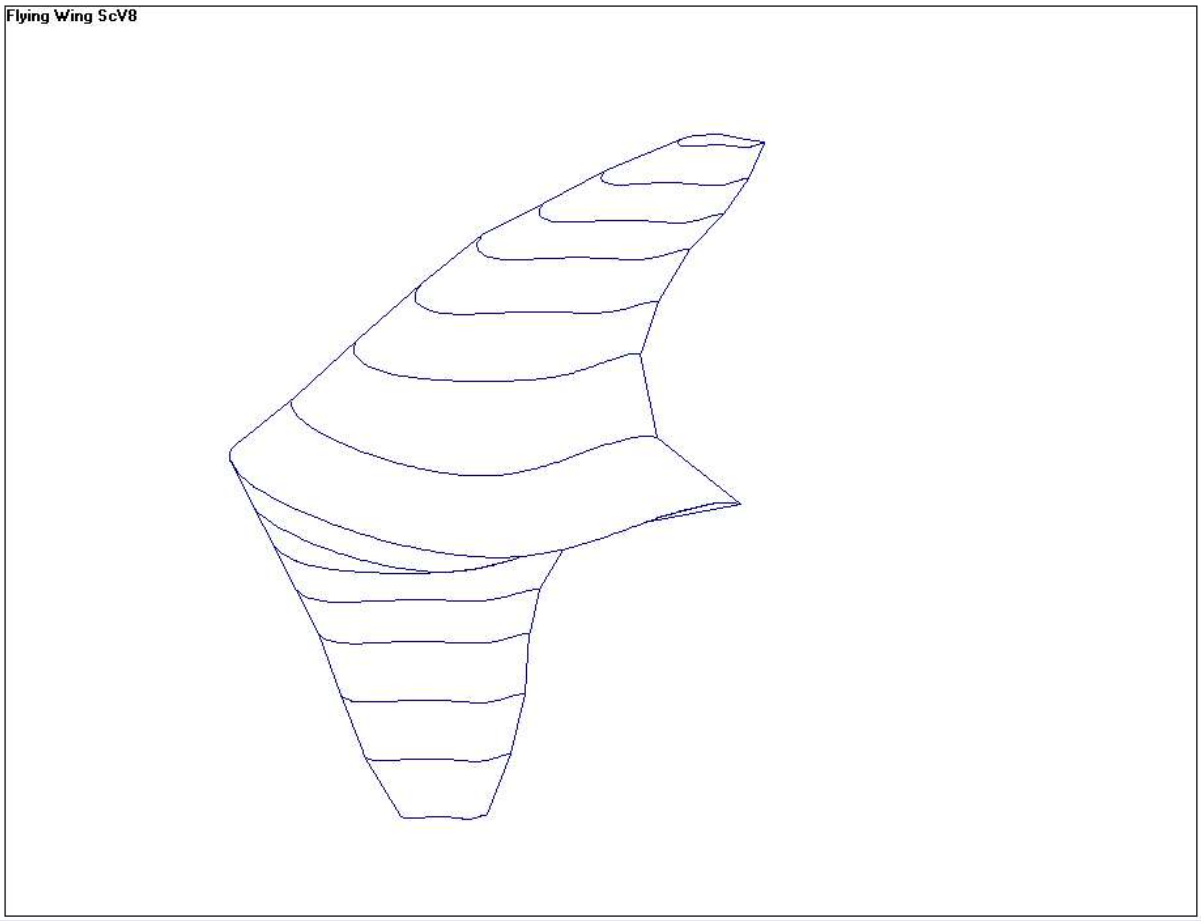


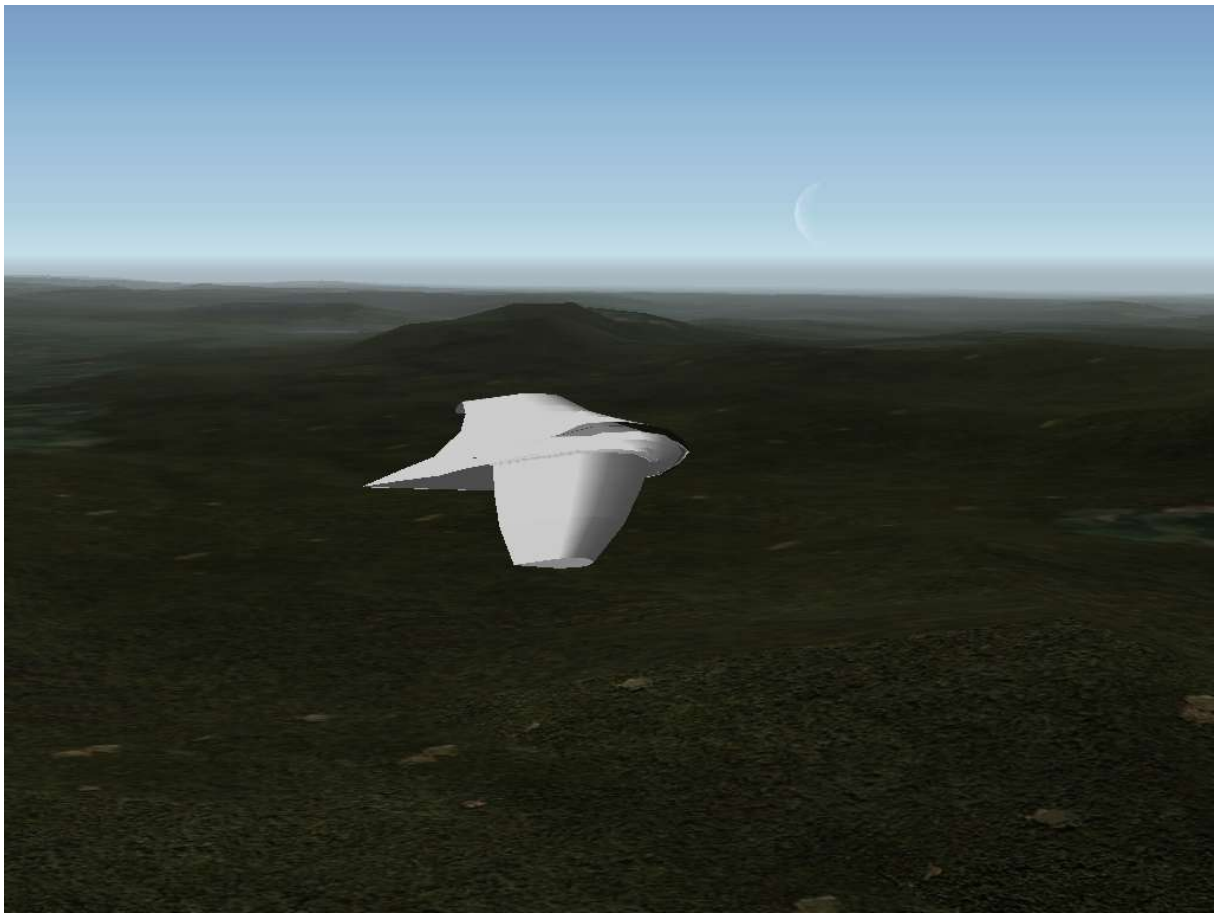


3D Shape of the Flying Wing ScV8






Flying Wing ScV8



Flying Wing ScV8 Data

Name des Flügels = WolfOptimumDb.flg

Flächeninhalt (F) = 37,785838 m²
Flächenbelastung = 22,309945 kg / m² = 223,099457 g / dm²
Streckung (A) = 5,5643
Bezugsflügeltiefe (lμ) = 3,0386 m
aktuelle Luftdichte (p) = 1,225 kg / m³ in 0 m Höhe

Rücklage des Geometrischen Neutralpunktes (XC) = 1,9541 m
Rücklage des Elliptischen Neutralpunktes (XE) = 2,0243 m
Rücklage des Aerodynamischen Neutralpunktes (XN) = 1,9962 m
Rücklage des Druckpunktes=Schwerpunkt (XD) = 1,7227 m
Stabilitätsmaß (SM) = 9 %

Nullauftriebswinkel des gesamten Flügels (A0) = -1,51 Grad
Nullmomentbeiwert des gesamten Flügels (CM0) = 0,04129
Auftriebsanstieg des Flügels (dCA) = 4,19669
Momentanstieg des Flügels (dCM) = -0,05814

Auftriebsbeiwert des gesamten Flügels (CA) = 0,458709
Momentbeiwert des gesamten Flügels (CM) = 0,03493
