



ESDU TECHNICAL MEMORANDUM

CONTRIBUTION TO ROLLING MOMENT DERIVATIVE DUE TO SIDESLIP RESULTING FROM INTERFERENCE EFFECT OF FIN ON TAILPLANE, $(L_v)_{TH}$

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CONTRIBUTION TO ROLLING MOMENT DERIVATIVE DUE TO SIDESLIP
RESULTING FROM INTERFERENCE EFFECT OF FIN ON TAILPLANE, $(L_v)_{TH}$

CONTENTS

	Page
1. NOTATION AND UNITS	1
2. INTRODUCTION	4
3. METHOD	5
3.1 Range of Data in Derivations 1, 2 and 3	5
3.2 Prediction of $(L_v)_{TH}$	6
4. ACCURACY AND APPLICABILITY	8
4.1 Accuracy	8
4.2 Applicability	8
5. DERIVATION AND REFERENCES	11
5.1 Derivation	11
5.2 References	11
6. EXAMPLE	12
FIGURES	14

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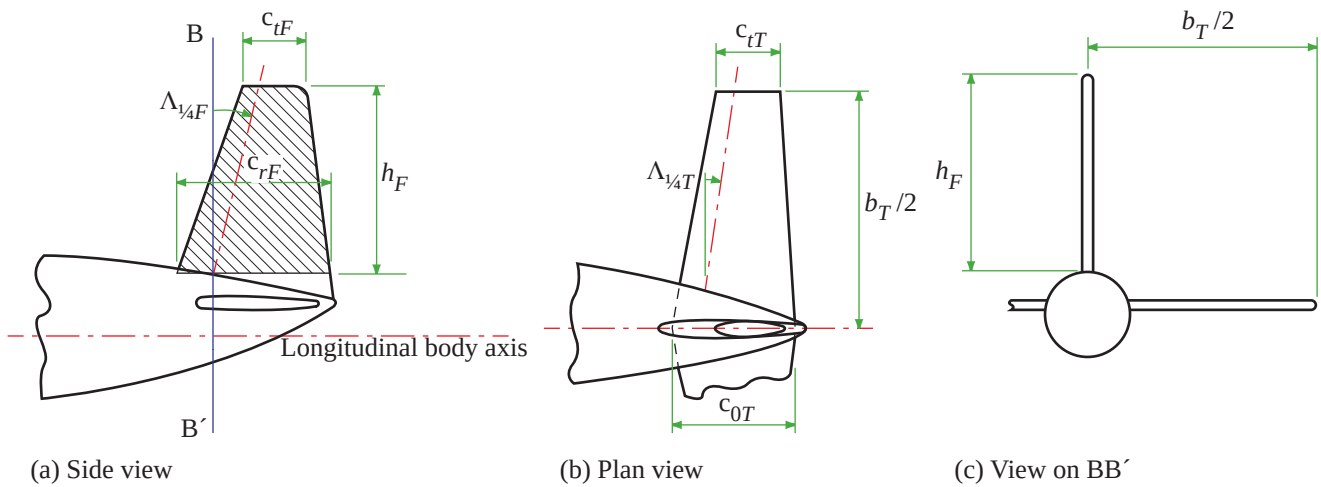
CONTRIBUTION TO ROLLING MOMENT DERIVATIVE DUE TO SIDESLIP RESULTING FROM INTERFERENCE EFFECT OF FIN ON TAILPLANE, $(L_v)_{TH}$

