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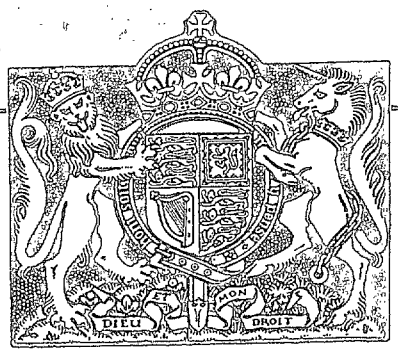

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Tables of Multhopp and other Functions for use in Lifting-Line and Lifting-Plane Theory

By

V. M. Falkner, B.Sc., A.M.I.Mech.E., with Appendix by
E. J. Watson, B.A., of the Aerodynamics Division, N.P.L.

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Lifting line eqn is

$$\alpha(y) = \frac{c_0}{a_0} + \frac{1}{8\pi} \int_{-s}^{s} \frac{\frac{d}{dy}(c\zeta)}{y-\eta} d\eta \qquad (1)$$

i.e. $\alpha(y) = \frac{1}{8\pi} \int_{-s}^{s} \frac{\frac{d}{dy}(c\zeta_0)}{y-\eta} d\eta + \frac{c_0}{a_0} + \frac{1}{8\pi} \int_{-s}^{s} \frac{\frac{d}{dy}(c\zeta_1)}{y-\eta} d\eta$

If the discontinuities in $\alpha(y)$ the appropriate Multhopp bending eln. can be shifted to satisfy

$$\alpha(y) = \frac{1}{8\pi} \int_{-s}^{s} \frac{\frac{d}{d\eta}(c\zeta_0)}{y-\eta} d\eta \qquad (2)$$

bearing the subsequent equation for ζ_0

$$\zeta = \zeta_0 + \zeta_1 = -\frac{a_0}{8\pi} \int_{-s}^{s} \frac{\frac{d}{d\eta}(c\zeta_0)}{y-\eta} d\eta \qquad (3)$$

which can be solved by Fourier analysis methods

Tables of Multhopp and other Functions for use in Lifting-Line and Lifting-Plane Theory

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with Appendix by E. J. WATSON, B.A., of the Aerodynamics Division, N.P.L.

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Summary.—The report gives the derivation and computed tables of two classes of functions suitable for the solution of problems of spanwise aerodynamic loading of wings either by lifting-line or lifting-plane theory. The functions are based on lifting-line theory, but, by a consideration of the connection between lifting-line and lifting-plane theory through the application of Munk's stagger theorem to the calculation of induced drag, it is deduced that the functions must be equally suitable for lifting-plane theory.

The first range of functions, called Multhopp or M functions, is associated with discontinuities of induced downwash, while the second, called P functions because of the polygonal representation of induced downwash, is connected with discontinuities in rate of change of induced downwash.

Examples are given of the combination of functions to produce given curves of induced downwash, and evidence of the close relation between the results for a continuous and stepped downwash curve suggests that the functions tabulated will be sufficient to cover almost any problem in wing loading.

1. *Introduction.*—In lifting-line and lifting-plane theory, problems of aerodynamic loading involving discontinuities, as, for example, the discontinuity of downwash due to a deflected wing flap, are not normally soluble if the spanwise loading functions are limited to the terms of a finite Fourier series. Special functions are required to deal with discontinuities, and it is the object of this report to give two classes of these, the first associated with spanwise discontinuities in the induced downwash, and the second with the less severe discontinuities of rate of change of downwash in the spanwise direction. Both classes of function are connected specifically with lifting-line theory, and we shall call the first Multhopp or M functions, after the discoverer of the formula, and the second by the term P functions, these being associated with polygonal distributions of induced downwash. A description of the functions will now be given, after which some attention will be paid to the connection between lifting-line and lifting-plane theory.

2. *Description of Multhopp functions.*—The Multhopp or M functions as defined here are the values of spanwise circulation $K/4sV$, where s is the semispan, such that the induced downwash calculated by lifting-line theory is uniform along the span except at a discontinuity, where it suffers an abrupt change. There are two main types of Multhopp function, associated with tip flaps and tip ailerons respectively, the former being such that the induced downwash w/V has the value unity for $0 \leqslant \phi \leqslant \phi^*$ and $\pi - \phi^* \leqslant \phi \leqslant \pi$ and zero for $\phi^* \leqslant \phi \leqslant \pi - \phi^*$ where ϕ is the current angular measure spanwise, and ϕ^* the particular value at the discontinuity. For tip ailerons, the corresponding value of w/V is 1 for $0 \leqslant \phi \leqslant \phi^*$, zero for $\phi^* \leqslant \phi \leqslant \pi - \phi^*$,

and -1 for $\pi - \phi^* \leqslant \phi \leqslant \pi$. In addition to these two main types, there are two complementary functions associated with centre flaps and centre ailerons respectively. The function corresponding to any combination of discontinuities can be derived by summing arithmetically one or more of the separate functions, both circulation and induced downwash being additive.

2.1. The formulae for these functions were given by Multhopp, and the writer is indebted to Mr. E. J. Watson for an introduction to the method of Fourier conjugates by which the formulae were derived. Mr. Watson has written a short paper which is included as an Appendix to this report. In this, he demonstrates the simplicity of the application of the principle, and he has also derived additional expressions for the integrals of these functions which will be considered in a later paper.

