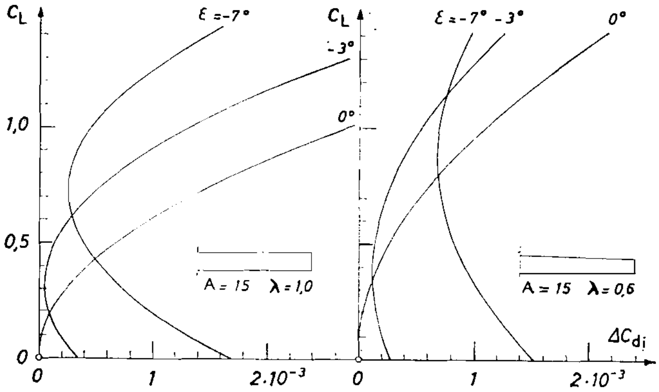
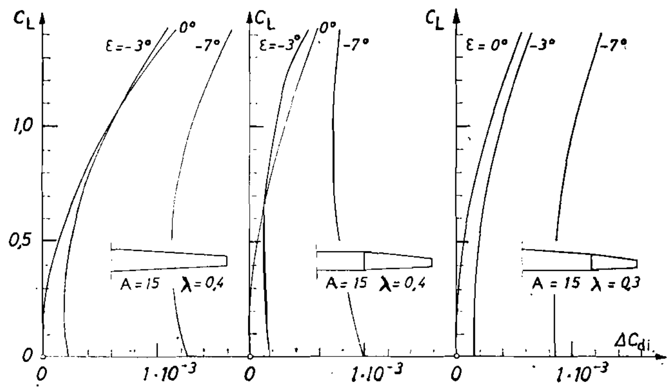


Figures 3 and 4



Figures 5, 6 and 7

Figure 3 shows the extra induced drag ΔC_{di}, i.e., (C_{di} — C_{di}, ell.) against the lift coefficient C_L for a rectangular wing of aspect ratio 15 with 3 different amounts of twist. The twist sequence, in this and all following examples is shown in such a way that the leading and trailing edges of the wings are straight lines.

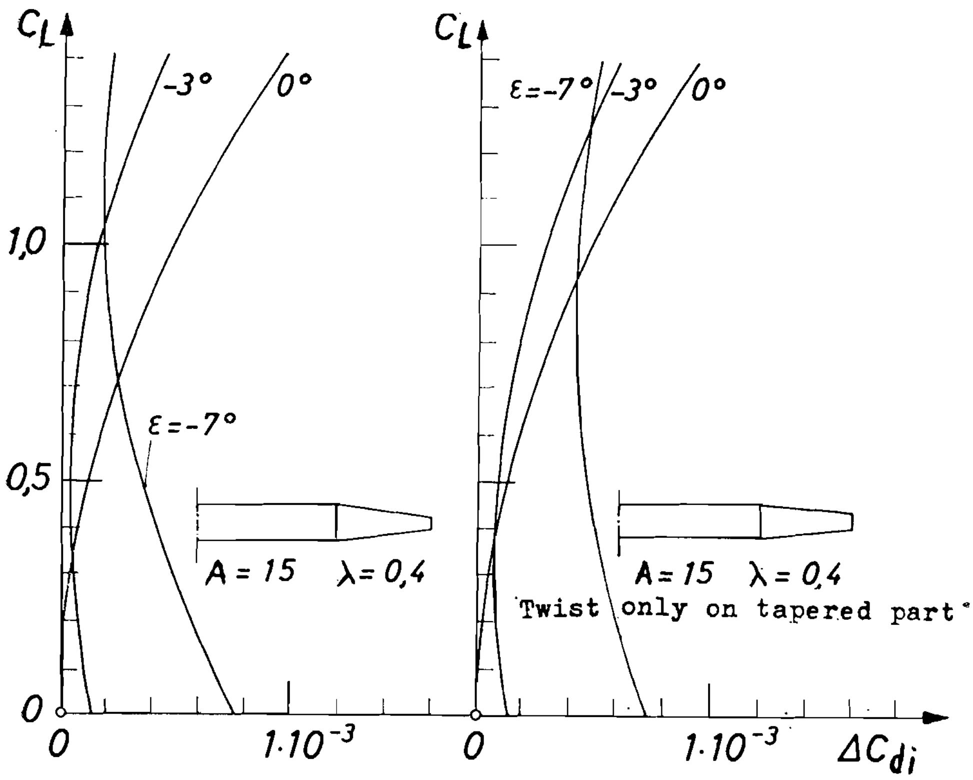
One observes at once that the untwisted rectangular wing is especially unsuitable. A twist of $\varepsilon = -3°$ would be favorable for the high-speed range of C_L 0.2-0.3 but already at C_L=1.17 would give an extra drag of $\Delta C_d = 2 \times 10^{-3}$. [Negative values of ε represent wash out.—Ed.]

The larger twist of $\varepsilon = -7°$ must be rejected as it produces, at high speed, a $\Delta C_{di} = 1 \times 10^{-3}$, which increases the sinking speed in Figure 1 at 160 km/h by about 23 cm/s or reduces the effective aspect ratio of 17 to about 7. A really practical compromise is therefore hardly to be found with a rectangular planform.

Figures 4 and 5 show the extra induced drag for simple tapered wings with the same angles of twist.

With increasing taper ratio λ, i.e., $\left(\frac{\text{tip chord}}{\text{root chord}}\right)$ the ΔC_{di} curves become correspondingly flatter, though their minimal values become increasingly large. Comparison of these curves with each other will show that the rectangular wing with $\varepsilon = -3°$ twist, and the tapered wing with λ=0.4 and $\varepsilon = 0°$ twist, obviously give the least extra drag in the high-speed range. On the other hand, above C_L=0.45, the tapered wing with λ=0.6 and $\varepsilon = -3°$ twist will be superior.

Following on this one should still consider whether other planforms could give even better results. Figure 7 shows, as an example, ΔC_{di} for a double-tapered wing and in Figures 6 and 8 a rectangular-tapered wing is shown. Without twist the C_{di} values for double-tapered and rectangular-tapered wings are always substantially lower than for simple-tapered wings. With $\varepsilon = -3°$ twist the double-tapered wing is worse than the rectangular-tapered wing in Figure 6, and in the high-speed range the tapered wing with λ=0.4 and $\varepsilon = -3°$, and the rectangular wing with $\varepsilon = -3°$ will be superior to it.



Figures 8 and 9