1. NOTATION AND UNITS

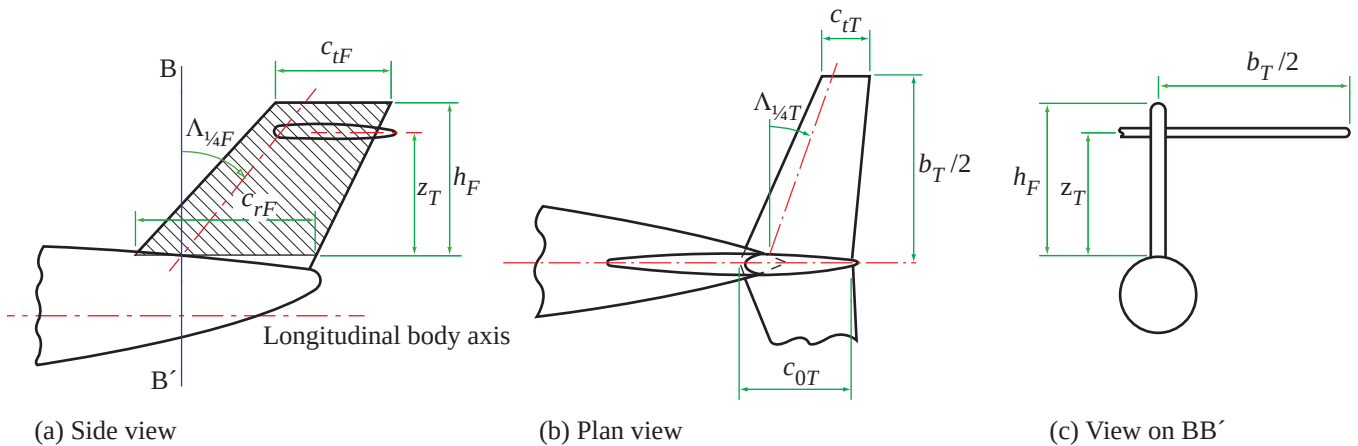
The Notation used here is based on that proposed in ARC R&M 3562 (Hopkin, 1970) in which the coefficients and aero-normalised derivatives are evaluated in aerodynamic-body axes with the origin at the centre of gravity of the aircraft and with the wing span as the characteristic length.

		<i>SI</i>	<i>British</i>
a_{1F}	fin lift-curve slope	rad^{-1}	rad^{-1}
a_{1T}	tailplane lift-curve slope	rad^{-1}	rad^{-1}
b	wing span	m	ft
b_T	tailplane span	m	ft
c_{oT}	tailplane centre-line chord	m	ft
c_{rF}	fin root chord	m	ft
c_{tF}	fin tip chord	m	ft
c_{tT}	tailplane tip chord	m	ft
h_F	height of fin above body, measured from fin root chord in direction normal to longitudinal body axis	m	ft
K_c	factor allowing for ratio of tailplane centre-line chord (assumed equal to local fin chord) to root chord; $K_c = 1$ for body-mounted tailplanes		
K_z	factor allowing for tailplane height; $K_z = 1$ for body-mounted tailplanes		
$\mathcal{L}$	rolling moment	N m	lbf ft
L_v	rolling moment derivative due to sideslip, $L_v = (\partial \mathcal{L} / \partial v) / \frac{1}{2} \rho_e V_e S b = [\partial C_l / \partial \beta]_e$		
$(L_v)_F$	contribution to L_v due to fin in presence of body, wing and tailplane (estimated in ESDU 82010)		
$(L_v)_{TH}$	contribution to L_v from horizontal tailplane as a result of fin-tailplane interference		

$(L_v)_{THo}$	average theoretical value of $(L_v)_{TH}$ for case $c_{oT}/c_{rF} = 1$ with tailplane at foot of fin (no body present) and with fin and tailplane section lift-curve slopes equal to 2π . Based on fin area and fin height as reference dimensions. See Section 3.2		
S_F	fin area (see Sketches 1.1 and 1.2), $(c_{rF} + c_{tF})h_F/2$	m ²	ft ²
S	wing area	m ²	ft ²
V	velocity of aircraft relative to air	m/s	ft/s
v	sideslip velocity	m/s	ft/s
z_T	height of intersection of fin-mounted tailplane with fin, measured from fin root chord in direction normal to longitudinal body axis	m	ft
β	angle of sideslip	radian	radian
$\Lambda_{1/4F}$	fin quarter-chord sweep angle	degree	degree
$\Lambda_{1/4T}$	tailplane quarter-chord sweep angle	degree	degree
λ_F	fin taper ratio, c_{tF}/c_{rF}		
λ_T	tailplane taper ratio, c_{tT}/c_{oT}		
ρ	density of air	kg/m ³	slug/ft ³
<i>Subscript</i>			
e	denotes datum conditions		



Sketch 1.1 Fin and tailplane geometries for body-mounted tailplanes



NOTES

- (i) Area S_F is shown shaded.
- (ii) BB' indicates the fin root quarter-chord station, defined by the plane normal to the longitudinal body axis which passes through the point at which the fin quarter-chord line intersects the body.
- (iii) Fin chords are defined parallel to the longitudinal body axis and fin, tailplane and body heights are defined perpendicular to it.

Sketch 1.2 Fin and tailplane geometries for fin-mounted tailplanes