C-17 Globemaster III

Image from www.fas.org

Andrew Smithey
Ryan Wagner
Brady White

C-17 Mission

- Strategic airlift for U.S. Air Force
- Deployment of troops or cargo to operating bases or forward deployment areas
- Capable of performing theater airlift missions

Image from www.fas.org

Basic Geometry

- Length: 173.92 ft
- Diameter: 33.67 ft
- Wingspan: 170.75 ft
- Wing Area: 3800 ft^2
- Wing Sweep: 25°
- Wing Anhedral: 3°
- H.T. span: 65 ft
- H.T. Area: 845 ft^2
- H.T. Sweep: 27°
- H.T. Anhedral: 3°
- V.T. Area: 685 ft^2
- V.T. Sweep: 41 °

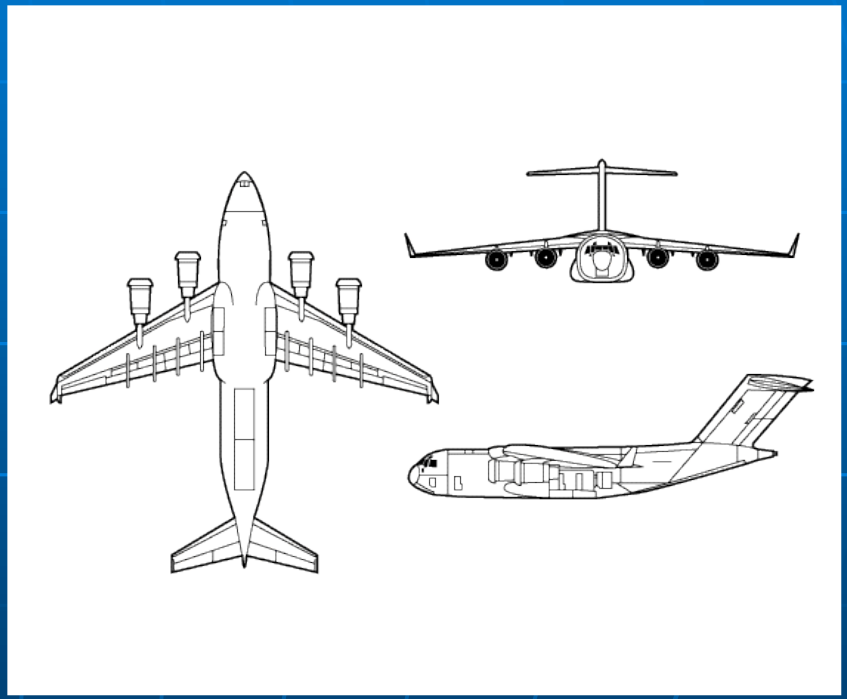


Image from www.fas.org

Winglet Geometry

Image from www.fas.org

- Height: 8.92 ft
- Sweep: 30° (aft)
- Vertical Angle: 15°

Cruise Conditions

- Weight: 585,000 lb (max peace-time)
- Mach Number: 0.76
  (450 kts at 29,000 ft)
- Range: 4,741 nm (without mid-air refueling)
- C_L: 0.578
  - $C_{L\alpha}$: 0.11458 /°
  - α: 5.0446°
- Neutral point located 73.0 ft from nose (65% of m.a.c.)
- 10% static longitudinal stability

Induced Drag at Cruise

- Cruise C_L: 0.578
- C_{Di}: 0.0111
- Aspect Ratio: 7.673
- e: 1.01
- Winglets give Oswald efficiency factor greater than 1.0

Drag at Cruise

For cruise condition:

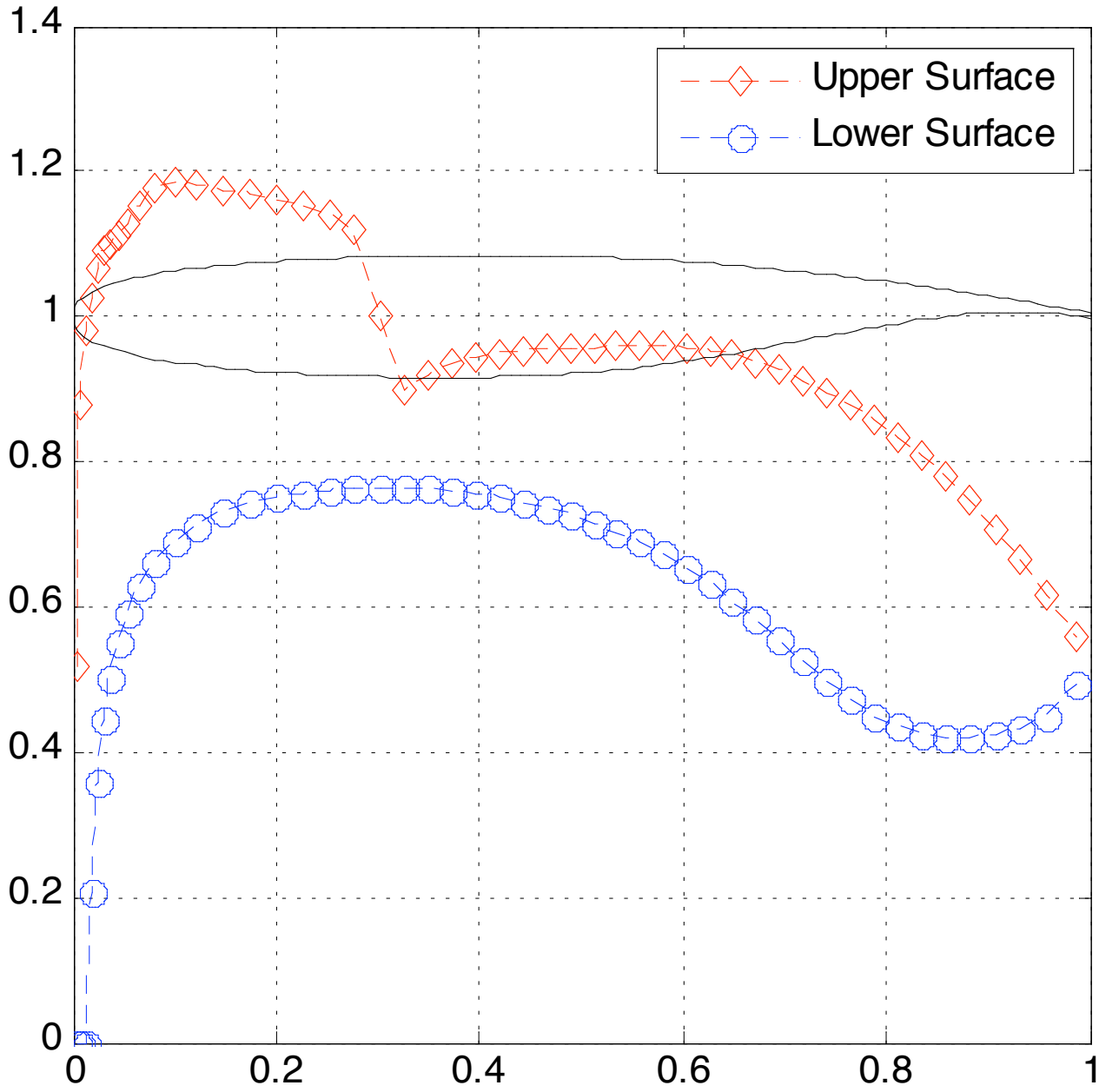
- Friction Drag: C_{Df}=0.00510
- Form Drag: C_{Dform}=0.00109
- Wave Drag: C_{Dwave}=0.00169