Let us denote the four Multhopp functions by M_{CF}, M_{TF}, M_{CA} and M_{TA} where the four suffices refer to centre flaps, tip flaps, centre ailerons and tip ailerons respectively. Further, let the position of the discontinuity along the semispan be defined by two numerical suffices, *e.g.*, M_{CF50} will represent the function for centre flaps with discontinuity at $0{\cdot}50$ of the semispan.

The general expressions for the functions are as follows:—

$$M_{TF} = \frac{1}{\pi}\left[(\cos\phi^* - \cos\phi)\log_e \frac{\sin\frac{1}{2}|\phi - \phi^*|}{\sin\frac{1}{2}(\phi + \phi^*)}\right.$$

$$\left. + (\cos\phi^* + \cos\phi)\log_e \frac{\cos\frac{1}{2}(\phi + \phi^*)}{\cos\frac{1}{2}(\phi - \phi^*)} + 2\phi^* \sin\phi\right]$$

or

$$M_{TF} = \frac{1}{\pi}\left[(\cos\phi^* - \eta)\log_e \frac{\eta\sin\phi^* - \sqrt{(1-\eta^2)}\,.\cos\phi^*}{\eta\sin\phi^* + \sqrt{(1-\eta^2)}\,.\cos\phi^*}\right.$$

$$\left. - \cos\phi^* \log_e \frac{1 + \eta\cos\phi^* + \sqrt{(1-\eta^2)}\,.\sin\phi^*}{1 + \eta\cos\phi^* - \sqrt{(1-\eta^2)}\,.\sin\phi^*} + 2\phi^*\sqrt{(1-\eta^2)}\right].$$

Limiting values

$$\phi = \phi^* \qquad M_{TF} = \frac{1}{\pi}\left[2\cos\phi^* \log_e \cos\phi^* + 2\phi^* \sin\phi^*\right]$$

$$= \frac{1}{\pi}\left[2\eta^* \log_e \eta^* + 2\phi^* \sqrt{(1-\eta^*)}\right]$$

$$\phi^* = 0 \qquad M_{TF} = 0$$

$$\phi^* = \frac{\pi}{2} \qquad M_{TF} = \sin\phi = \sqrt{(1-\eta^2)}$$

$$M_{CF} = \sin\phi - M_{TF} = \sqrt{(1-\eta^2)} - M_{TF}$$

$$M_{TA} = \frac{1}{\pi}\left[(\cos\phi^* - \cos\phi)\log_e \frac{\sin\frac{1}{2}|\phi - \phi^*|}{\sin\frac{1}{2}(\phi + \phi^*)} - (\cos\phi^* + \cos\phi)\log_e \frac{\cos\frac{1}{2}(\phi + \phi^*)}{\cos\frac{1}{2}(\phi - \phi^*)}\right]$$

$$= \frac{1}{\pi}\left[(\eta - \cos\phi^*)\log_e \frac{\eta\sin\phi^* + \sqrt{(1-\eta^2)}\,.\cos\phi^*}{|\eta\sin\phi^* - \sqrt{(1-\eta^2)}\,.\cos\phi^*|}\right.$$

$$\left. + \eta\log_e \frac{1 + \eta\cos\phi^* + \sqrt{(1-\eta^2)}\,.\sin\phi^*}{1 + \eta\cos\phi^* - \sqrt{(1-\eta^2)}\,.\sin\phi^*}\right].$$

Limiting values

$$\text{For } \phi = \phi^*,\ M_{TA} = \frac{1}{\pi}\left[-2\cos\phi^*\log_e\cos\phi^*\right] = \frac{1}{\pi}\left[-2\eta^*\log_e\eta^*\right].$$

Centre ailerons are calculated from the formula

$$M_{CA} + M_{TA} = M_{TA}\,[\phi^* = \tfrac{1}{2}\pi].$$

The four functions have been calculated and are given in Table 1 to five places of decimals for a range of the discontinuity $\eta^* = 0(0{\cdot}05)1$ for $\eta = 0(0{\cdot}025)1$. The range of M for centre and tip flaps lies between the curve $K/4sV = \sin\phi = \sqrt{(1-\eta^2)}$, which gives uniform w/V over the full span, and the line $K/4sV = 0$.

The functions of Table 1 are suitable for lifting-line or vortex-lattice calculations when calculations are based on uniform intervals of η. In addition, a range of the functions is given in angular measure in Table 5 for $\phi^* = 0$, 54, 60, 78 and 90 deg for $\phi = 0$ to 90. These are suitable for use when lifting-line solutions are required to be calculated in angular measure.

Selections from Table 1 have been plotted in Figs. 1 to 4 and the singularity at the point of discontinuity should be noted. It can be shown that, at this point, $dK/d\eta$ is infinite, while the radius of curvature is zero and changes sign.

2.2. An alternative derivation of the functions is in the form of an infinite series. The writer[2] has shown that the circulation can be derived as a development of an exact solution for an elliptic wing with discontinuities of incidence, due to Lockwood Taylor.

