ADA ADVANCED DESIGN ALLIANCE
ENGINEERING CENTER

Document No.: **NC00.00.00.004**
Engineering Report: **XFLR5 v6.05 Results Validation**

Applicable paragraphs of airworthiness requirements: N/A

	Name	Signature	Date
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Checked	-	-	-
Approved	-	-	-

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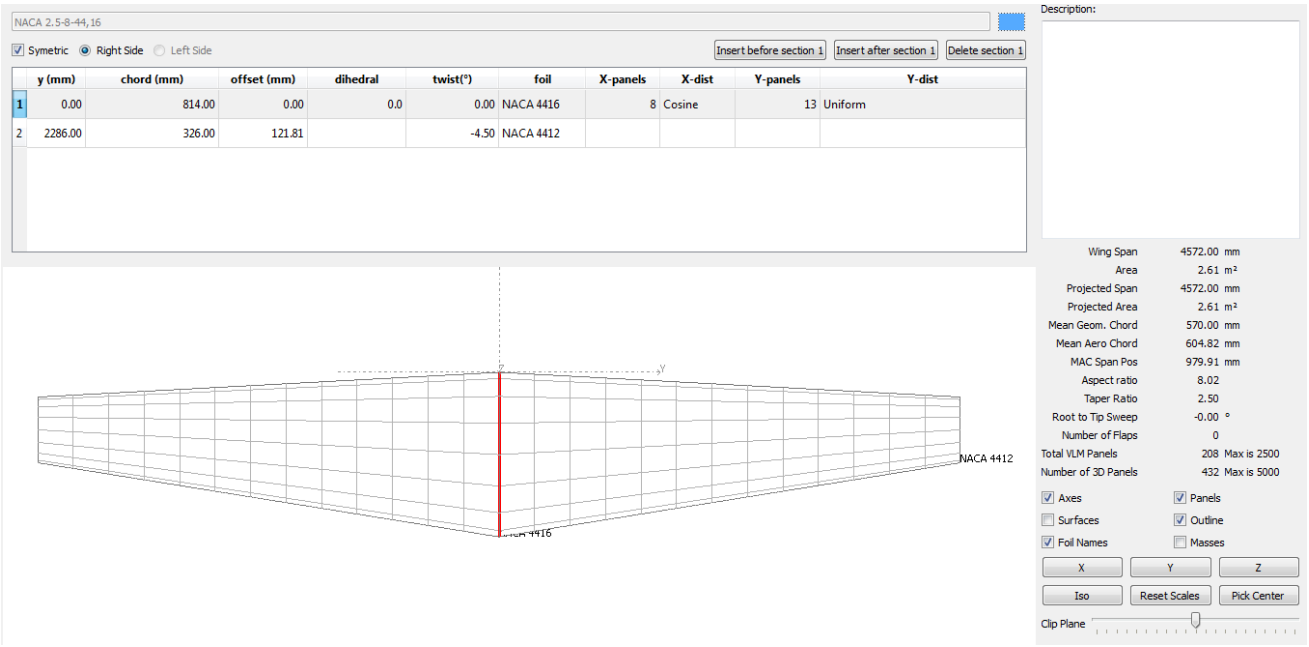
SCOPE

XFLR is a software use for aerodynamic analysis of gliders. The purpose of this report is to validate results generated by XFLR5 v6.05 against experimental data published in NACA TN 1270 report [1].