Induzierter Gesamtwiderstandsbeiwert (CWI) = 0,01204
Güte (CWI/CWI ell.) = 1,0006
Rollmomentbeiwert des gesamten Flügels (CL) = 0
Induzierter Giermomentbeiwert (CNI) = 0
Giermomentbeiwert (CN) = 0
Geschwindigkeit für den Stationären Flug (v_einsatz) = 27,909999 m/s

Info Normierung !
Normierter Wert = Originaler Wert * t / 2 / b!

Mit Hilfe von Eppler berechnete Flügelpolare :
Profil-Widerstandsbeiwert (CWP) = 0,005629
Induzierter-Gesamtwiderstandsbeiwert (CWI) = 0,01204
Gesamt-Widerstandsbeiwert (CWG) = 0,01768
Gleitzahl (E) = 25,9468
Steigzahl (e) = 17,57336
Sinkgeschwindigkeit (vs) = 1,076 m/s
Gleitwinkel = 2,21°

Flying Wing WolfOptimum ScV8

y	x	t	Profil	Sehnenwinkel	Dihedralwinkel	Pfeilwinkel
0	0.000	103.61	Mitte5	4.3°	2°	23°
20	8.489	74.06	Mitte5	4.1°	2°	23°
40	16.979	58.27	Straak	0.0°	2°	23°
60	25.468	49.17	Optimumdick1	0.0°	2°	23°
80	33.964	43.05	Straak	0.0°	2°	23°
100	42.447	37.41	Straak	0.0°	-6°	23°
120	50.937	29.96	Straak	0.0°	-6°	23°
140	62.484	17.64	Optimum2	0.0°	-6°	30°