For tip flaps, it appears that

$$\frac{K}{4sV} = \frac{2}{\pi}\left[\phi^* - \tfrac{1}{2}\sin 2\phi^*\right]\sin\phi + \frac{2}{3\pi}\left[\tfrac{1}{2}\sin 2\phi^* - \tfrac{1}{4}\sin 4\phi^*\right]\sin 3\phi$$

$$+ \frac{2}{5\pi}\left[\tfrac{1}{4}\sin 4\phi^* - \tfrac{1}{6}\sin 6\phi^*\right]\sin 5\phi + \ldots\ldots$$

and for tip ailerons

$$\frac{K}{4sV} = \frac{1}{\pi}\left[\sin\phi^* - \tfrac{1}{3}\sin 3\phi^*\right]\sin 2\phi + \frac{1}{2\pi}\left[\tfrac{1}{3}\sin 3\phi^* - \tfrac{1}{5}\sin 5\phi^*\right]\sin 4\phi$$

$$+ \frac{1}{3\pi}\left[\tfrac{1}{5}\sin 5\phi^* - \tfrac{1}{7}\sin 7\phi^*\right]\sin 6\phi + \ldots\ldots\ldots$$

These formulae reveal that for tip flaps, the lift coefficient due to the Multhopp function is $C_L = (8s^2/S)\,(\phi^* - \tfrac{1}{2}\sin 2\phi^*)$, and for centre flaps $C_L = (8s^2/S)\,(\pi/2 - \phi^* + \tfrac{1}{2}\sin 2\phi^*)$. Also, the rolling moment coefficient is given by $C_l = (s^2/S)\,[\tfrac{1}{3}\sin 3\phi^* - \sin\phi^*]$ for tip ailerons, and $C_l = (s^2/S)\,[-\tfrac{4}{3} - \tfrac{1}{3}\sin 3\phi^* + \sin\phi^*]$ for centre ailerons. An alternative form for C_l is obtained by using the relation

$$\sin\phi^* - \tfrac{1}{3}\sin 3\phi^* = \tfrac{4}{3}\,(1-\eta^{*2})\,\sqrt{(1-\eta^{*2})}.$$

These may be written

$$C_L \text{ for } M_{CF} = \frac{8s^2}{S}\,T_1$$

$$C_L \text{ for } M_{TF} = \frac{8s^2}{S} T_3$$

$$C_l \text{ for } M_{CA} = -\frac{s^2}{S} T_5$$

$$C_l \text{ for } M_{TA} = -\frac{s^2}{S} T_7$$

where $T_1 = \frac{\pi}{2} - \phi^* + \sin\phi^* \cos\phi^*$, $T_3 = \frac{\pi}{2} - T_1$,

$T_5 = \frac{4}{3}[1 - (1 - \eta^{*2})^{3/2}]$, $T_7 = \frac{4}{3} - T_5$.

Additional constants which will be used in vortex-lattice theory have also been included. These are

$$T_2 = \frac{16}{\pi} T_1, \quad T_4 = \frac{16}{\pi} T_3, \quad T_6 = \frac{2}{\pi} T_5, \quad \text{and} \quad T_8 = \frac{2}{\pi} T_7.$$

The constants T_1 to T_8 are given in Table 2 to five places of decimals for $\eta^* = 0(0{\cdot}05)1$ and again in Table 6 for values of ϕ^*.

The bending moment of the half-wing symmetrical loading, and the limiting conditions at the wing tip in the form $dM/d(\sqrt{(1-\eta^2)}$ are also required. The following are the formulae which have been obtained by Mr. Watson:—

$$\int_0^1 \frac{K}{4sV} \eta\, d\eta \text{ for } M_{TF} = T_{10} = \frac{1}{6\pi}\left[-2\cos^3\phi^* \log_e \tan\left(\frac{\pi}{4} + \frac{\phi^*}{2}\right) - \sin 2\phi^* + 4\phi^*\right]$$

from which it follows that the position of the centre of pressure on the half wing in terms of the semispan is $\frac{32}{\pi}\frac{T_9}{T_2}$ or $\frac{2T_9}{T_1}$ for centre flaps and $\frac{32}{\pi}\frac{T_{10}}{T_4}$ or $\frac{2T_{10}}{T_3}$ for tip flaps where $T_9 + T_{10} = 0{\cdot}\dot{3}$.

When $\eta \to 1$, $M \to T_n\sqrt{(1-\eta^2)}$ where

$$T_{11} \text{ centre flaps} = 1 - \frac{2}{\pi}\phi^*$$

$$T_{12} \text{ tip flaps} = \frac{2}{\pi}\phi^*$$

$$T_{13} \text{ centre ailerons} = \frac{2}{\pi}\left[1 - \sin\phi^*\right]$$

$$T_{14} \text{ tip ailerons} = \frac{2}{\pi}\sin\phi^*.$$

Values of T_9 and T_{10} are given in Table 3 and of T_{11}, T_{12}, T_{13} and T_{14} in Table 4.

3. *Description of P functions.*—The P functions are based on the circulation $K/4sV$ required by lifting-line theory to induce a spanwise downwash which is zero over the middle part of the wing and varies linearly from zero at the discontinuity to ± 1 at the wing tips. The symmetrical function is denoted by P_S and the antisymmetrical by P_{AS}.

