Aeroelastic Prediction Workshop #4
High Angle Working Group Introduction

AIAA Drag Prediction Workshop 8 / Aeroelastic Prediction Workshop 4

June 7th, 2026

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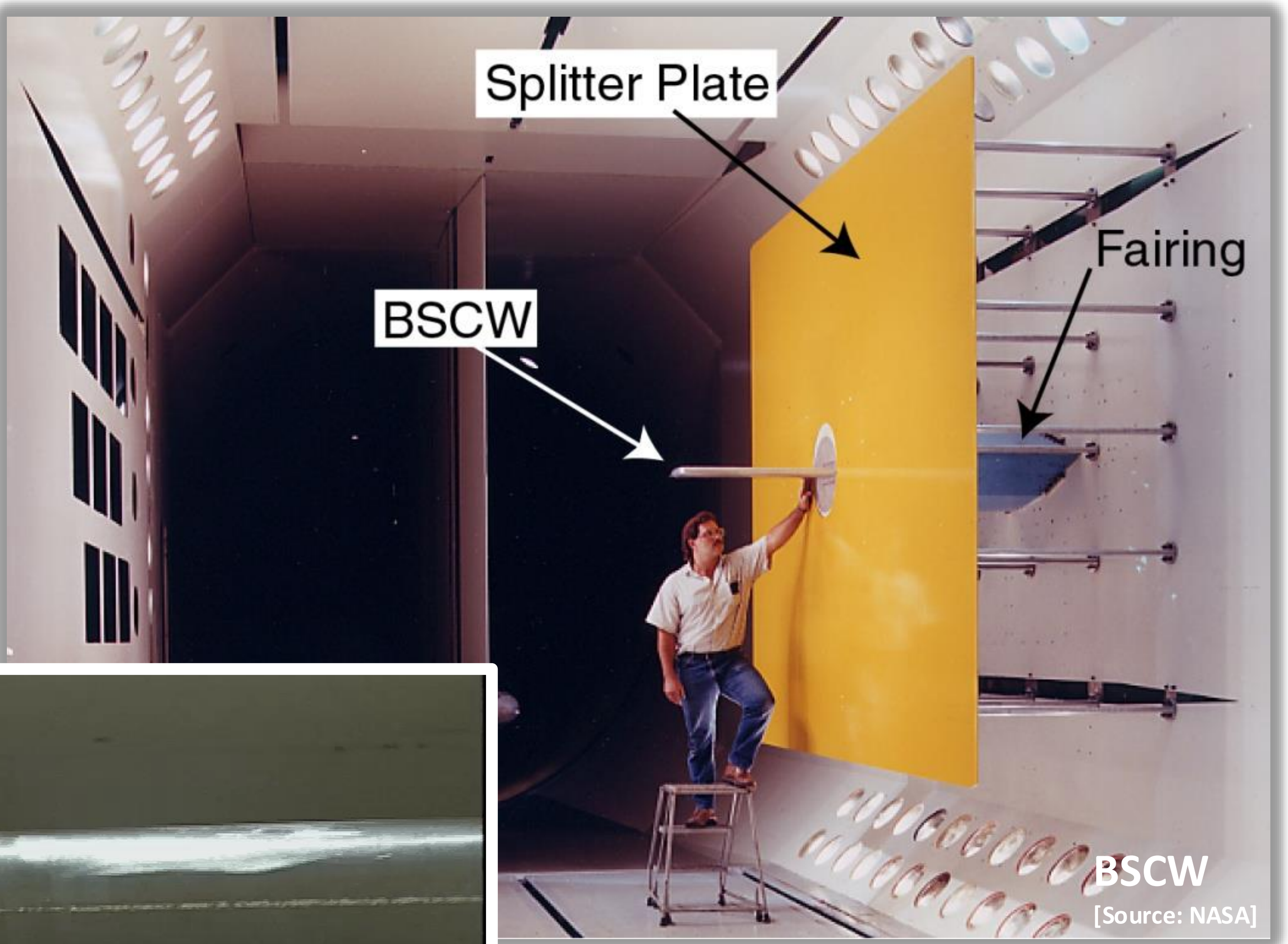
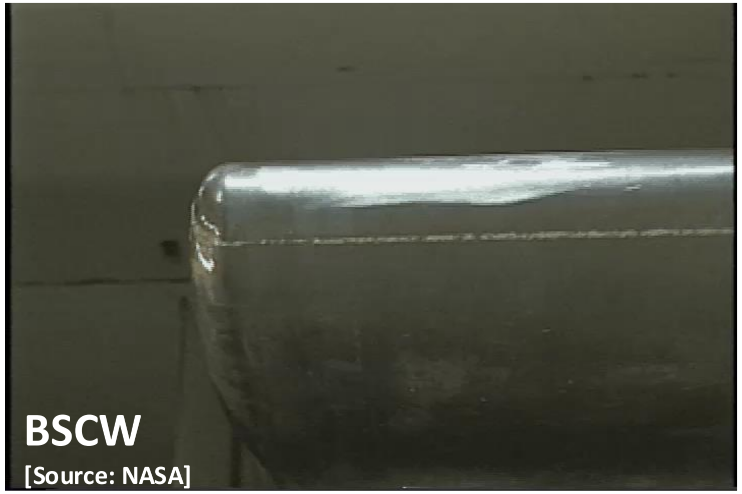
Aeroelasticity Branch, NASA Langley Research Center