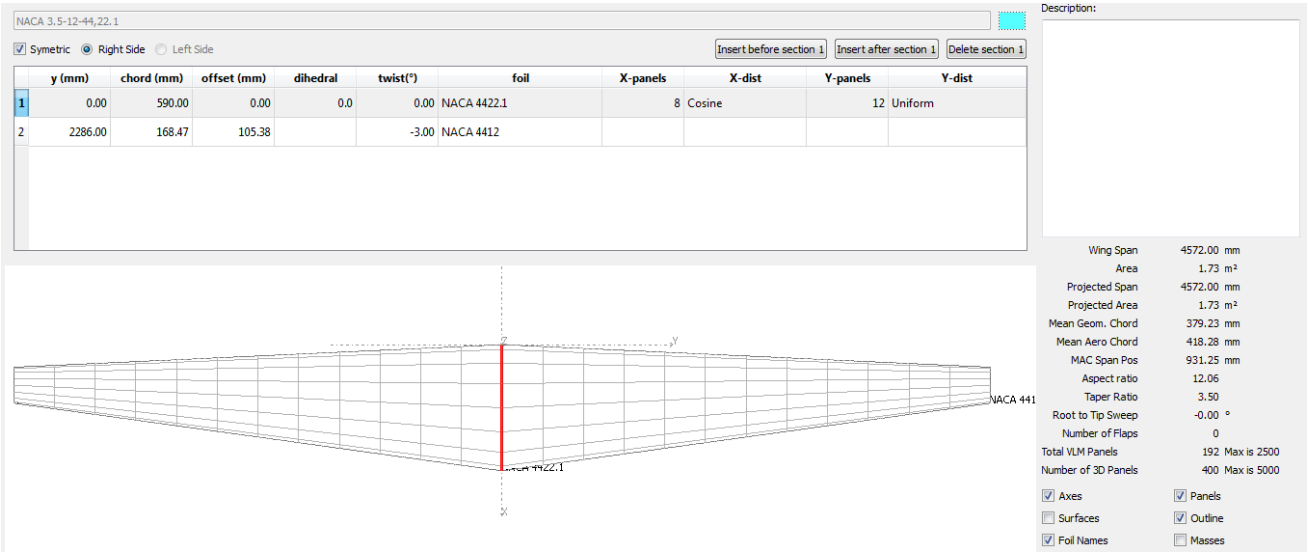
General

Two wings have been simulated – NACA 2.5-8-44,16 and NACA 3.5-12-44,22.1, as designated in the report, smooth leading edge only, air density in the wind tunnel 2.836 kg/m3, kinematic viscosity 0.74e-5m2/s (estimated). Wing tips have not been simulated due to limitation of the method. All three "built-in" methods of analysis have been used, i.e. LLT, VLM, and 3D Panels.

Wing NACA 2.5-8-44,16 has been analyzed for Re=4.32e6 and M=0.13.