The formulae for these functions have been calculated by Mr. Watson, and are as follows:—

$$P_S = \frac{-1}{2\pi\,(1-\cos\phi^*)}\left[(\cos\phi^*-\cos\phi)^2\log_e\frac{\sin\frac{1}{2}\,|\phi-\phi^*|}{\sin\frac{1}{2}\,(\phi+\phi^*)}\right.$$

$$\left.+\,(\cos\phi^*+\cos\phi)^2\log_e\frac{\cos\frac{1}{2}\,(\phi+\phi^*)}{\cos\frac{1}{2}\,(\phi-\phi^*)}+(4\phi^*\cos\phi^*-2\sin\phi^*)\sin\phi\right]$$

$$P_{AS} = \frac{-1}{2\pi\,(1-\cos\phi^*)}\left[(\cos\phi^*-\cos\phi)^2\log_e\frac{\sin\frac{1}{2}\,|\phi-\phi^*|}{\sin\frac{1}{2}\,(\phi+\phi^*)}\right.$$

$$\left.-\,(\cos\phi^*+\cos\phi)^2\log_e\frac{\cos\frac{1}{2}\,(\phi+\phi^*)}{\cos\frac{1}{2}\,(\phi-\phi^*)}-\phi^*\sin 2\phi\right].$$

Mr. Watson also finds that $\int_{-1}^{1} P_S\,d\eta = T_{15}$

and $\int_{-1}^{1} P_{AS}\eta\,d\eta = \frac{1}{4}T_{17}$ where $T_{15} = \dfrac{\sin\phi^*-\phi^*\cos\phi^*-\frac{1}{3}\sin^3\phi^*}{1-\cos\phi^*}$

and $$T_{17} = \frac{1}{3\,(1-\cos\phi^*)}\left[\cos^3\phi^*\sin\phi^*-\tfrac{5}{2}\cos\phi^*\sin\phi^*+\tfrac{3}{2}\phi^*\right]$$

from which it follows that for

$$K/4sV = P_S,\quad c_L = \frac{8s^2}{S}\,T_{15}$$

and for $K/4sV = P_{AS},\quad c_l = -\dfrac{s^2}{S}\,T_{17}$;

that $$\int_0^1 P_S\eta\,d\eta = \frac{1}{12\pi\,(1-\cos\phi^*)}\left[\cos^4\phi^*\log_e\tan\left(\frac{\pi}{4}+\frac{\phi^*}{2}\right)+\cos^2\phi^*\sin\phi^*\right.$$

$$\left.+\,6\sin\phi^*-8\phi^*\cos\phi^*\right] = T_{19}$$

and that the limits $dP/d(\sqrt{(1-\eta^2)})$ for $\eta \to 1$ are given

by $P_S\,(\eta\to 1) = T_{20}\sqrt{(1-\eta^2)}$ and $P_{AS}(\eta\to 1) = T_{21}\sqrt{(1-\eta^2)}$

where $$T_{20} = \frac{2}{\pi}\left[\frac{\sin\phi^*-\eta^*\phi^*}{1-\eta^*}\right]$$

and $$T_{21} = \frac{1}{\pi}\left[\frac{\phi^*-\eta^*\sin\phi^*}{1-\eta^*}\right].$$

The values of P_S and P_{AS} have been computed for $\eta^* = 0(0{\cdot}05)1$ and are given in Table 7. It should be noted that the values for $\eta^* = 1$ are all zero.

The values of T_{15}, T_{17}, T_{20} and T_{21}, as well as two other constants used in vortex-lattice theory and defined by $T_{16} = \frac{16}{\pi} T_{15}$ and $T_{18} = \frac{2}{\pi} T_{17}$, have been calculated and are given in Table 8 for $\eta^* = 0(0{\cdot}05)1$.

The constant T_{19} which defines the position of the centre of pressure of the symmetrical half wing loading in terms of the semispan by the formula $\frac{32}{\pi} \frac{T_{19}}{T_{16}}$ or $2 \frac{T_{19}}{T_{15}}$ is also given in Table 8.

A selection of symmetrical and antisymmetrical functions from Table 7 has been plotted, together with the corresponding distribution of induced downwash in Figs. 5, 6.

The notation is again adopted that two numerals added to the suffix denote the position of the discontinuity, *e.g.*, P_{S10} is the symmetrical function for $\eta^* = 0{\cdot}10$.

4. *Validity and use of Functions.*—The functions described are based on lifting-line theory, and are used to augment a Fourier series for the circulation in circumstances which would otherwise require the use of an infinite Fourier series. The functions are based on the simplest representation of the curve of induced downwash, a procedure which is necessary because the satisfactory calculation of induced drag and yawing moment in lifting-line theory demands induced downwash curves which are simple and free of infinities. It is easy to show that the same functions must be used for lifting-plane theory. The application of the latter theory by the vortex-lattice method depends on the multiplication of line vortices on the wing surface, and in accordance with Munk's Stagger Theorem, the calculation of induced drag depends on the shearing of these vortices until they form a single bound vortex filament disposed as in lifting-line theory. The conclusion is inevitable that the satisfactory pursuance of lifting-plane theory requires the use of loading functions which are equally suitable for lifting line theory.

The functions given can be combined to give a polygonal distribution of induced downwash of which one side need not extend for more than $0{\cdot}05$ span. In view of the closeness of this spacing, it is very unlikely that other functions to give curved distributions of w/V—apart from the usual terms of the Fourier series—will be necessary.

4.1. Examples of combinations of the functions are now given. For the first example, consider the symmetrical distribution of w/V shown in Fig. 7, which has a peak at $\eta = 0$ and falls to zero at $\eta = \pm 0{\cdot}1$. It is easy to show that the function w/V is due to a circulation $K/4sV$ made up of $\sqrt{(1 - \eta^2)} - 10P_{S00} + 9P_{S10}$. The function $\sqrt{(1 - \eta^2)}$ is the same as M_{TF00}, and the combined function is plotted in Fig. 7 with the induced downwash. The total lift is given by $C_L = (8s^2/S)\ [1{\cdot}5708 - 10\ (0{\cdot}66667) + 9\ (0{\cdot}57731)]$ or $C_L = (8s^2/S)\ (0{\cdot}09989)$.