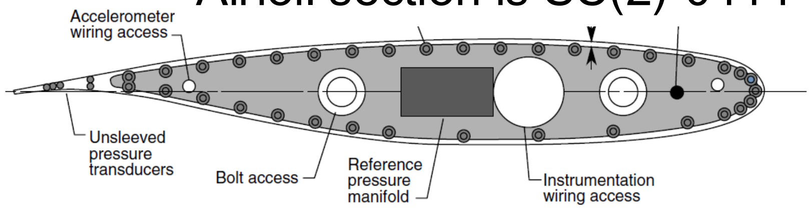
June 6, 2026

High-Angle WG: BSCW Wing Configuration

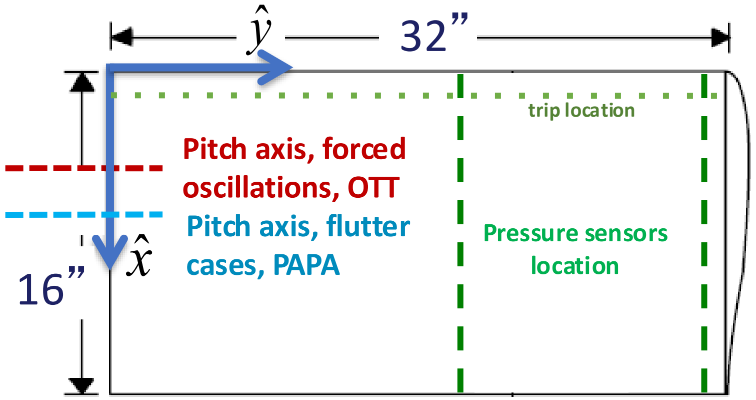




Airfoil section is SC(2)-0414



Cross-section at 60% span, showing the layout of the unsteady pressures.

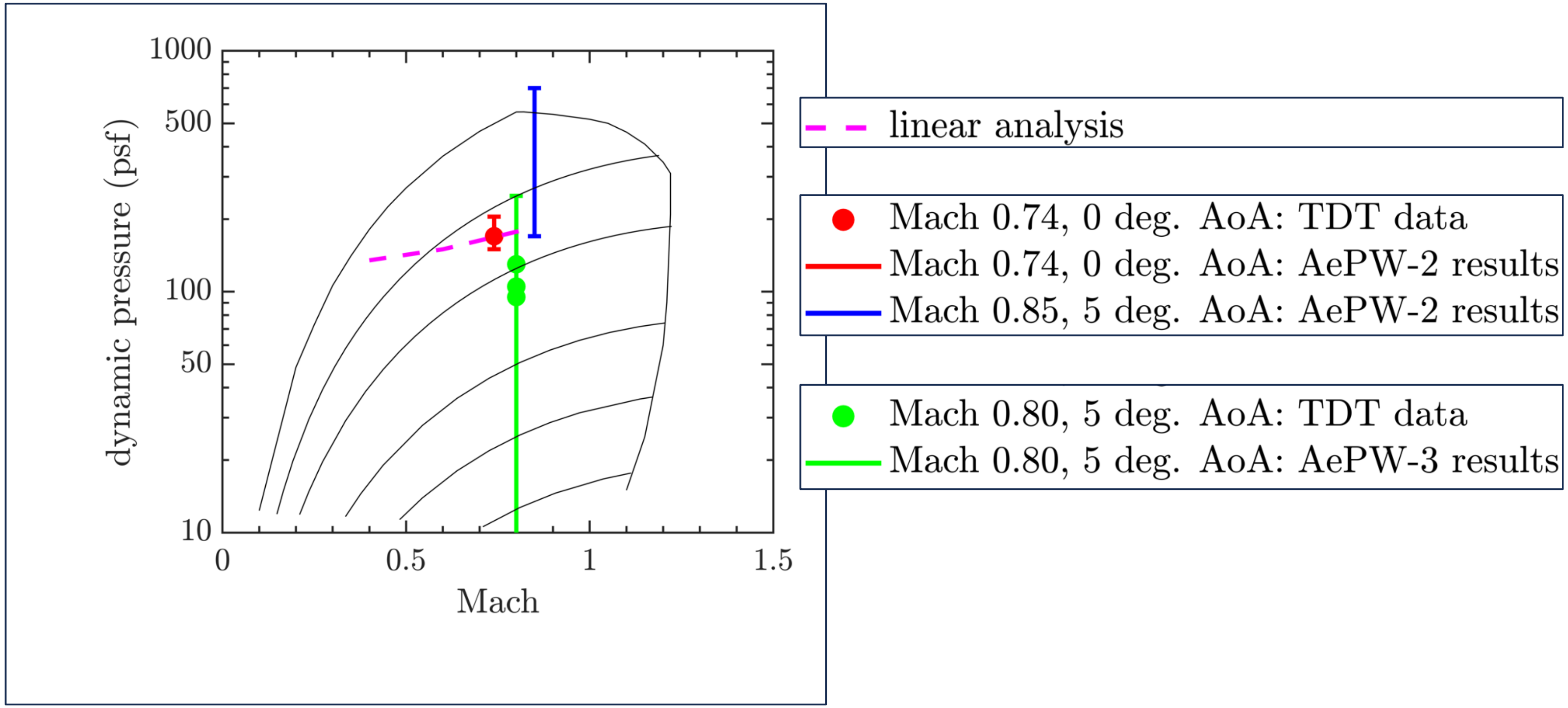


Model planform. Dimensions are in inches.

BSCW Wing Configuration Past Workshop Conditions

- AePW-1:
  - Steady-rigid and forced-oscillation cases at Mach 0.85, AoA = 5° ✓
- AePW-2:
  - Forced-oscillation case at Mach 0.70, AoA = 3° ✓
  - Flutter prediction at Mach 0.74, AoA = 0° ✓
  - Unsteady-rigid, forced-oscillation, and flutter cases at Mach 0.85, AoA =5° ✓ ✓ ✓
- AePW-3:
  - <u>Flutter prediction at Mach 0.80, AoA = 5°</u> ✓
  - Shock-buffet case at Mach 0.80, AoA = 5° ✓

AePW-3: What have we learned?