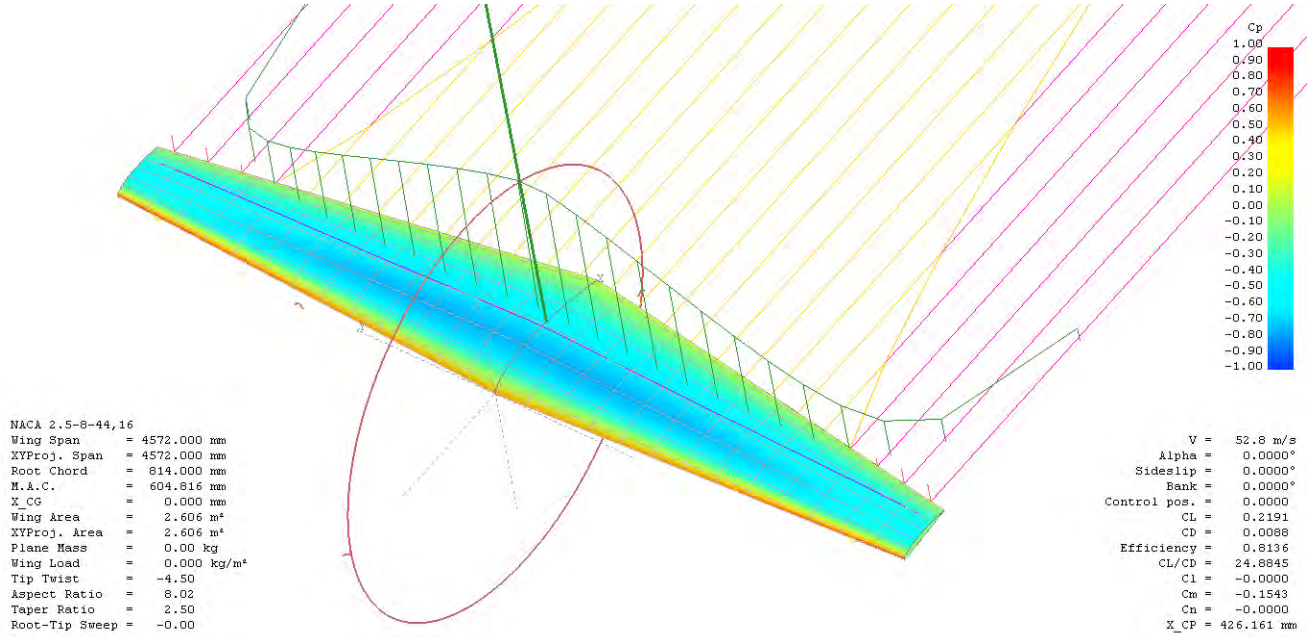


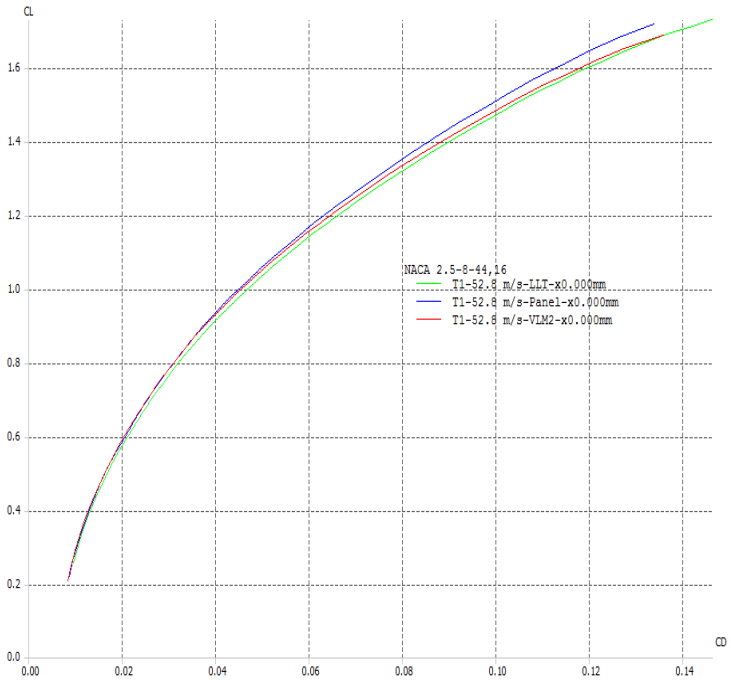
Wing NACA 3.5-12-44,22.1 has been analyzed for Re=4e6 and M=0.19.