Again, the antisymmetrical peaks shown in Fig. 8 are due to $K/4sV$ built up of $6P_{AS40} - 10P_{AS50} + 4P_{AS60}$ which is also plotted. The combined C_e is $-(s^2/S)\ [6\ (0{\cdot}48948) - 10\ (0{\cdot}39768) + 4\ (0{\cdot}30312)] = -(s^2/S)\ (0{\cdot}17256)$.

Finally, the symmetrical segment shown in Fig. 9 which may be regarded as part of a general polygonal distribution is due to $K/4sV$ built up with $3M_{TF40} - 4M_{TF50} + 6P_{S40} - 5P_{S50}$, the lift coefficient being $C_L = (8s^2/S)\ (0{\cdot}62385)$.

The curve for $K/4sV$ applicable to any polygonal function of w/V can be built up without difficulty.

5. *Cross-connection between Functions.*—For purposes of checking, and to demonstrate how the polygonal functions can be represented approximately by a combination of the stepped functions, the function P_{S50} has been recalculated with the downwash replaced by a stepped

line. The downwash curves are shown in Fig. 10, and the true solution P_{S50} is also compared with the solution for the stepped downwash curve, which is $0{\cdot}2\,M_{TF55} + 0{\cdot}2\,M_{TF65} + 0{\cdot}2\,M_{TF75} + 0{\cdot}2\,M_{TF85} + 0{\cdot}2\,M_{TF95}$. The two curves are in close agreement, and this is taken as confirmatory evidence that the analysis is correct, and that stepping the curve of induced downwash at intervals of $0{\cdot}1$ semispan affords a ready means of obtaining a quick approximate solution for any given case. The true lift coefficient is $(0{\cdot}25184)\ 8s^2/S$, while that obtained from the stepped solution is $(0{\cdot}25059)\ 8s^2/S$.

6. *Conclusion.*—In conclusion, it is thought that the tables given here are adequate to build up by addition the circulation corresponding to any symmetrical or antisymmetrical curve of induced downwash, with or without discontinuities, by replacing the downwash curve by a polygonal or stepped curve. It is confidently hoped that the spacing will be small enough for the resulting functions to be suitable for the solution of any likely problem in wing loading.

The writer desires to acknowledge the work of Misses S. D. Brown, W. M. Tafe and B. M. Skelton who were responsible for the computing and checking of the tables, and to express his thanks to the Staff of Mathematics Division for a final check of the tables by differencing on the National Machine.

APPENDIX

Calculation of the Circulation from the Downwash

By

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1. In lifting-line theory the induced downwash is given in terms of the circulation by the equation:—

$$w(y) = \frac{1}{4\pi}\int_{-s}^{+s}\frac{(dK/dy_1)\ dy_1}{y - y_1}, \qquad (1)$$

which is used in calculating the lift distribution across the span of the aerofoil. In some cases the usual methods for this calculation fail owing to the presence of singularities in the downwash at certain points, and in order to overcome this difficulty it is necessary to remove the singularities. To do this requires the solution of the inverse problem—that of finding the circulation in terms of the downwash. This idea was used by Multhopp[1] to solve the case of flaps or ailerons on a wing.

In equation (1) we write $y = s\eta,\ y_1 = s\eta_1,$ .. .. (2)

and $\eta = \cos\phi,\ \eta_1 = \cos\theta.$ .. .. (3)

We then obtain $w(\phi) = \dfrac{1}{4\pi s}\displaystyle\int_0^{\pi}\frac{(dK/d\theta)\ d\theta}{\cos\theta - \cos\phi}$,

whence $$\frac{w}{V}(\phi)\sin\phi = \frac{1}{\pi}\int_0^{\pi}\frac{\sin\phi\,\dfrac{d}{d\theta}\left(\dfrac{K}{4sV}\right)}{\cos\theta - \cos\phi}\,d\theta. \qquad (4)$$

This is the condition (*see* Ref. 3, Lemma 4) that $(w/V)\sin\phi$ (regarded as an odd function of ϕ) and $d(K/4sV)/d\phi$ (regarded as an even function of ϕ) shall be Fourier conjugates—*i.e.*, if

$$\frac{K}{4sV} = \sum_1^\infty A_n \sin n\phi \qquad (5)$$

so that

$$\frac{d}{d\phi}\left(\frac{K}{4sV}\right) = \sum_1^\infty nA_n \cos n\phi \qquad (6)$$

then

$$\frac{w}{V}(\phi)\sin\phi = \sum_1^\infty nA_n \sin n\phi. \qquad (7)$$

Now the formula inverse to equation (4) is also given in Ref. 3, Lemma 4, and is

$$\frac{d}{d\phi}\left(\frac{K}{4sV}\right) = -\frac{1}{\pi}\int_0^\pi \frac{\sin\theta\left(\frac{w}{V}(\theta)\sin\theta\right)}{\cos\theta - \cos\phi}\,d\theta \qquad (8)$$

whence by integration

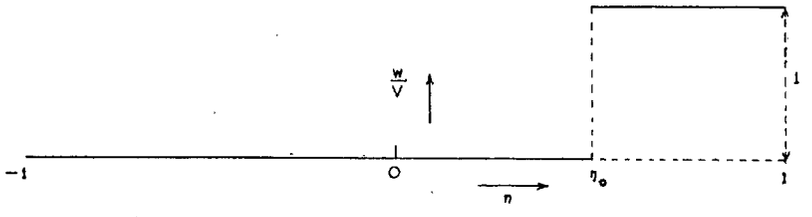
$$\frac{K}{4sV} = -\frac{1}{\pi}\int_0^\pi \frac{w}{V}(\theta)\sin\theta \log\frac{\sin\frac{1}{2}|\theta-\phi|}{\sin\frac{1}{2}(\theta+\phi)}\,d\theta. \qquad (9)$$

This is the formula used by Multhopp.

