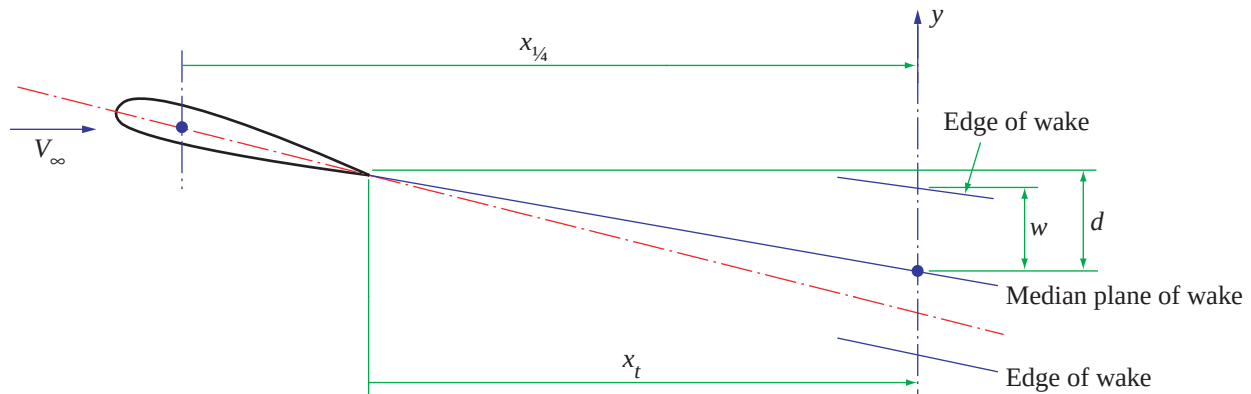


KINETIC PRESSURE IN THE WAKE BEHIND A WING

1. NOTATION AND UNITS

		<i>SI</i>	<i>British</i>
A	aspect ratio, $2s/\bar{c}$		
C_L	wing lift coefficient		
C_{D0}	wing profile drag coefficient		
c_r	wing root chord	m	ft
c_t	wing tip chord	m	ft
$\bar{c}$	standard (or geometric) mean chord	m	ft
d	vertical distance of median plane of vortex sheet below wing trailing-edge, measured normal to direction of free-stream velocity (see Sketch 1.1)	m	ft
q_∞	free-stream kinetic pressure, $\frac{1}{2}\rho V_\infty^2$	N/m ²	lbf/ft ²
q_w	kinetic pressure in the wake	N/m ²	lbf/ft ²
$(q_w)_m$	kinetic pressure at median plane of wake	N/m ²	lbf/ft ²
s	wing semi-span	m	ft
V_∞	free-stream velocity	m/s	ft/s
w	semi-width of wake (see Sketch 1.1)	m	ft
x_t	distance aft of trailing-edge of root chord, measured parallel to direction of free-stream velocity (see Sketch 1.1)	m	ft
$x_{1/4}$	distance aft of quarter-chord point of root chord, measured parallel to direction of free-stream velocity (see Sketch 1.1)	m	ft
y	vertical distance from median plane of wake (see Sketch 1.1)	m	ft
α	angle of attack	degree	degree
λ	ratio of wing tip chord to root chord, c_t/c_r		
ρ	air density	kg/m ³	slug/ft ³



Sketch 1.1

2. NOTES

The normalised values of wake width, $2w/c_r$, and kinetic pressure at the median plane of the wake, $(q_w)_m/q_\infty$, for unswept wings (Derivations 1 to 5) are plotted against x_t/c_r and C_{D0} in Figures 1 and 2. The variation of the kinetic pressure across the wake width is shown in Figure 3. The data refer to conditions near the plane of symmetry on a wing with fully attached flow at low speeds. The data have been calculated from the formulae

$$\frac{2w}{c_r} = 1.1 \left(C_{D0} \frac{x_t}{c_r} \right)^{1/2}, \quad (2.1)$$

$$\frac{(q_w)_m}{q_\infty} = 1 - 2 \left[C_{D0} / \left(\frac{x_t}{c_r} \right)^{1/2} \right] + C_{D0} / \left(\frac{x_t}{c_r} \right), \quad (2.2)$$

$$\frac{q_w - (q_w)_m}{q_\infty - (q_w)_m} = 1 - \left[1 - \left(\frac{y}{w} \right)^{1.75} \right]^2. \quad (2.3)$$

The position of the median plane of the wake for unswept wings may be obtained from Figures 4a to 4c which give the parameter d/sC_L , plotted against $x_{1/4}/s$ for a number of values of λ at $A = 6, 9$ and 12 . These Figures are based on data given in Derivations 3 and 4 and give the position of the median plane of the wake averaged over the inner 30 per cent of the wing span to correspond to a typical tailplane span. The data apply to lift coefficients in the linear range with variation of angle of attack (*i.e.* for fully attached flow) at low speeds. They apply to the vortex sheet behind a wing alone. Over the width of a body the vortex sheet is considerably distorted; the value of d in this region is generally much reduced and may even be of opposite sign, see Derivation 4 and Reference 6.

For interpolation between aspect ratios in Figure 4 it is recommended that a cross-plot in terms of $1/A$ be drawn, bearing in mind that d/sC_L is asymptotic to zero as $A \rightarrow \infty$ *i.e.* $1/A \rightarrow 0$.