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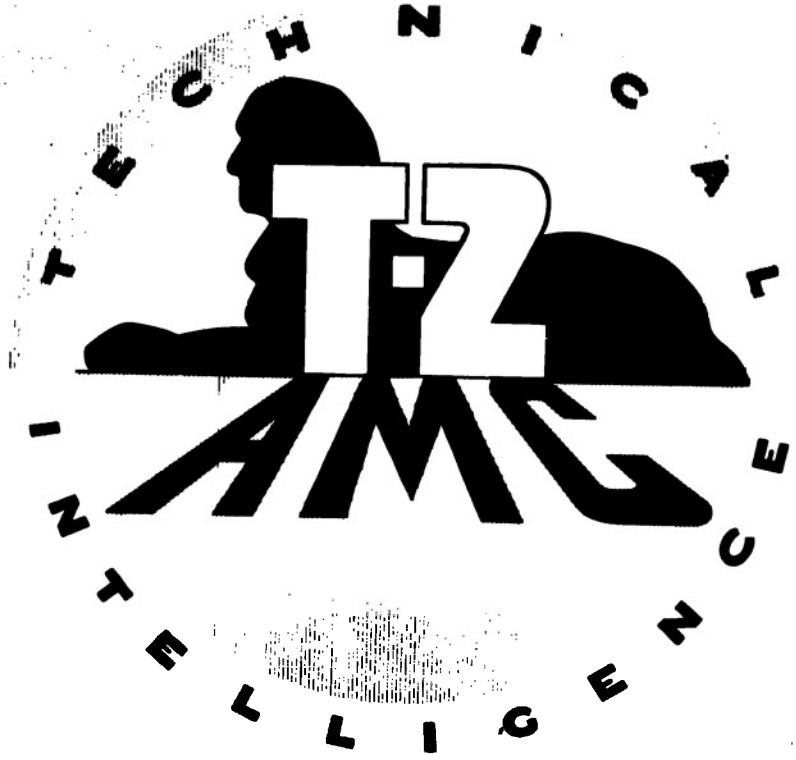

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Technical Note No. Aero 1819a

October, 1946

ROYAL AIRCRAFT ESTABLISHMENT, FARNBOROUGH

Systematic Measurements of Downwash Behind Sweptback Wings, by Hans Triebes A.I.T.H.B. Report 45/8.

Abstract

ATI No. 9327

by

H.M. Lyon, M.A.

ADDENDUM

In the abstract of A.I.T.H.B * report 45/8 given in Technical Note No. Aero 1819 only the rate of change of downwash with wing incidence was shown in the diagrams. For a given change in incidence the reduction in C_L due to sweepback causes a loss of downwash, apart from any change in lift distribution.

The attached Table II gives the lift curve slope and the rate of change of tailplane incidence with C_L, as well as the rate of change of downwash with wing incidence, for all the wings and test conditions. The slopes are measured over a moderate incidence range. At large incidences the Reynolds number of the tests (0.4×10^6) is too small to give useful results.

The effect of the change of lift distribution due to sweepback is to reduce downwash and increase tailplane incidence α_H for a given change in C_L. Thus, on both tapered and constant chord wings, $d\alpha_H/dC_L$ increases with sweepback.

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* Aerodynamic Institute, Technical High School, Brunswick.

TABLE II - $dC_L/d\alpha$ of the wing alone (from FB.1629, UM.2069, UM.2103) and of the arrangement tested 'without tail plane' in the downwash investigation, also the factors $d\delta_H/d\alpha$ and $d\alpha_H/dC_L$ for all wings and test conditions.

Wing	$\frac{dC_L}{d\alpha}$ wing alone	$\frac{dC_L}{d\alpha}$ wing with stings
Elliptic wing	3.96	3.71
10/00/5	3.89	3.94
06/00/5	3.73	3.89
02/00/5	3.70	3.76
10/-30/5	3.38	3.08
10/15/5	3.85	3.89
10/30/5	3.62	3.52
10/45/5	3.33	3.22
02/45/5	3.50	3.48

Tail plane position		Elliptic wing		10/00/5		06/00/5		02/00/5		10/-30/5	
ξ_L	ζ_L	$\frac{d\delta_H}{d\alpha}$	$\frac{d\alpha_H}{dC_L}$	$\frac{d\delta_H}{d\alpha}$	$\frac{d\alpha_H}{dC_L}$	$\frac{d\delta_H}{d\alpha}$	$\frac{d\alpha_H}{dC_L}$	$\frac{d\delta_H}{d\alpha}$	$\frac{d\alpha_H}{dC_L}$	$\frac{d\delta_H}{d\alpha}$	$\frac{d\alpha_H}{dC_L}$
0.5	0.0	0.64	0.091	0.61	0.100	0.56	0.094	-	-	-	-
1.0	0.0	0.52	0.122	0.47	0.136	0.52	0.129	0.58	0.113	0.52	0.142
1.5	0.0	0.49	0.129	0.45	0.141	0.48	0.139	0.53	0.127	0.49	0.151
1.0	-0.4	0.46	0.137	0.36	0.164	0.41	0.158	0.47	0.143	0.38	0.184
1.0	-0.2	0.49	0.129	0.40	0.154	0.47	0.142	0.52	0.129	0.44	0.166
1.0	+0.2	0.46	0.137	0.39	0.157	0.45	0.147	0.49	0.138	0.43	0.169
1.0	0.4	0.43	0.144	0.33	0.172	0.38	0.166	0.42	0.156	0.36	0.190

Tail plane position		10/15/5		10/30/5		10/45/5		02/45/5	
ξ_L	ζ_L	$\frac{d\delta_H}{d\alpha}$	$\frac{d\alpha_H}{dC_L}$	$\frac{d\delta_H}{d\alpha}$	$\frac{d\alpha_H}{dC_L}$	$\frac{d\delta_H}{d\alpha}$	$\frac{d\alpha_H}{dC_L}$	$\frac{d\delta_H}{d\alpha}$	$\frac{d\alpha_H}{dC_L}$
0.5	0.0	0.57	0.112	0.50	0.138	0.40	0.180	0.55	0.129
1.0	0.0	0.45	0.143	0.41	0.163	0.35	0.195	0.44	0.160
1.5	0.0	0.43	0.148	0.40	0.166	0.33	0.201	0.41	0.169
1.0	-0.4	0.35	0.169	0.32	0.188	0.25	0.225	0.39	0.175
1.0	-0.2	0.39	0.159	0.36	0.177	0.30	0.210	0.42	0.166
1.0	+0.2	0.38	0.161	0.35	0.188	0.30	0.210	0.40	0.172
1.0	0.4	0.32	0.177	0.30	0.193	0.25	0.225	0.37	0.180

δ_H = downwash angle

α_H = angle of incidence at the tail = $\alpha + \eta_T - \delta_H$

Wing Nomenclature: 02/45/5 = Taper ratio 0.2, sweepback 45°, Aspect ratio 5

10/-30/5 = Taper ratio 1.0, Sweepback -30°, Aspect ratio 5

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ABSTRACT:

Table is presented which gives lift curve slope, rate of change of tailplane incidence with lift coefficient, and rate of change of downwash with wing incidence, for all wings and under all test conditions. Slopes are measured over a moderate incidence range. Change of lift distribution caused by sweepback reduces downwash and increases tailplane incidence for a given change in lift coefficient.

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