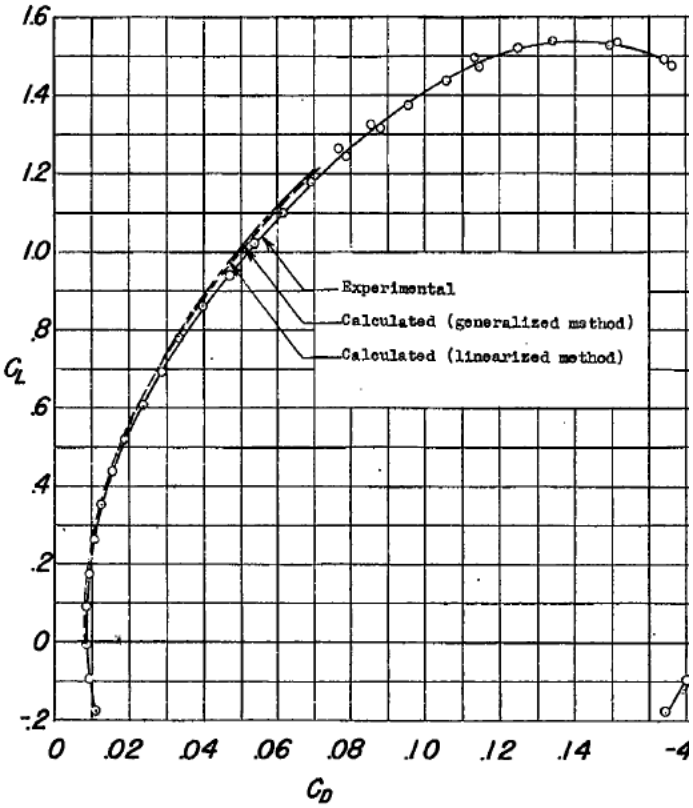


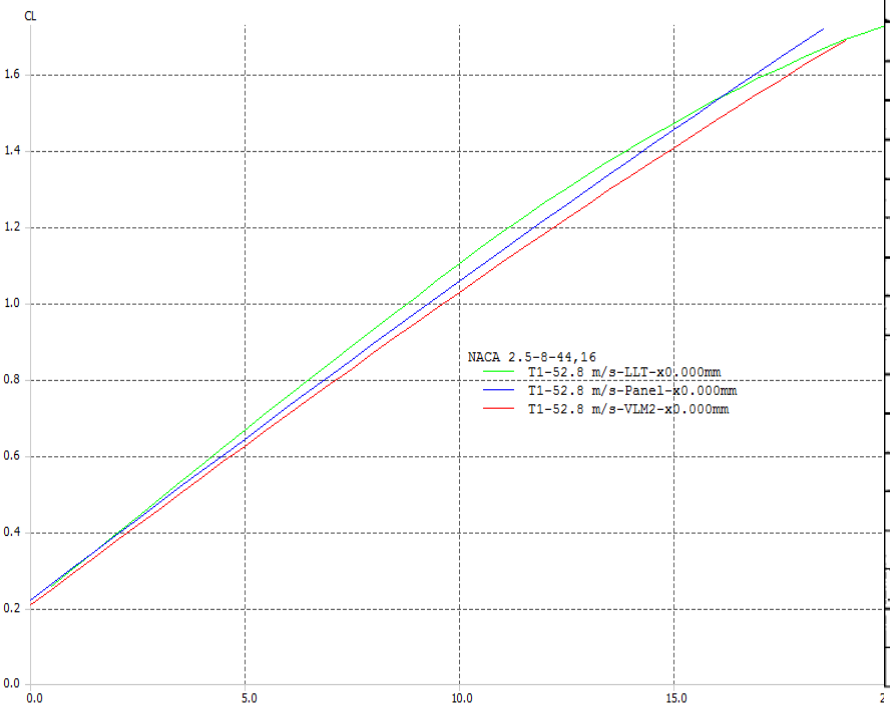
Results

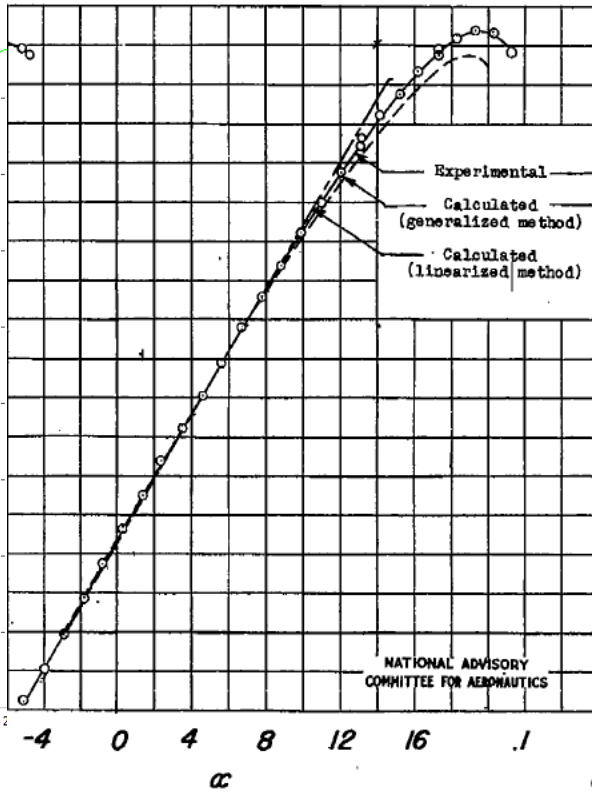
NACA 2.5-8-44,16

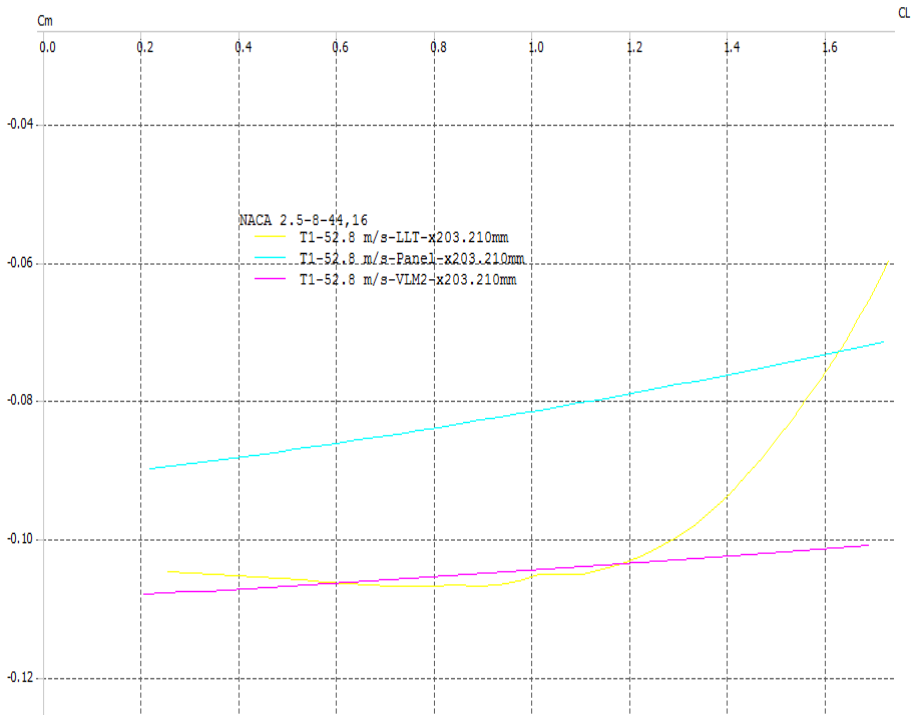