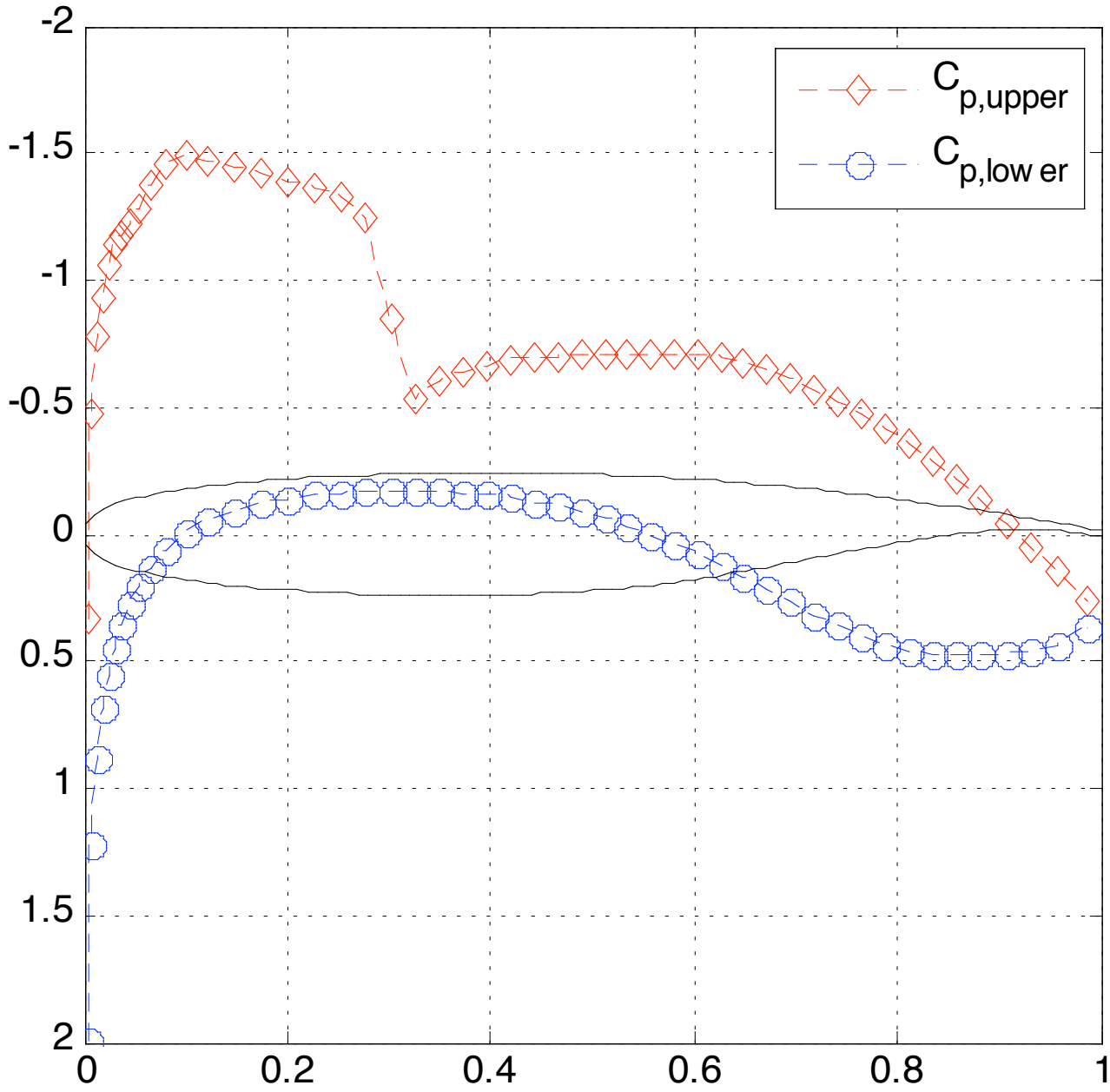
Wave Drag at Cruise

- "Best Guess" airfoil given limited data
  - NASA Supercritical SC(2)-0412
    - Design C_l = 0.4
    - 12% thick

