(KEY CONCEPT) [D-2-1]

Higher sweep

Lower sweep
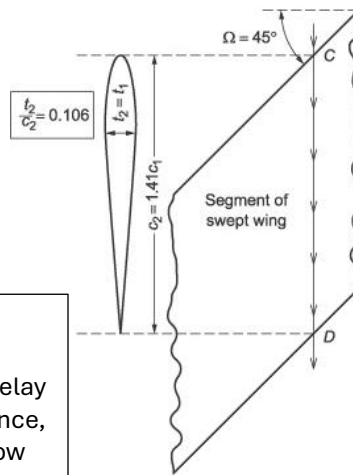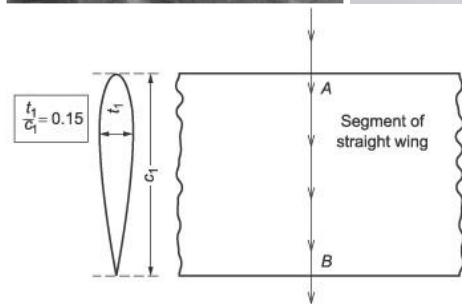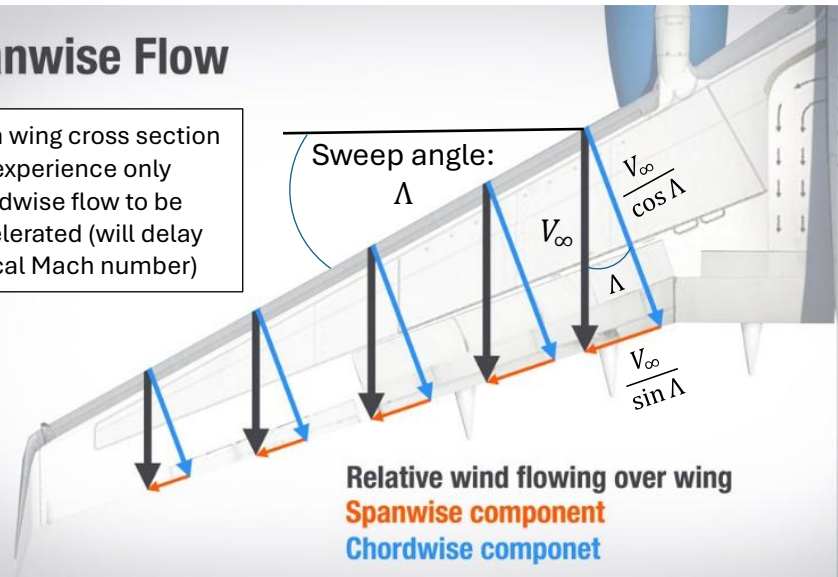
Spanwise Flow

Each wing cross section will experience only chordwise flow to be accelerated (will delay critical Mach number)

Sweep angle: Λ

V_∞

$\frac{V_\infty}{\cos \Lambda}$

Λ

$\frac{V_\infty}{\sin \Lambda}$

Relative wind flowing over wing
Spanwise component
Chordwise componet

$\frac{t_1}{c_1} = 0.15$ t_1 c_1

A

Segment of straight wing

B

$\Omega = 45°$ C

$\frac{t_2}{c_2} = 0.106$ $t_2 = t_1$ $c_2 = 1.41 c_1$

Segment of swept wing

D

Incoming flow over a swept wing will experience a "modified" airfoil: an "elongated" much "thinner" shape (will delay critical Mach number, delay drag divergence, and minimize wave drag at supersonic flow

Minimum drag coefficient of wing: $C_{D,min}$

Thickness to chord ratio: t/c

0.02

0.01

9

6

4

0.02

Sweep angle (deg): Λ

0.01

11

35

47

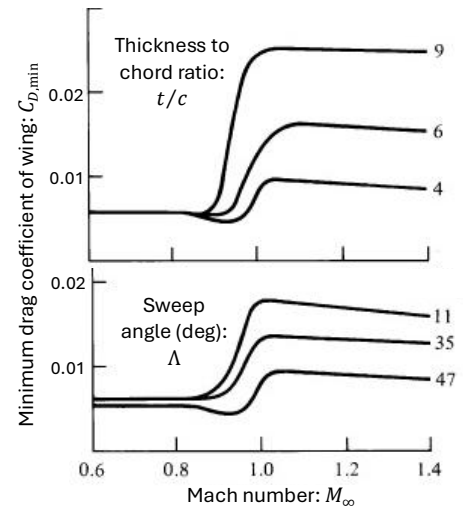0.6   0.8   1.0   1.2   1.4

Mach number: M_∞

Image of F-111 (source: U.S. Air Force)   Spanwise flow sketch (source: boldmethod.com)
Wing and airfoil sketch (source: J.D. Anderson "Fundamentals of Aerodynamics" 2016)