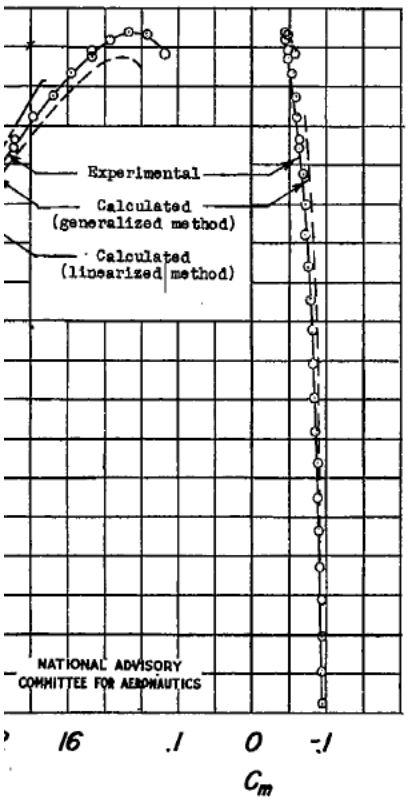




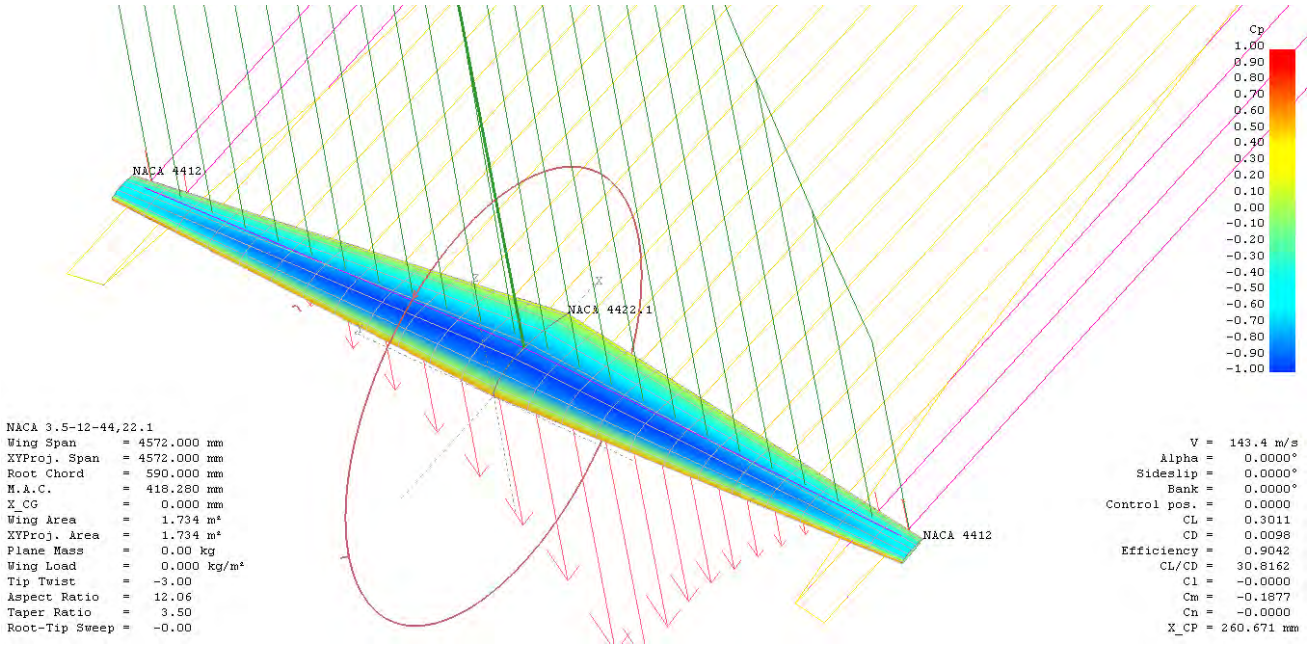

CL
1.6
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0.0
0.0
5.0
10.0
15.0
NACA 2.5-8-44,16
T1-52.8 m/s-LLT-x0.000mm
T1-52.8 m/s-Panel-x0.000mm