2. To consider the effect of a simple discontinuity in the downwash we take

$$\left.\begin{aligned}\frac{w}{V} &= 1 \ (\eta_0 < \eta < 1, \textit{ i.e.}, 0 < \phi < \phi_0)\\ &= 0 \ (-1 < \eta < \eta_0, \textit{ i.e.}, \phi_0 < \phi < \pi)\end{aligned}\right\} \qquad (10)$$

as shown.

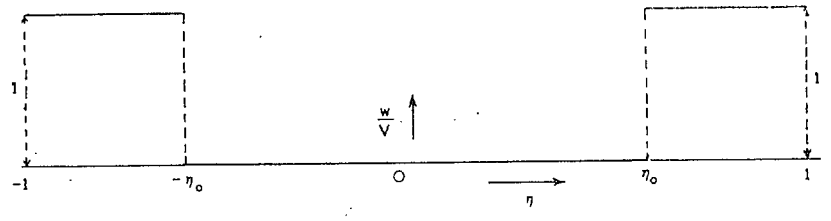


We then find from equation (9)

$$\begin{aligned}\frac{K}{4sV} &= -\frac{1}{\pi}\int_0^{\phi_0} \sin\theta \log\frac{\sin\frac{1}{2}|\theta-\phi|}{\sin\frac{1}{2}(\theta+\phi)}\,d\theta\\ &= \frac{1}{\pi}\left[(\cos\phi_0 - \cos\phi)\log\frac{\sin\frac{1}{2}|\phi-\phi_0|}{\sin\frac{1}{2}(\phi+\phi_0)} + \phi_0\sin\phi\right] \qquad (11)\\ &= f(\phi, \phi_0) \text{ (say).}\end{aligned}$$

By adding various multiples of functions of this type we obtain results appropriate to any arrangement of discontinuities. In particular we have the formulae, given by Multhopp[1], for the two following cases.

(1) *Tip Flaps*

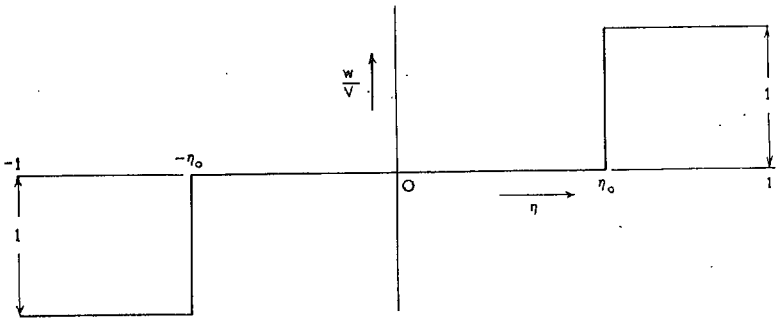


$$\frac{K}{4sV} = f(\phi, \phi_0) + f(\pi - \phi, \phi_0)$$

$$= \frac{1}{\pi}\left[(\cos\phi_0 - \cos\phi)\log\frac{\sin\frac{1}{2}|\phi - \phi_0|}{\sin\frac{1}{2}(\phi + \phi_0)}\right.$$

$$\left. + (\cos\phi_0 + \cos\phi)\log\frac{\cos\frac{1}{2}(\phi + \phi_0)}{\cos\frac{1}{2}(\phi - \phi_0)} + 2\phi_0\sin\phi\right] \quad \ldots \quad (12)$$

(2) *Tip Ailerons*



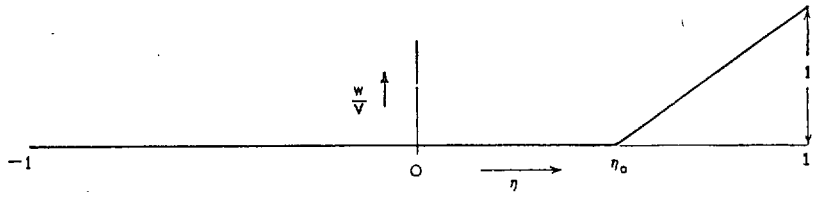
$$\frac{K}{4sV} = f(\phi, \phi_0) - f(\pi - \phi, \phi_0)$$

$$= \frac{1}{\pi}\left[(\cos\phi_0 - \cos\phi)\log\frac{\sin\frac{1}{2}|\phi - \phi_0|}{\sin\frac{1}{2}(\phi + \phi_0)}\right.$$

$$\left. - (\cos\phi_0 + \cos\phi)\log\frac{\cos\frac{1}{2}(\phi + \phi_0)}{\cos\frac{1}{2}(\phi - \phi_0)}\right] \quad \ldots \quad (13)$$