- Large spread in BSCW flutter predictions from AePW-3 (though not as bad as AePW-2)
- We need more experimental data: more flutter data points, and more on-and off-body flow data at each flutter point

Past Experimental Data

EXPERIMENTAL UNSTEADY PRESSURES AT FLUTTER ON THE SUPERCRITICAL WING BENCHMARK MODEL

AIAA-93-1592-CP

Bryan E. Dansberry, Michael H. Durham*, Robert M. Bennett**, José A. Rivera*, Walter A. Silva*, and Carol D. Wieseman*; Structural Dynamics Division, NASA Langley Research Center, Hampton, VA 23681-0001
and David L. Turnock*
Lockheed Engineering and Sciences Corporation

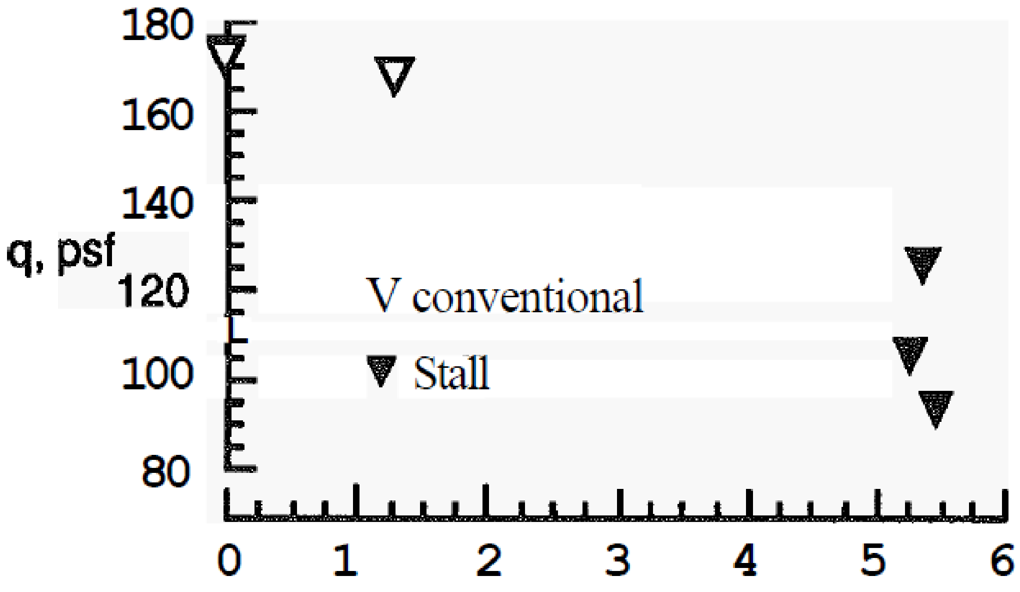


Figure 9. Stall flutter boundary in R-12 at M = 0.80.

Past Experimental Data

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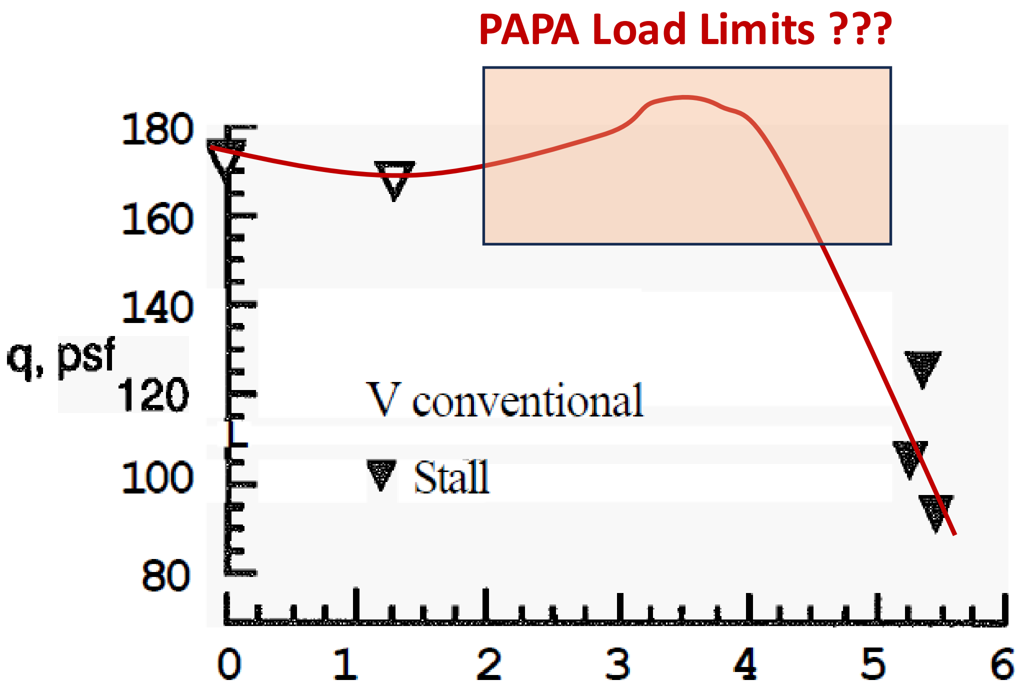


Figure 9. Stall flutter boundary in R-12 at M = 0.80.

Experiment: Spring 2026

- Unsteady Pressure Sensitive Paint
- Two rows of pressure sensors + several on splitter plate
- PIV
- Flutter and buffet data at Mach, Q, AoA range