T1-52.8 m/s-VLM2-x0.000mm

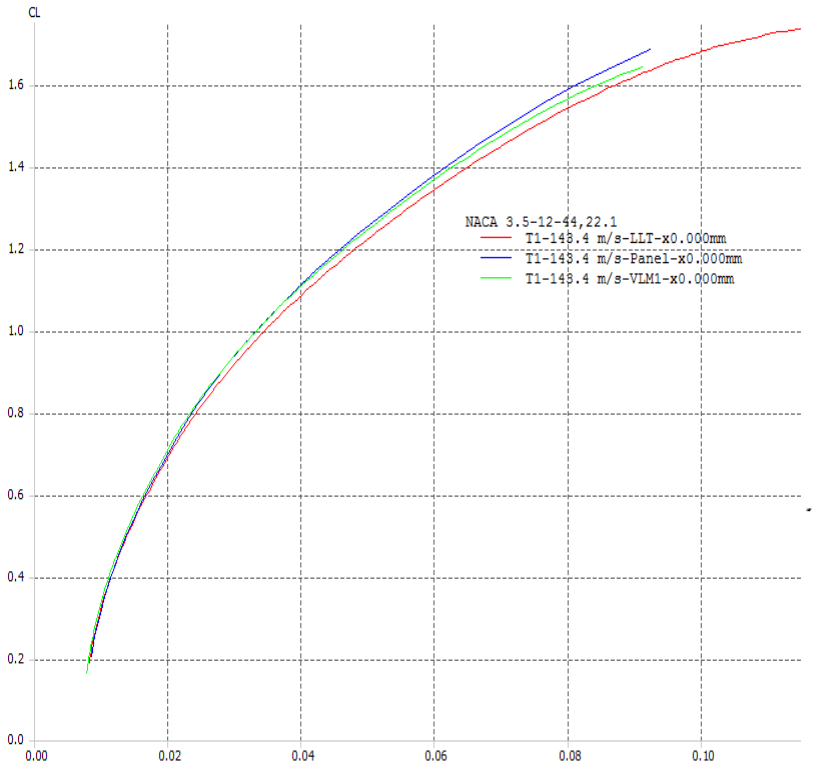

Experimental
Calculated
(generalized method)
Calculated
(linearized method)
NATIONAL ADVISORY
COMMITTEE FOR AERONAUTICS
-4
0
4
8
12
16
.1
α