X-PLANE

y meter	x	t	Profil	Sehnenwinkel	Dihedralwinkel
0.00	0.0	5.01	Mitte5	4.5°	2°
1.04	0.44	3.49	Mitte5	3.7°	2°
2.08	0.88	2.67	Straak	2.1°	2°
3.12	1.32	2.20	Optimum2	-0.1°	2°
4.16	1.76	1.90	Optimum2	0.2°	2°
5.20	2.21	1.63	Optimum2	0.3°	-6°
6.24	2.65	1.30	Optimum2	0.4°	-6°
7.28	3.09	0.76	Optimum2	0.0°	-6°

QBASIC Program

```
'Wing Planform Flying Wing ScV8
'Kapt. Wolf Scheuermann
'
CLS
SCREEN 12
VIEW (0, 0)-(479, 479)
WINDOW (-1, -1)-(5, 5)
PRINT "Flying Wing ScV8"
PRINT

PI = ATN(1) * 4
RAD = PI / 180

A = 2.5    'aspect ratio
n = 4.4    'wingspan
m = 2.3    'taper
s = 140    'Scale

Schritt = n / 7
PRINT "x", "t"
FOR x = 0 TO n + .1 STEP Schritt
  t = (A + EXP(1.5 - x) - EXP(x - 4)) / m
  PRINT USING "###.##   ###.##"; s * x / n; s * t / n
  y = x * TAN(23 * RAD)
  PSET (x, y), 12
  PSET (x, y + t), 12
NEXT
END
```

Design Targets

Item	Goal	Threshold
Vstall	25 kt	60 kt
Vmax	200 kt	120 kt
RoC	2000 fpm	500 fpm
Vcruise	50 to 80 kt	150 kt
maxTOW	1000 kg	400 kg
Crew	2	1
Baggage	50 lbs	20 lbs
Thrust	1000 lbs	350 lbs
Propulsion	jet	piston/electric impeller
Range	700 NM	1500 NM
Wingspan	12 m	20 m
Aspect ratio	4	8
Total costs	10000 US$	25000 US$

Design Values

Proposed
Vmax = 130 kt
Vstall [kt]? 34
Wing aspect ratio A? 5.6
Vcruise [kt]? 77.5
Range = 940 NM
Thickness 13 %

Calculated
W/hp = 11.66396 lbs/hp = 7.09504 kg/kW
W/S = 4.574991 lbs/ft² = 22.33694 kg/m² = 2.233694 g/cm²
Endurance = 12.12903 h
Power = 159.2779 hp = 118.7735 kW
Wing span: b = 47.68695 ft = 14.53498 m
Takeoff Weight = 1857.81 lbs = 842.7028 kg
Reynold's number Re = 7099754
Thrust produced = 847.7693 lbs
Wing weight = 756.1021 lbs = 342.9679 kg
Stall speed: vstall = 59.50906 kt
GroundRoll = 752.4086 ft = 229.3341 m
Takeoff distance over 50 ft = 1017.165 ft = 310.0319 m
$Range_{Calc}$ = 899.34 NM

X-Plane Flying Wing ScV8

FLYING WING V8 CHECKLIST

BEFORE TAKE OFF

Weight and Balance	checked
Outside Check	completed
Controls	checked
Power	zero
Battery	on
Fuel Selector	both
Fuel	sufficient
Ignition	on
Starter	press until engine starts
N1	20 %
Oil Pressure and Temperatur	in limits
Generator	on
Gear	down and locked
Altimeter	set and checked

TAKE OFF

Trim	neutral
Brakes	off
Timer	set
Take off power	full
Rotate	at 60 kt

AFTER TAKE OFF

Climb Rate	checked
Gear	up
Take off time	recorded
Cruise power	set
Trim	neutral

EMERGENCY

Power	zero
Gear	down and locked
Fuel Selector	off
Ignition	off
Battery	off
Chute	deploy

READY FOR LANDING

Trim	3 up
Landing power	set
Gear	down and locked

AFTER LANDING

Power	zero
Landing time	recorded
Taxi	to parking position
Trim	neutral
Brakes	set
Generator	off
Ignition	off
Battery	off
Fuel Selector	off

by Captn. Wolf Scheuermann

OPTIMIZED COCKPIT PANEL LAYOUT:

FlyWing V8b

Kapt. Wolf Scheuermann

DIALS
- Airspeed Indicator
- Magnetic Compass
- Altimeter
- Variometer
- G-Force Indicator
- N1 Indicator
- Fuel Flow Meter

INDICATORS
- Fuel Quantity Gauge
- Gear Position Indicator Light
- Battery Voltage Indicator
- Brake Indicator
- Oil Pressure Gauge
- Oil Temperature Gauge

LEVER
- Elevator Trim Wheel
- Throttle Lever
- Gear Lever

SWITCHES
- Battery Switch
- Ignition Switch
- Generator Switch
- Jet Engine Starter Button
- Chute deploy button

CLOCK
- Timer

OTHER
- Call Sign Plate