3. We come now to the case where the downwash is continuous, but has a change of gradient, and start with the case

$$\left.\begin{aligned} \frac{w}{V} &= \frac{\eta - \eta_0}{1 - \eta_0} \quad (\eta_0 < \eta < 1) \\ &= 0 \qquad (-1 < \eta < \eta_0) \end{aligned}\right\} \quad \ldots \quad (14)$$



In terms of ϕ we have

$$\left.\begin{aligned} \frac{w}{V} &= A\ (\cos\phi - \cos\phi_0) \qquad (0 < \phi < \phi_0) \\ &= 0 \qquad\qquad\qquad\qquad (\phi_0 < \phi < \pi) \end{aligned}\right\} \quad .. \quad .. \quad .. \quad .. \quad .. \quad (15)$$

where $$A = \frac{1}{1 - \cos\phi_0} \quad .. \quad .. \quad .. \quad .. \quad .. \quad .. \quad .. \quad .. \quad .. \quad (16)$$

Thus we have from equation (9)

$$\frac{K}{4sV} = -\frac{1}{\pi}\int_0^{\phi_0} A\ (\cos\theta - \cos\phi_0)\ \sin\theta\ \log\frac{\sin\frac{1}{2}\,|\theta - \phi|}{\sin\frac{1}{2}\,(\theta + \phi)}\,d\theta$$

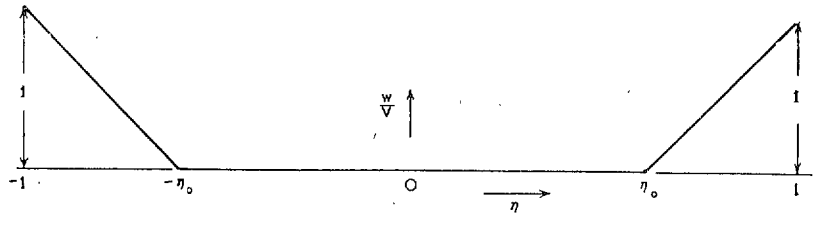
$$= -\frac{A}{2\pi}\Big[(\cos\phi_0 - \cos\phi)^2\ \log\frac{\sin\frac{1}{2}\,|\phi - \phi_0|}{\sin\frac{1}{2}\,(\phi + \phi_0)}$$

$$+ (2\phi_0\ \cos\ \phi_0 - \sin\ \phi_0)\ \sin\ \phi - \tfrac{1}{2}\phi_0\ \sin 2\phi\Big] \quad .. \quad .. \quad .. \quad .. \quad (17)$$

$$= F\ (\phi,\ \phi_0)\ \text{(say)}.$$

We shall take two cases of this type, one symmetrical and one antisymmetrical.

(1) *Symmetrical*



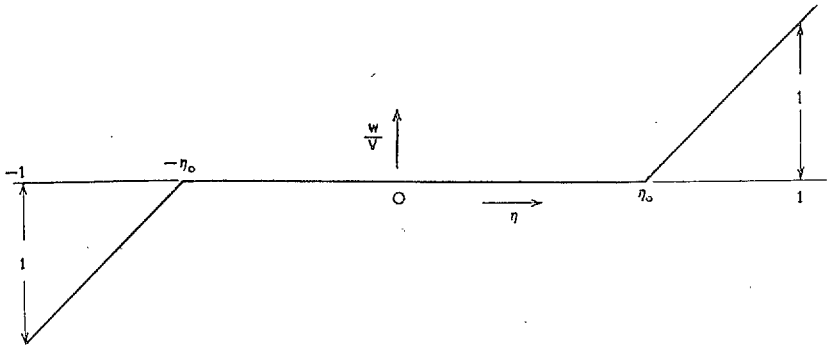
$$\frac{K}{4sV} = F\ (\phi,\ \phi_0) + F\ (\pi - \phi,\ \phi_0)$$

$$= \frac{-A}{2\pi}\Big[(\cos\phi_0 - \cos\phi)^2\ \log\frac{\sin\frac{1}{2}\,|\phi - \phi_0|}{\sin\frac{1}{2}\,(\phi + \phi_0)}$$

$$+ (\cos\phi_0 + \cos\phi)^2\ \log\frac{\cos\frac{1}{2}\,(\phi + \phi_0)}{\cos\frac{1}{2}\,(\phi - \phi_0)}$$

$$+ (4\phi_0\ \cos\phi_0 - 2\ \sin\phi_0)\ \sin\phi\Big] \quad .. \quad .. \quad .. \quad .. \quad .. \quad (18)$$

(2) *Antisymmetrical*



$$\frac{K}{4sV} = F(\phi, \phi_0) - F(\pi - \phi, \phi_0)$$

$$= -\frac{A}{2\pi}\left[(\cos\phi_0 - \cos\phi)^2 \log\frac{\sin\frac{1}{2}|\phi - \phi_0|}{\sin\frac{1}{2}(\phi + \phi_0)}\right.$$

$$\left. - (\cos\phi_0 + \cos\phi)^2 \log\frac{\cos\frac{1}{2}(\phi + \phi_0)}{\cos\frac{1}{2}(\phi - \phi_0)} - \phi_0 \sin 2\phi\right] . \quad .. \quad .. \quad (19)$$

4. It may also be observed that the downwash distribution of equation (14) can be obtained by integration from that of equation (10). Denoting these downwashes by $(w/V)_2$ and $(w/V)_1$ respectively, we have

$$\left(\frac{w}{V}\right)_2 = \frac{1}{1 - \eta_0}\int_{\eta_0}^{1}\left(\frac{w}{V}\right)_1 d\eta_0$$

or

$$\left(\frac{w}{V}\right)_2 = \frac{1}{1 - \cos\phi_0}\int_0^{\phi_0}\left(\frac{w}{V}\right)_1 \sin\phi_0\, d\phi_0 \ .$$