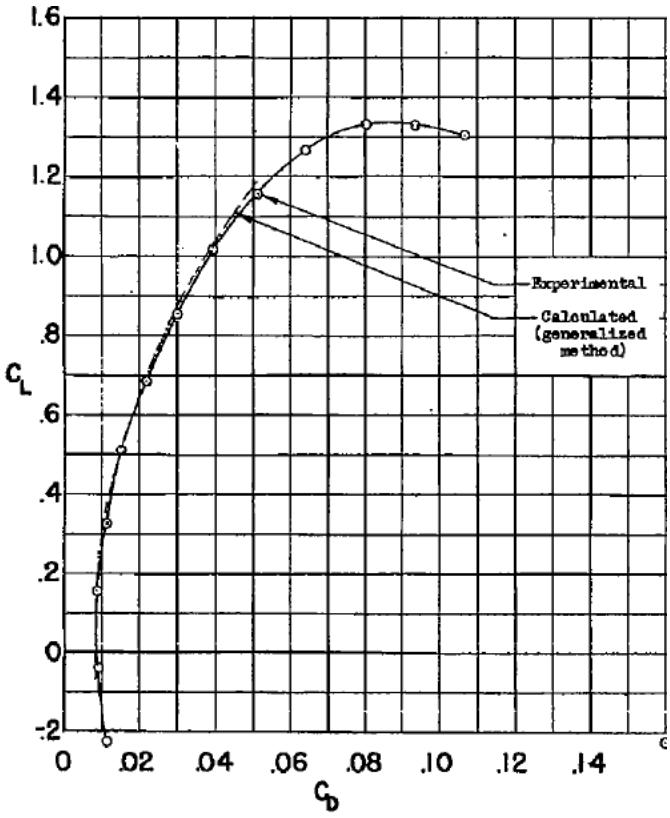

Cm
CL
0.0
0.2
0.4
0.6
0.8
1.0
1.2
1.4
1.6
-0.04
-0.06
-0.08
-0.10
-0.12
NACA 2.5-8-44,16
T1-52.8 m/s-LLT-x203.210mm
T1-52.8 m/s-Panel-x203.210mm
T1-52.8 m/s-VLM2-x203.210mm

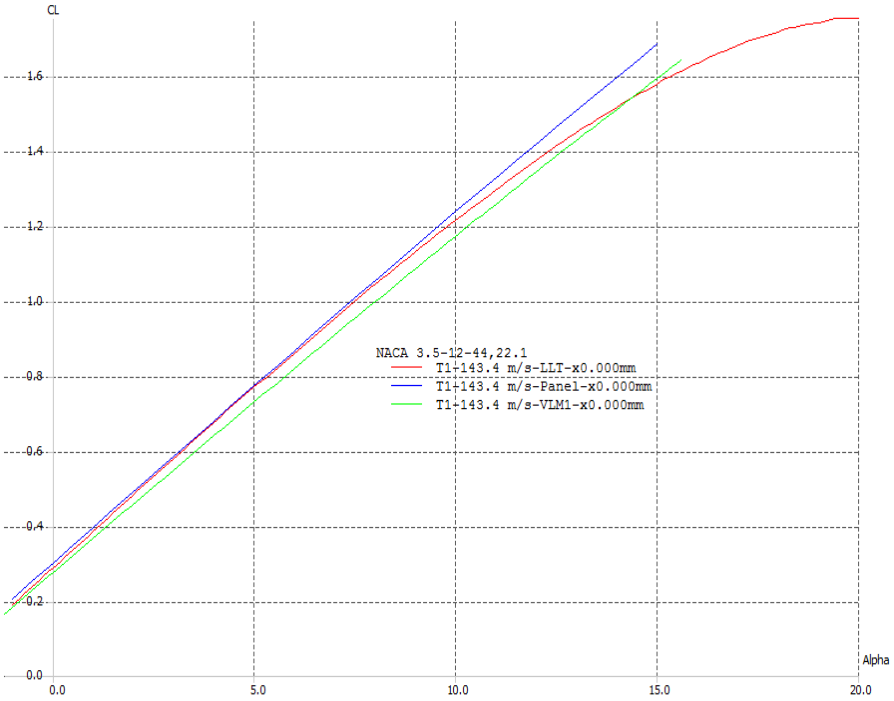

Experimental
Calculated
(generalized method)
Calculated
(linearized method)
NATIONAL ADVISORY
COMMITTEE FOR AERONAUTICS
16
.1
0
-.1
Cm

