

ESDU Flaps 08.01.01

PITCHING MOMENT COEFFICIENT INCREMENT DUE TO FLAPS FOR UNSWEPT WINGS

See Item No. 97002 for an introduction to Items on high-lift devices. This Item has been superseded by Item Nos 98009,98017,99004 and 99014. It has been retained in the Series because it is cross-referenced in other Items and because it allows treatment of a split flap with forward translation (see Sketch 1.1).

1. NOTATION AND UNITS

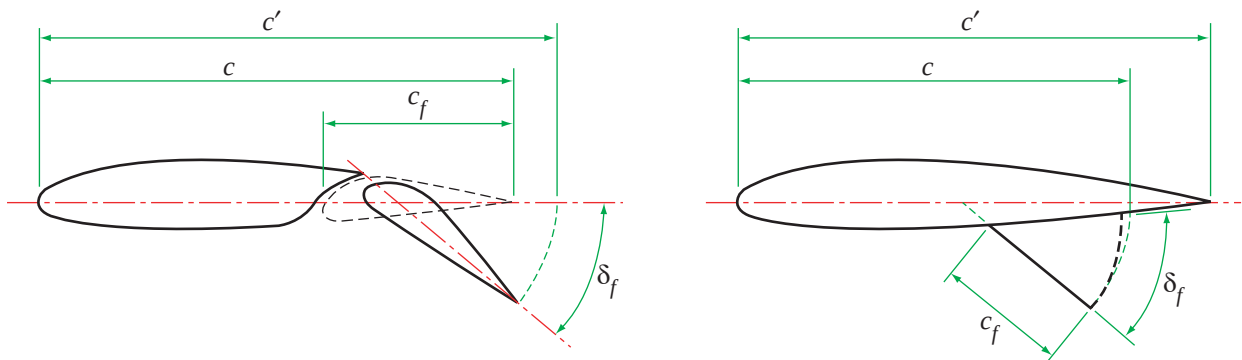
		SI	British
A	aspect ratio, $b/\bar{c}$		
b	wing span	m	ft
b_f	flap span	m	ft
C_{LN}	lift coefficient of wing with flap retracted, at required incidence		
C_{mN}	pitching moment coefficient of wing with flap retracted, at required incidence		
c	local wing chord (see Sketch 1.1)	m	ft
c_f	flap chord (see Sketch 1.1)	m	ft
c'	local extended or reduced chord (see Sketch 1.1)	m	ft
$\bar{c}$	standard mean chord of wing with flap retracted (wing area/span)	m	ft
$\bar{c}'$	standard mean chord of wing with full-span flap extended (extended wing area/span)	m	ft
K	conversion factor for part-span flap, $\Delta C_m / \Delta C_{mRF}$		
t	local wing thickness	m	ft
ΔC_{LF}	lift coefficient increment due to full-span flap on wing of aspect ratio 6, based on area of wing with flap retracted (see Item Nos 74009, Aero F.01.01.08 and 09)		
$\Delta C'_{LF}$	lift coefficient increment (measured at 6° incidence above zero-lift angle with flap retracted) due to full-span flap on a wing of aspect ratio 6, based on area of wing with flap extended (see Item No. Aero F.01.01.08)		

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ΔC_m	pitching moment coefficient increment due to part-span flap, based on $\bar{c}$ and area of wing with flap retracted and referred to wing quarter-chord line		
ΔC_{mRF}	pitching moment coefficient increment due to full-span flap on rectangular wing with same t/c as wing under consideration, based on $\bar{c}$ and area of wing with flap retracted and referred to wing quarter-chord line		
$\Delta C'_{mRF}$	pitching moment coefficient increment (measured at 6° incidence above zero-lift angle with flap retracted) due to full-span flap on rectangular wing with same t/c as wing under consideration, based on $\bar{c}'$ and area of wing with flap extended and referred to quarter-chord line of extended wing		
δ_f	flap angle (see Sketch 1.1)	deg	deg
λ	ratio of wing tip chord to wing centre-line chord (taper ratio)		



Sketch 1.1

2. NOTES

In Figure 1 the ratio $\Delta C'_{mRF} / \Delta C'_{LF}$ is plotted against c_f / c' for various values of t/c for the wing. In Figure 2 the part-span conversion factor K is plotted against b_f / b for various values of λ . The data were obtained from Derivation 2.

The pitching moment coefficient increment, like the lift coefficient increment, is practically independent of test conditions over the linear range of the lift-incidence curve, and likewise it is independent of the angle of incidence of the wing for flaps that do not extend the trailing edge of the wing. More generally, this is true of the full-span pitching moment coefficient increment based on the extended chord. Accordingly, all extended chord increments of the coefficients are measured at a constant angle of incidence, i.e. 6° from the zero-lift line with the flap retracted.

According to lifting-line theory the pitching moment coefficient and its increment are also independent of aspect ratio for values greater than four. It should be noted that the pitching moment coefficient increment for full-span flaps is dependent on the wing planform taper ratio, λ .