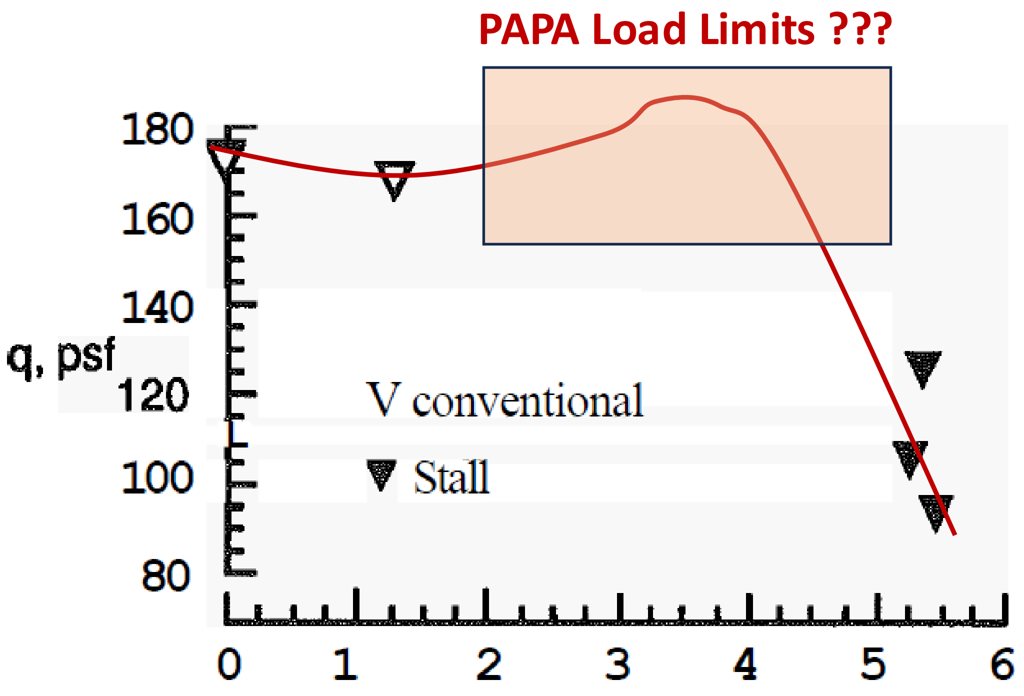
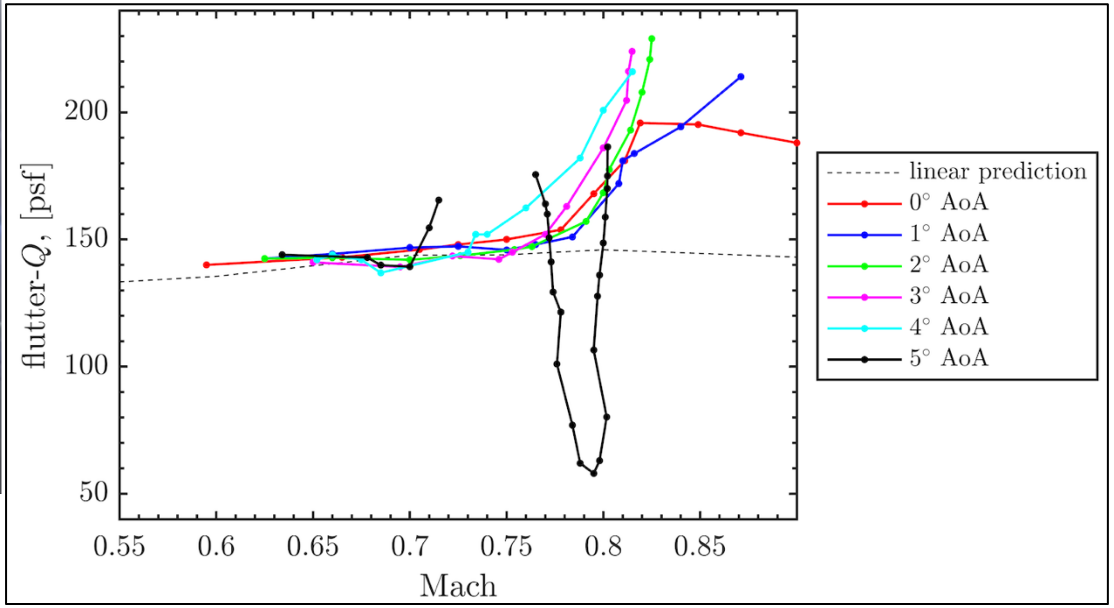


Figure 9. Stall flutter boundary in R-12 at M = 0.80.

Experiment: Spring 2026, Phase 1



BSCW Model as installed in the TDT in 2026 test, Credit: NASA.

AePW-4 High-Angle WG Cases

- Case 1
  - Flutter prediction at Mach 0.80 and angle-of-attack sweep: 0° – 6°
- Case 2
  - Flutter prediction at Mach 0.74, 0.76, 0.78 and angle-of-attack 3°

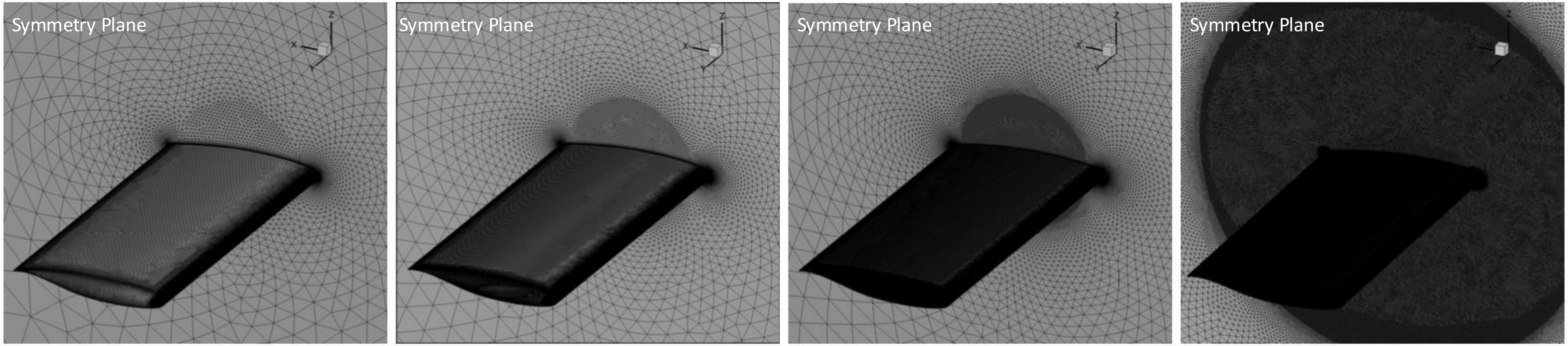
BUT, In February 2025, we introduced a 2D Case

- Case 3
  - 2D BSCW flutter prediction at Mach 0.80 and angle-of-attack sweep: 0° – 6°

CAD, Grids, Computational domain, Flow conditions,….