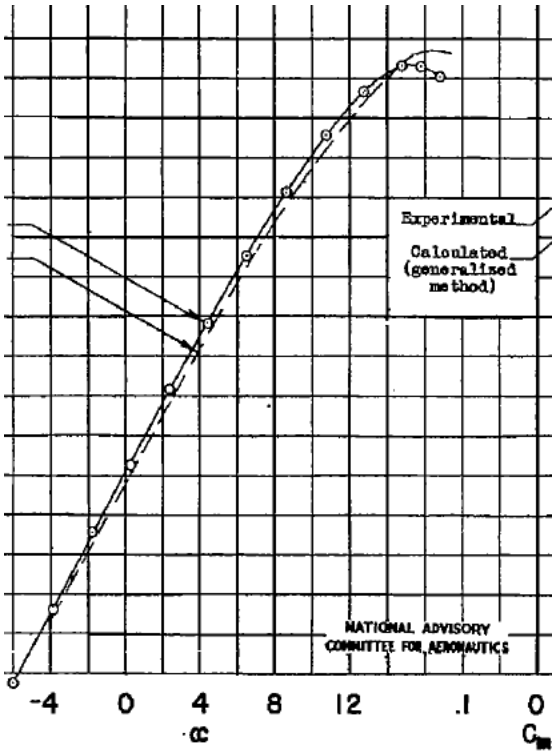
NACA 3.5-12-44,22.1

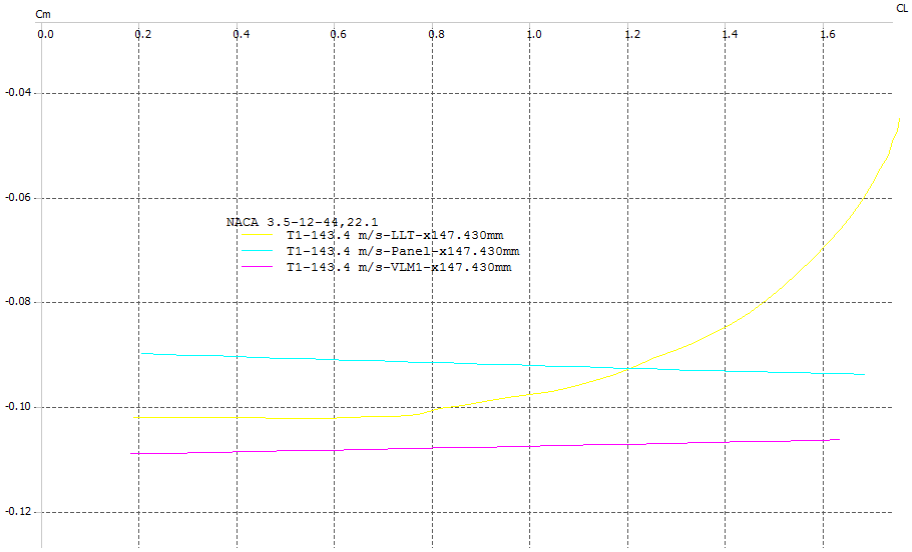


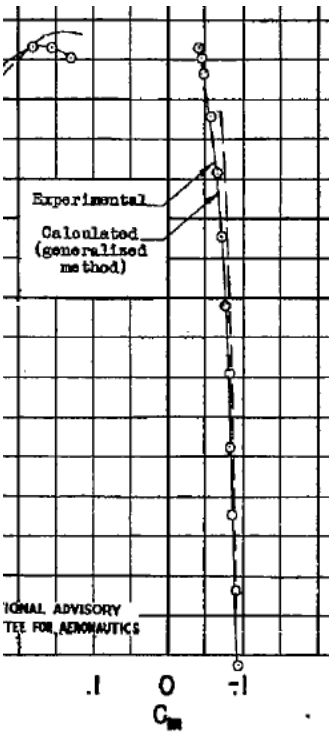





CL
1.6
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0.0
0.0
5.0
10.0
15.0
20.0
Alpha
NACA 3.5-12-44,22.1
T1-143.4 m/s-LLT-x0.000mm
T1-143.4 m/s-Panel-x0.000mm
T1-143.4 m/s-VLM1-x0.000mm


Experimental
Calculated (generalised method)
NATIONAL ADVISORY COMMITTEE FOR AERONAUTICS
-4
0
4
8
12
.1
0
α
C_m


Cm
CL
0.0
0.2
0.4
0.6
0.8
1.0
1.2
1.4
1.6
-0.04
-0.06
-0.08
-0.10
-0.12
NACA 3.5-12-44,22.1
T1-143.4 m/s-LLT-x147.430mm
T1-143.4 m/s-Panel-x147.430mm
T1-143.4 m/s-VLM1-x147.430mm


Experimental
Calculated (generalised method)
.1
0
-.1
C_m

Conclusion

1. None of XLRF methods predict stall.
2. CL is rather close to the experimental data up to AOA~8 (3.5-12-44,22.1) and 12(2.5-8-44.16) degrees. VLM method gives the best approximation within this range of AOA.
3. CD is somewhat optimistic and reasonably consistent with experimental data up to CL~1.0. LLT method demonstrates the best approximation within the specified range of AOA.
4. Cm is always somewhat greater (negative) then experimental data and is within reasonable proximity up to CL~1.0. 3D panels method gives the closest to experimental data results.

References

1. NACA TN 1270 “Experimental and Calculated of Several NACA 44-Series Wings With Aspect Ratios 8, 10, And 12 And taper Ratios 2.5 and 3.5”
2. Guidelines for XFLR5 v6.03 “Analysis of foils and wings operating at low Reynolds numbers”.