12.6.2 Leading-Edge-Suction Method

This method requires knowledge of the difference between the operating C_L and the design C_L (Raymer Fig 12.38). From this figure the leading edge suction factor, S, can be used in Eq. (12.57) to calculate the value of K, which will have a value somewhere between K_0 and K_{100}. Note that Figure 12.37 is an example for a wing with an aspect ratio A = 3.54. $K_0 = 1/C_{L_\alpha}$, and the value of C_{L_α} can be found from Fig. 12.7. $K_{100} = 1/\pi A$.

A somewhat simpler, although probably less accurate, approach is to use a similar figure from Ref. 12.6.2.1. This is shown here as Fig. 12.6.2.1. This figure is for delta wing-body combinations, with a leading edge radius of 0.045% .

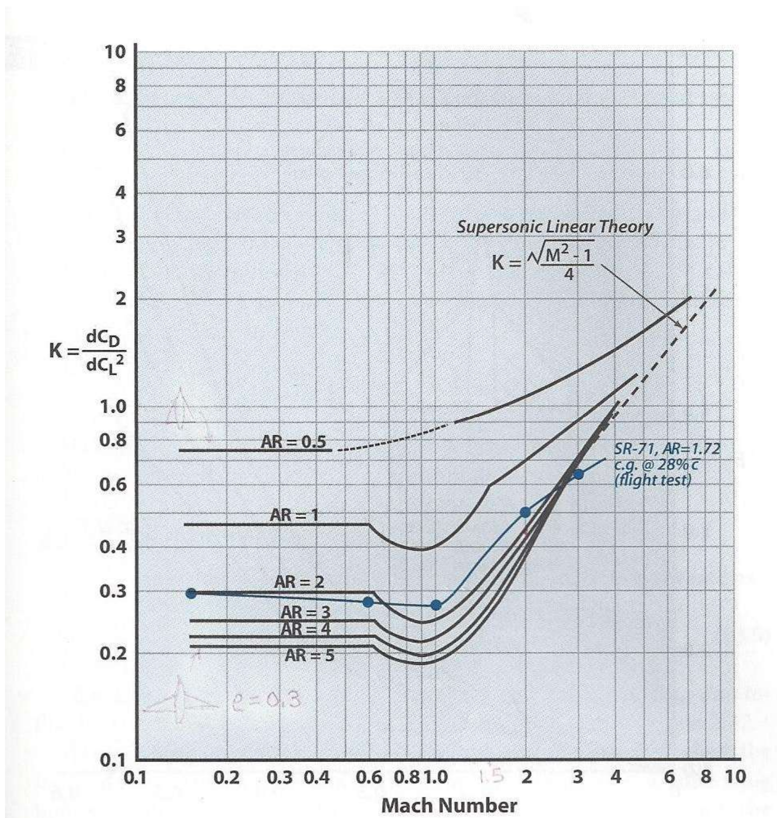

Fig. 12.6.2.1 *K* vs. Mach for Delta Wing-Body

This figure may be used for first-order analysis of a supersonic configuration.

Above a Mach number of about 3, the value of *K* for wings of aspect ratio of 2 or greater reduces to that predicted by supersonic linear theory or

$$K = \frac{\sqrt{M^2 - 1}}{4} \qquad (12.6.2.1)$$

The reduction to two dimensional flow is illustrated in Fig. 12.6.2.2. The Mach cone angle is given by arcsin (1/M), so for a freestream Mach number of M = 1.414 the Mach cone angle is 45^0. The influence of the wing tips exists on one half of the planform. At Mach 3 the cone angle is 19.47^0 and only 17.5% of the planform experiences any influence of the wing tips.

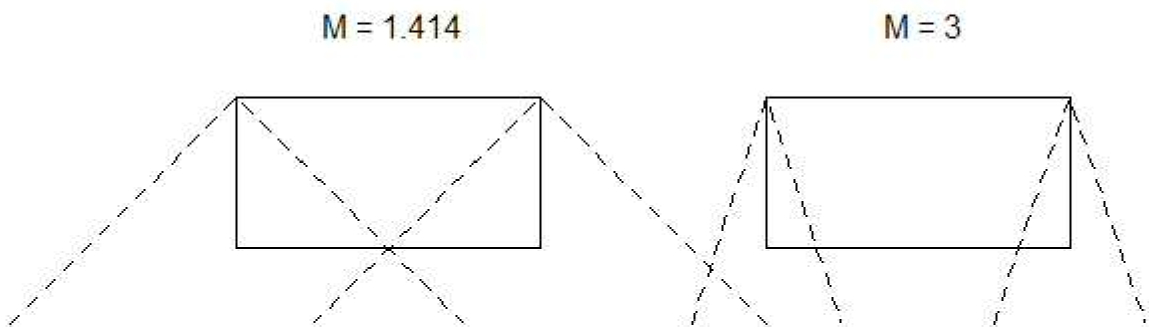

Fig 12.6.2.2 Cones of Influence for Aspect Ratio 2 Wing

References

12.6.2.1 Nicolai, L., and Carichner, G., "Fundamentals of Aircraft and Airship Design, Volume I", AIAA, 2010.