- On AePW-2 website: https://nescacademy.nasa.gov/workshops/AePW2/public/ under Analysts Information you can download BSCW iges file. Gridding guidelines adopted from the DPW are also listed.
- Note that the iges file consists of BSCW wing mounted on a splitter plate. But…
- For AePW-1, AePW-2, and AePW-3, we assumed wing-only that is attached to a plane of symmetry.
- Several grids are also available for download.
- BSCW structural model is described, and NASTRAN files are available.

CAD, Grids, Computational domain, Flow conditions,….

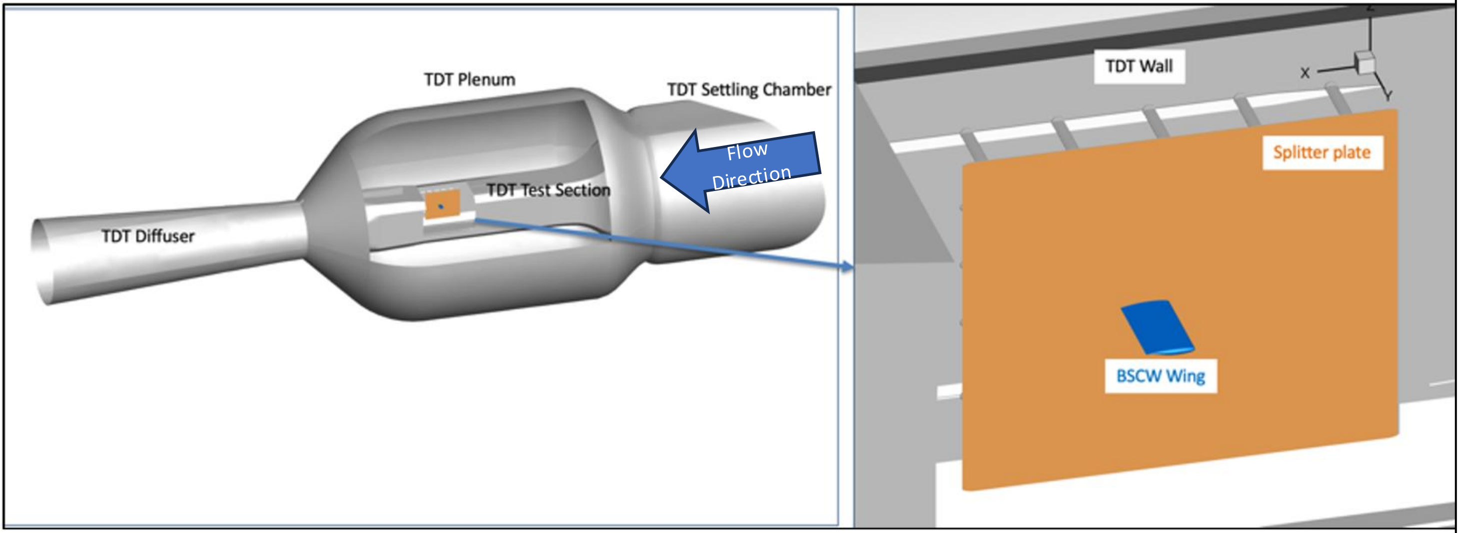


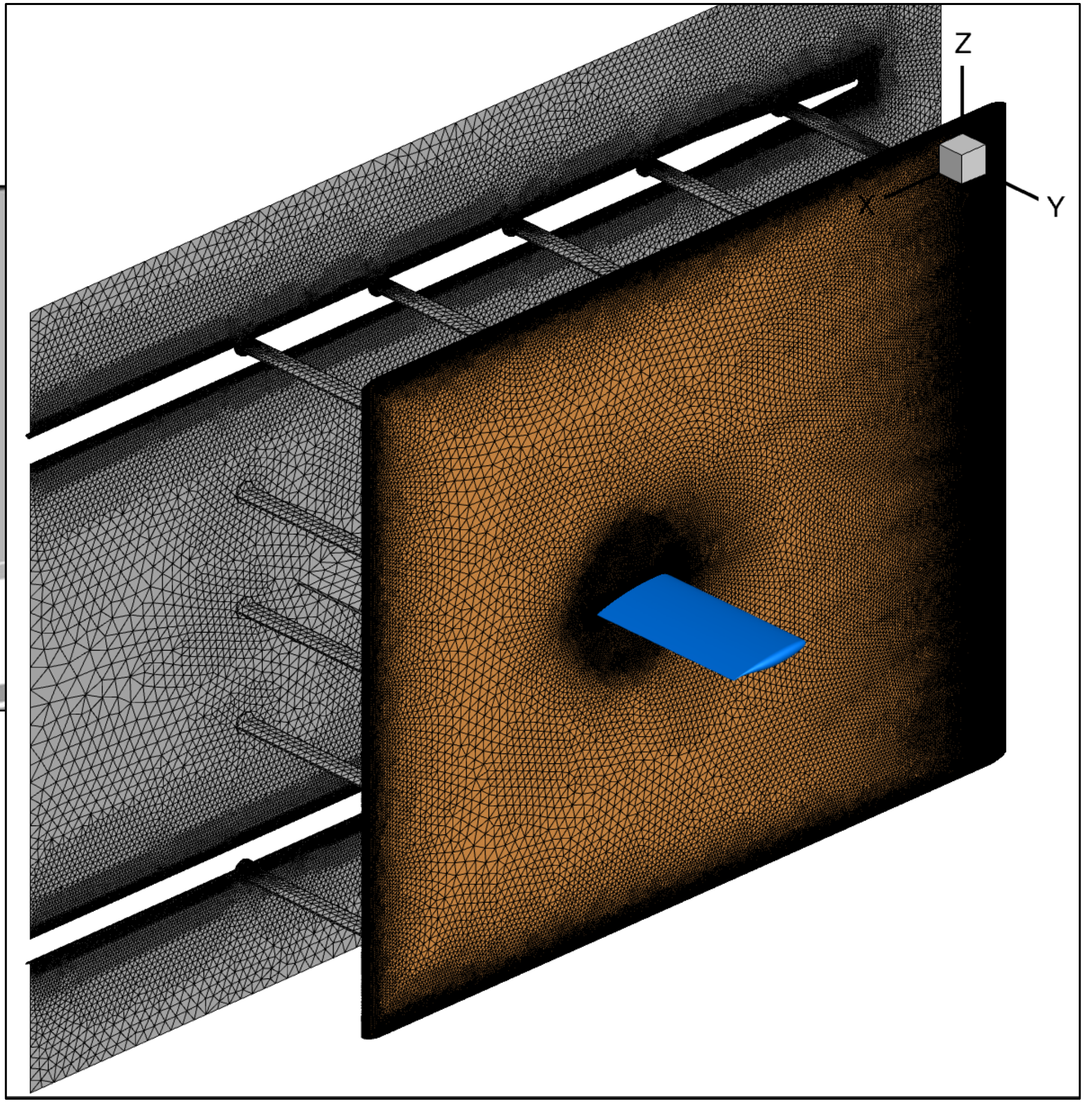
(a) Coarse grid, 3M nodes. (b) Medium grid, 9M nodes. (c) Fine grid, 27M nodes. (d) Xfine grid, 99M nodes.