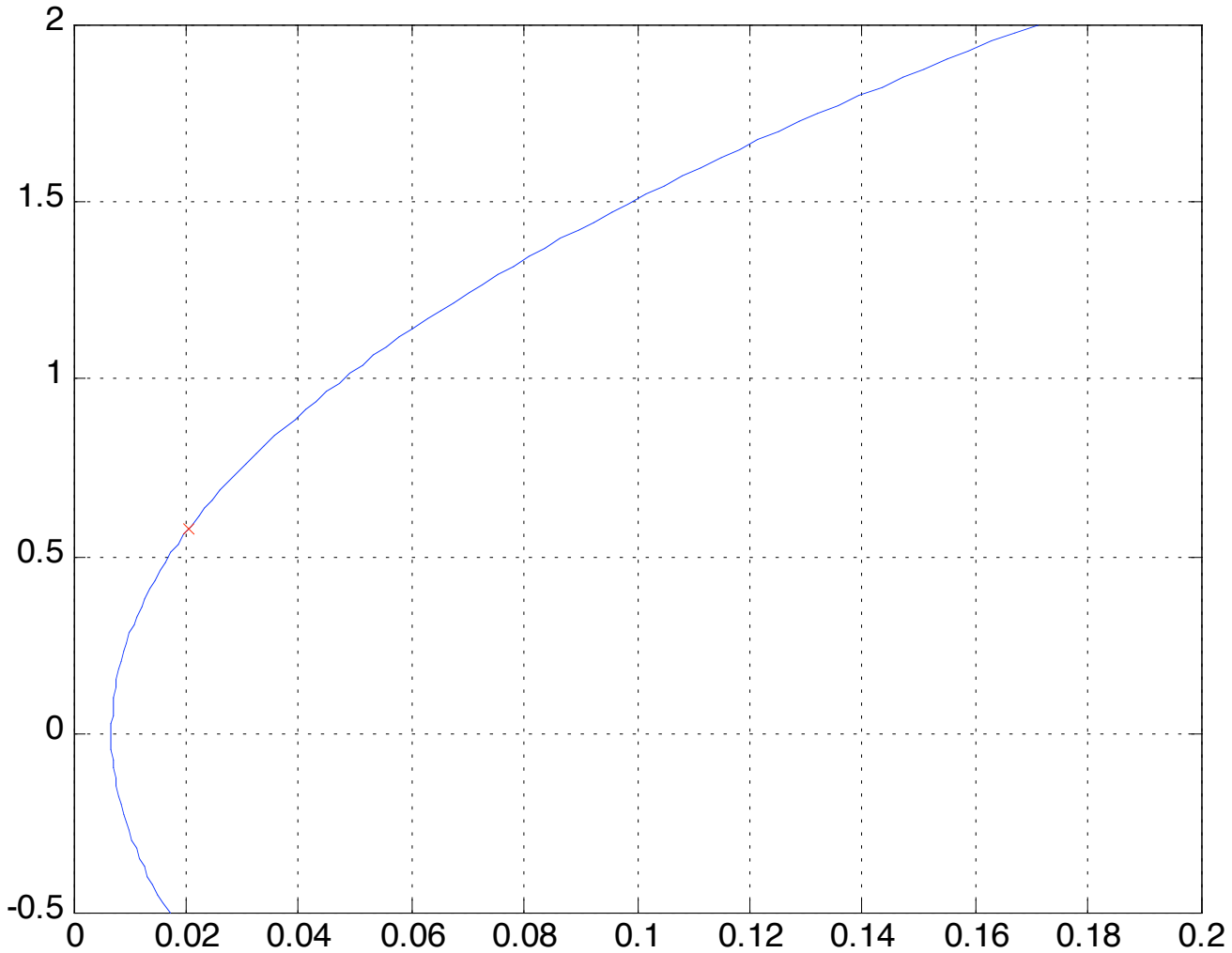
Image from NASA Technical Paper 2969

TSFOIL Results:
2D C_l = 0.872
C_p = -0.841


Upper Surface
Lower Surface
1.4
1.2
1
0.8
0.6
0.4
0.2
0
0
0.2
0.4
0.6
0.8
1


-2
-1.5
-1
-0.5
0
0.5
1
1.5
2
0
0.2
0.4
0.6
0.8
1
$C_{p,upper}$
$C_{p,lower}$

Drag Polars



Takeoff/Landing

Note: Lift coefficients determined from gross maximum takeoff weight.

Image from www.fas.org

- Takeoff (at sea level)
  - Mach Number: 0.18
  - C_L: 3.156
- Landing (at sea level)
  - Mach Number: 0.13
  - C_L: 5.014
- The C-17 was designed for STOL capabilities and can takeoff and land in distances as short as 3,500 ft.
- A sophisticated high-lift system is needed for both takeoff and landing.

High-lift System

Image from www.fas.org

- Externally-blown flaps for superior STOL performance
- $C_{Lmax} \approx 7.2$
- T-tail configuration used to avoid large downwash from high-lift system
- Vertical tail and rudder sized for engine out conditions

F117-PW-100 Turbofan Engine

- Manufactured by Pratt & Whitney
- Military variant of PW2000 used on Boeing 757
- C-17 uses 4 of these engines certified at 40,400 lb of thrust apiece
- Capable of thrust reversal

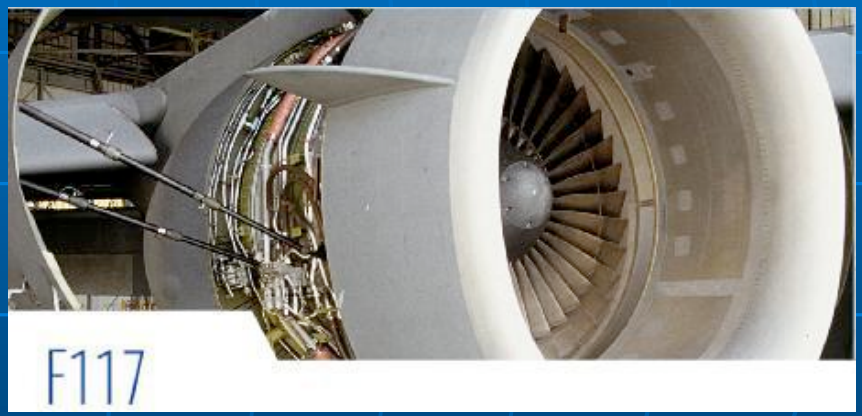


Image from www.pw.utc.com

References

- Federation of American Scientists
  - www.fas.org
- Jane's 2003 Edition, Jane's Information Group
- NASA Langley Research Center
  - http://oea.larc.nasa.gov/PAIS/Partners/C_17.html
- NASA Technical Paper 2969: NASA Supercritical Airfoils, 1990.
- Nicolai, Fundamentals of Aircraft Design, 1976
- Pratt & Whitney
  - www.pw.utc.com