



Contribution of body to yawing moment and sideforce derivatives due to rate of yaw, $(N_r)_B$ and $(Y_r)_B$



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CONTENTS

	Page
1. NOTATION AND UNITS	1
2. INTRODUCTION	4
3. METHOD	4
3.1 General	4
3.2 Yawing Moment Derivative	5
3.3 Sideforce Derivative	6
4. ACCURACY AND APPLICABILITY	6
4.1 Accuracy	6
4.1.1 Yawing moment derivative	6
4.1.2 Sideforce derivative	7
4.2 Applicability	7
5. DERIVATION AND REFERENCES	9
5.1 Derivation	9
5.2 References	11
6. EXAMPLES	12
6.1 Example I	12
6.2 Example II	13
FIGURE 1	14

ESDU 83026 1983

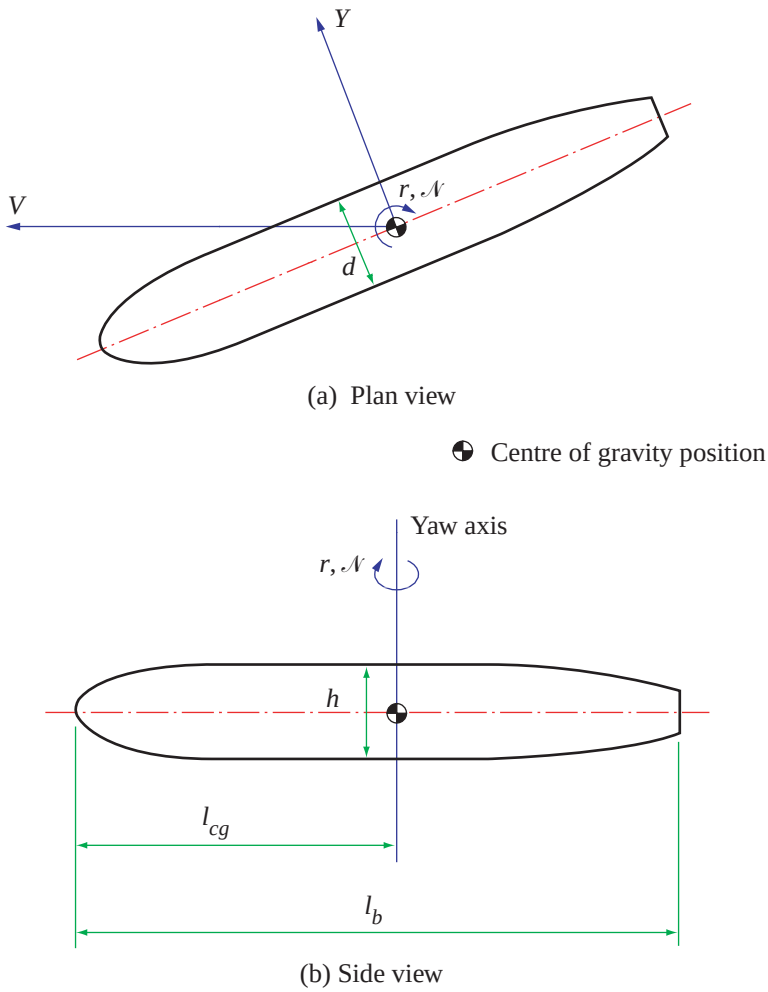
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1. NOTATION AND UNITS (see Sketch 1.1)

The derivative notation used is that proposed in ARC R&M 3562 (Hopkin, 1970) and described in ESDU 86021. Coefficients and aeronormalised derivatives are evaluated in aerodynamic body axes with origin at the aircraft centre of gravity and with the wing span as the characteristic length. The derivatives N_r and Y_r are often written as C_{nr} and C_{Yr} , and $N_{\dot{v}}$ and $Y_{\dot{v}}$ as $C_{n\dot{\beta}}$ and $C_{Y\dot{\beta}}$, in other systems of notation, but attention must be paid to the reference dimensions used. In particular, in forming C_{nr} and C_{Yr} differentiation C_n and C_Y may be carried out with respect to $rb/2V$ not rb/V as implied in the Hopkin system. Similarly $C_{n\dot{\beta}}$ and $C_{Y\dot{\beta}}$ may involve differentiation with respect to $\dot{\beta}b/2V$ not $\dot{\beta}b/V$. It is also to be noted that a constant datum value of V is employed by Hopkin.

		SI	British
b	wing span	m	ft
C_n	yawing moment coefficient, $\mathcal{N}/\frac{1}{2}\rho V^2 S_W b$		
C_Y	sideforce coefficient, $Y/\frac{1}{2}\rho V^2 S_W$		
d	body maximum width	m	ft
h	body maximum height	m	ft
l_b	overall body length	m	ft
l_{cg}	distance from body nose to centre of gravity position	m	ft
M	Mach number		
$\mathcal{N}$	yawing moment	N m	lbf ft
N_r	yawing moment derivative due to rate of yaw, $N_r = (\partial \mathcal{N} / \partial r) / \frac{1}{2} \rho V S_W b^2$		
$(N_r)_B$	body contribution to N_r		
$N_{\dot{v}}$	yawing moment derivative due to rate of change of sideslip, $N_{\dot{v}} = (\partial \mathcal{N} / \partial \dot{v}) / \frac{1}{2} \rho S_W b^2$		
r	rate of yaw	rad/s	rad/s
S_{base}	cross-sectional area of body base	m ²	ft ²
S_b	area of side elevation of body	m ²	ft ²
S_{max}	maximum cross-sectional area of body	m ²	ft ²

S_W	wing (reference) area	m^2	ft^2
V	velocity of aircraft relative to air	m/s	ft/s
v	sideslip velocity	m/s	ft/s
$\dot{v}$	rate of change of sideslip velocity	m/s^2	ft/s^2
Y	sideforce	N	lbf
Y_r	sideforce derivative due to rate of yaw, $Y_r = (\partial Y / \partial r) / \frac{1}{2} \rho V S_W b$		
$(Y_r)_B$	body contribution to Y_r		
$Y_{\dot{v}}$	sideforce derivative due to rate of change of sideslip, $Y_{\dot{v}} = (\partial Y / \partial \dot{v}) / \frac{1}{2} \rho S_W b$		
α	angle of attack	radian	radian
β	angle of sideslip	radian	radian
$\dot{\beta}$	rate of change of angle of sideslip	rad/s	rad/s
ρ	density of air	kg/m^3	$slug/ft^3$



Sketch 1.1 Body geometry