Node centered…. ‘nc’
Cell centered…. ‘cc’

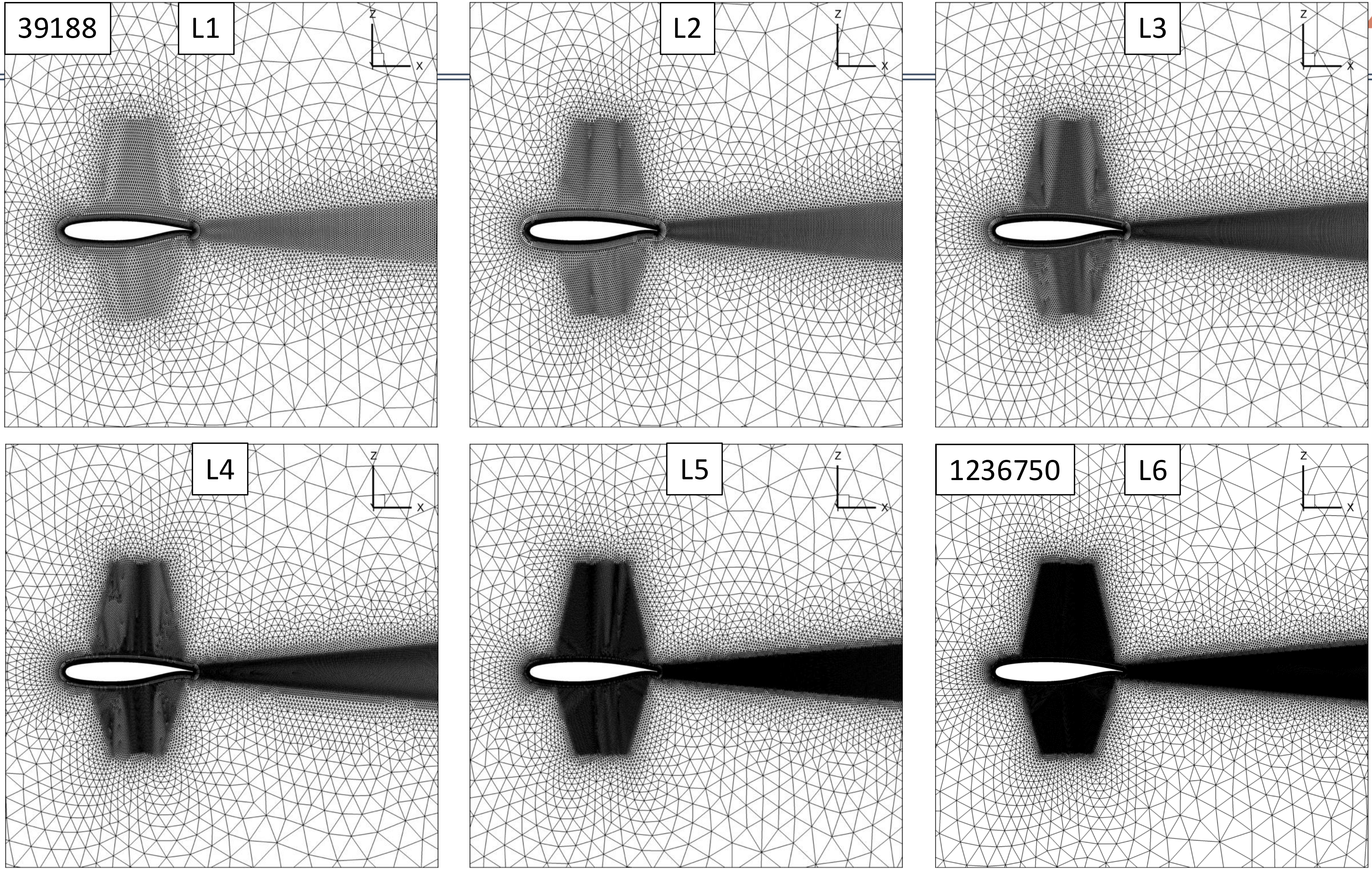
Computational Domain: Wing-only vs. BSCW-in-tunnel

BSCW-in-tunnel



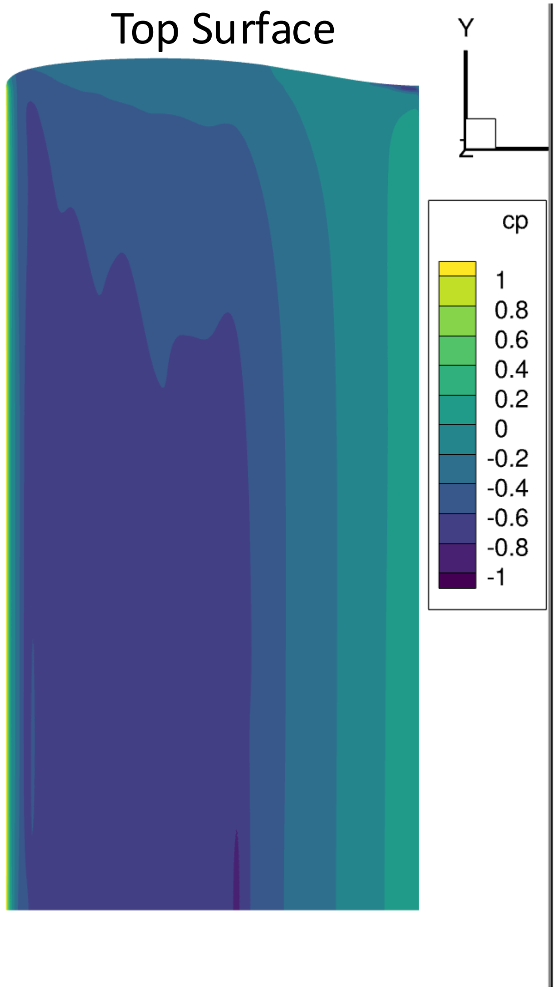


2D Mesh: 32-inch span wing with two symmetry planes

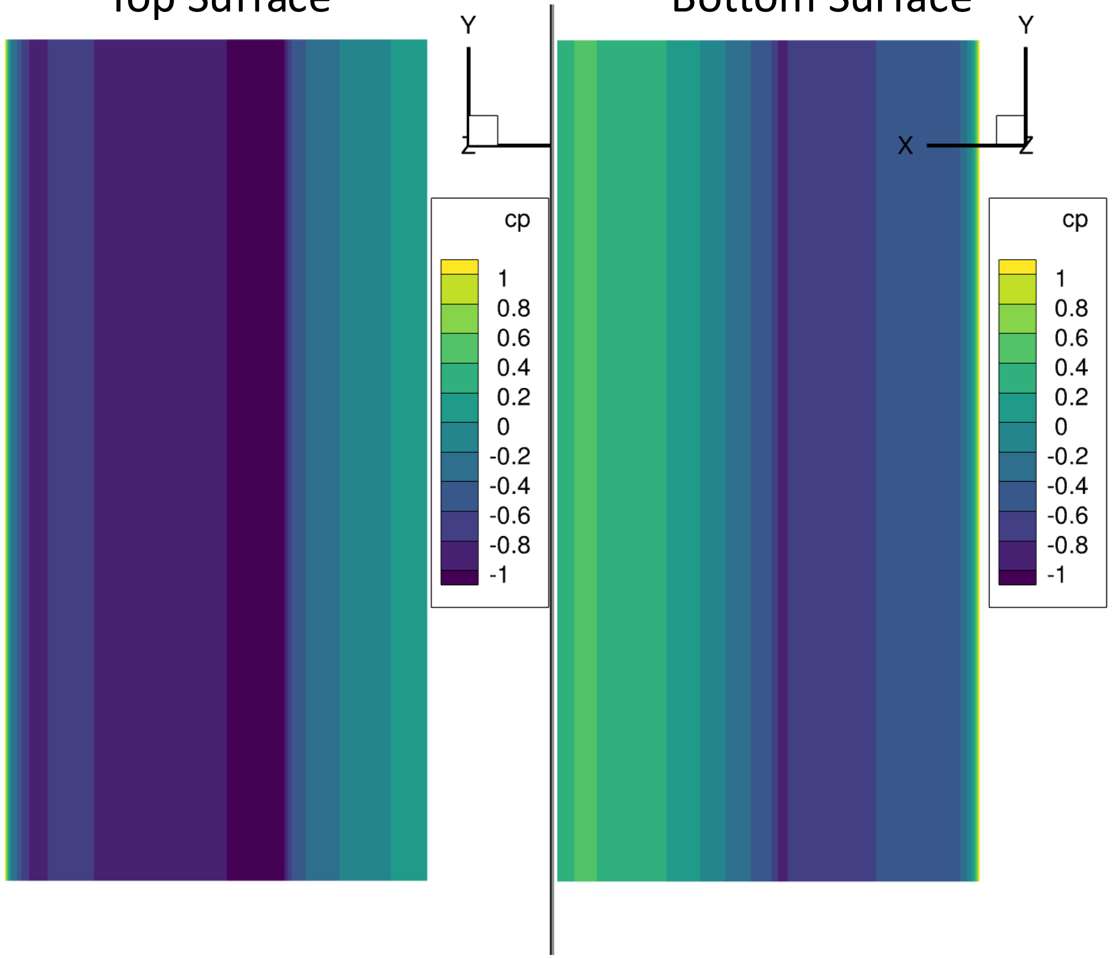


BSCW 2D vs 3D Aeroelastic Analysis, Mach 0.80 AoA = 0deg, q = 169 psf

3D Wing



2D Wing



Same structural model for 3D and 2D. Same inertia and stiffness values.

CAD, Grids, Computational domain, Flow conditions,….

AePW-3 Summary Paper, https://doi.org/10.2514/6.2024-0418

Table 2 BSCW flow conditions: Mach 0.8 with range of dynamic pressure (q); chord Reynolds number (Re_c); Reynolds number per foot (Re); velocity (V); speed of sound (a); static temperature, (T_{static}); density (ρ); ratio of specific heat (γ); viscosity (μ); Prandtl number (Pr); total pressure (H); and static pressure (P).

Mach	0.799	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.801	0.801
q [psf]	10.02	25.00	35.00	50.00	75.00	100.00	134.00	143.00	152.00	168.80	200.00	225.00	250.00
Re_c	237461	592224	829213	1184801	1777732	2371336	3178880	3392751	3606668	4006103	4748658	5343835	5939368
Re [1/ft]	178096	444168	621910	888601	1333299	1778502	2384160	2544563	2705001	3004577	3561493	4007876	4454526
V [ft/s]	440.45	440.63	440.59	440.51	440.39	440.21	440.05	440.00	439.96	439.88	439.70	439.58	439.46
a [ft/s]	551.08	550.94	550.85	550.71	550.48	550.25	549.94	549.86	549.78	549.62	549.34	549.11	548.88
T_{static} [$^\circ F$]	80.87	80.83	80.83	80.82	80.81	80.80	80.78	80.77	80.77	80.76	80.74	80.73	80.71
ρ [slug/ft^3]	0.000103	0.000258	0.000361	0.000515	0.000774	0.001032	0.001384	0.001477	0.001571	0.001745	0.002069	0.002329	0.002589
γ	1.1121	1.1122	1.1123	1.1124	1.1126	1.1128	1.1131	1.1131	1.1132	1.1133	1.1136	1.1138	1.1139
μ [lb-sec/ft^2]	2.555e-07	2.555e-07	2.555e-07	2.555e-07	2.555e-07	2.555e-07	2.554e-07	2.554e-07	2.554e-07	2.554e-07	2.554e-07	2.554e-07	2.554e-07
Pr	0.68394	0.68404	0.68410	0.68419	0.68435	0.68450	0.68471	0.68477	0.68483	0.68493	0.68513	0.68528	0.68544
H [psf]	40.00	99.72	139.61	199.45	299.18	399.00	534.69	570.61	606.53	673.59	798.21	898.01	997.83
P [psf]	28.21	70.32	98.45	140.64	210.97	281.37	377.05	402.38	427.71	475.00	562.87	633.25	703.64

CAD, Grids, Computational domain, Flow conditions,….

Mach 0.74

Mach	0.74	0.74	0.74	0.74	0.74	0.74	0.74	0.74
q [psf]	50.00	75.00	100.00	134.00	143.00	152.00	168.80	200.00
Re_c	1275964	1914959	2554246	3423935	3654400	3884927	4315413	5115471
Re [1/ft]	956973	1436219	1915684	2567951	2740800	2913695	3236560	3836603
V [ft/s]	407.58	407.37	407.23	407.09	407.04	406.99	406.89	406.71
a [ft/s]	550.82	550.56	550.30	549.93	549.84	549.74	549.56	549.23
T_{static} [$^\circ F$]	83.60	83.59	83.58	83.55	83.55	83.54	83.54	83.52
ρ [slug/ft^3]	0.000602	0.000904	0.001206	0.001617	0.001726	0.001836	0.002039	0.002418
γ	1.1116	1.1119	1.1121	1.1124	1.1125	1.1125	1.1127	1.1130
μ [lb-sec/ft^2]	2.564E-07	2.564E-07	2.564E-07	2.564E-07	2.564E-07	2.564E-07	2.564E-07	2.563E-07
Pr	0.68325	0.68343	0.68360	0.68385	0.68391	0.68398	0.68410	0.68432
H [psf]	221.92	332.99	444.03	594.95	634.93	674.92	749.56	888.22
P [psf]	164.50	246.83	329.14	441.01	470.65	500.29	555.62	658.40

CAD, Grids, Computational domain, Flow conditions,….

Mach 0.76

Mach	0.76	0.76	0.76	0.76	0.76	0.76	0.76	0.76
q [psf]	50.00	75.00	100.00	134.00	143.00	152.00	168.80	200.00
Re_C	1245425	1868520	2492233	3341185	3566044	3790959	4210646	4991103
Re [1/ft]	934069	1401390	1869175	2505889	2674533	2843219	3157984	3743327
V [ft/s]	418.22	418.15	418.01	417.82	417.78	417.73	417.67	417.50
a [ft/s]	550.43	550.18	549.93	549.58	549.49	549.40	549.23	548.92
T_{static} [$^\circ F$]	82.72	82.70	82.69	82.67	82.67	82.66	82.65	82.63
ρ [slug/ft^3]	0.000572	0.000858	0.001145	0.001535	0.001639	0.001742	0.001936	0.002295
γ	1.1118	1.1120	1.1122	1.1125	1.1125	1.1126	1.1128	1.1130
μ [lb-sec/ft^2]	2.560E-07	2.560E-07	2.560E-07	2.560E-07	2.560E-07	2.560E-07	2.560E-07	2.559E-07
Pr	0.68360	0.68377	0.68394	0.68417	0.68423	0.68430	0.68441	0.68463
H [psf]	213.86	320.74	427.68	573.16	611.67	650.19	722.01	855.54
P [psf]	155.96	233.91	311.91	418.00	446.09	474.18	526.56	623.94

CAD, Grids, Computational domain, Flow conditions,….

Mach 0.78

Mach	0.78	0.78	0.78	0.78	0.78	0.78	0.78	0.78
q [psf]	50.00	75.00	100.00	134.00	143.00	152.00	168.80	200.00
Re_C	1216355	1824869	2433950	3262935	3482495	3702106	4112185	4874236
Re [1/ft]	912266	1368652	1825462	2447201	2611871	2776579	3084139	3655677
V [ft/s]	428.90	428.83	428.70	428.53	428.48	428.43	428.35	428.19
a [ft/s]	550.03	549.79	549.55	549.22	549.13	549.05	548.88	548.58
T_{static} [$^\circ F$]	81.82	81.80	81.79	81.77	81.76	81.76	81.75	81.73
ρ [slug/ft^3]	0.000544	0.000816	0.001088	0.001460	0.001558	0.001656	0.001840	0.002182
γ	1.1119	1.1121	1.1123	1.1125	1.1126	1.1127	1.1128	1.1131
μ [lb-sec/ft^2]	2.556E-07	2.556E-07	2.556E-07	2.556E-07	2.556E-07	2.556E-07	2.555E-07	2.555E-07
Pr	0.68396	0.68413	0.68429	0.68451	0.68457	0.68463	0.68474	0.68495
H [psf]	206.41	309.56	412.78	553.16	590.33	627.50	696.88	825.74
P [psf]	148.06	222.05	296.08	396.78	423.44	450.10	499.87	592.30

AePW

Aeroelastic
Prediction
Workshop

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