Consequently the corresponding circulations are similarly related,

i.e.,

$$F(\phi, \phi_0) = \frac{1}{1 - \cos\phi_0}\int_0^{\phi_0} f(\phi, \phi_0)\sin\phi_0\, d\phi_0 \quad .. \quad .. \quad .. \quad .. \quad .. \quad (20)$$

which can easily be verified. In the same manner we obtain the symmetrical distribution of equation (18) from that for tip flaps of equation (12), and the antisymmetrical distribution of equation (19) from that for tip ailerons of equation (13).

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TABLE 1

M functions

$\eta^* = 0$ $\cos\phi^* = 0$ $\sin\phi^* = 1$ $\phi^* = \pi/2 = 1{\cdot}570796$

η	Tip flaps	Tip ailerons	η	Tip flaps	Tip ailerons
0	1·00000	0	0·550	0·83516	0·42191
0·025	0·99969	0·06973	0·575	0·81815	0·42141
0·050	0·99875	0·11740	0·600	0·80000	0·41964
0·075	0·99718	0·15671	0·625	0·78062	0·41658
0·100	0·99499	0·19055	0·650	0·75993	0·41217
0·125	0·99216	0·22032	0·675	0·73782	0·40637
0·150	0·98869	0·24681	0·700	0·71414	0·39910
0·175	0·98457	0·27054	0·725	0·68875	0·39027
0·200	0·97980	0·29188	0·750	0·66144	0·37976
0·225	0·97436	0·31110	0·775	0·63196	0·36741
0·250	0·96825	0·32841	0·800	0·60000	0·35302
0·275	0·96144	0·34395	0·825	0·56513	0·33632
0·300	0·95394	0·35787	0·850	0·52678	0·31693
0·325	0·94571	0·37026	0·875	0·48412	0·29432
0·350	0·93675	0·38120	0·900	0·43589	0·26765
0·375	0·92702	0·39076	0·925	0·37997	0·23556
0·400	0·91652	0·39898	0·950	0·31225	0·19537
0·425	0·90519	0·40591	0·9625	0·27128	0·17049
0·450	0·89303	0·41158	0·975	0·22220	0·14026
0·475	0·87999	0·41601	0·98125	0·19274	0·12193
0·500	0·86602	0·41920	0·990625	0·13661	0·08669
0·525	0·85110	0·42117	1·000	0	0

Centre flaps M is 0 for all values of η above

Centre ailerons M ,, ,, ,, ,,

TABLE 1—*continued*

M Functions

$\eta^* = 0{\cdot}05$ $\cos\phi^* = 0{\cdot}05$ $\sin\phi^* = 0{\cdot}998749$ $\phi^* = 1{\cdot}520776$

η	Centre flaps	Tip flaps	Centre ailerons	Tip ailerons
0	0·14924	0·85076	0	0
0·025	0·14507	0·85462	0·02621	0·04352
0·050	0·12716	0·87159	0·02204	0·09536
0·075	0·10722	0·88996	0·01156	0·14515
0·100	0·09671	0·89828	0·00829	0·18226
0·125	0·08902	0·90314	0·00649	0·21383
0·150	0·08288	0·90581	0·00535	0·24146
0·175	0·07774	0·90683	0·00454	0·26600
0·200	0·07330	0·90650	0·00394	0·28794
0·225	0·06939	0·90497	0·00347	0·30763
0·250	0·06589	0·90236	0·00311	0·32530
0·275	0·06270	0·89874	0·00279	0·34116
0·300	0·05979	0·89415	0·00254	0·35533
0·325	0·05708	0·88863	0·00232	0·36794
0·350	0·05456	0·88219	0·00214	0·37906
0·375	0·05218	0·87484	0·00198	0·38878
0·400	0·04995	0·86657	0·00183	0·39715
0·425	0·04782	0·85737	0·00170	0·40421
0·450	0·04579	0·84724	0·00158	0·41000
0·475	0·04385	0·83614	0·00148	0·41453
0·500	0·04196	0·82406	0·00138	0·41782
0·525	0·04015	0·81095	0·00129	0·41988
0·550	0·03839	0·79677	0·00121	0·42070
0·575	0·03667	0·78148	0·00114	0·42027
0·600	0·03500	0·76500	0·00106	0·41858
0·625	0·03335	0·74727	0·00100	0·41558
0·650	0·03173	0·72820	0·00093	0·41124
0·675	0·03012	0·70770	0·00087	0·40550
0·700	0·02852	0·68562	0·00081	0·39829
0·725	0·02693	0·66182	0·00075	0·38952
0·750	0·02534	0·63610	0·00070	0·37906
0·775	0·02372	0·60824	0·00065	0·36676
0·800	0·02208	0·57792	0·00060	0·35242
0·825	0·02039	0·54474	0·00055	0·33577
0·850	0·01865	0·50813	0·00051	0·31644
0·875	0·01682	0·46730	0·00044	0·29388
0·900	0·01488	0·42101	0·00038	0·26727
0·925	0·01274	0·36723	0·00032	0·23524
0·950	0·01029	0·30196	0·00026	0·19511
0·9625	0·00886	0·26242	0·00022	0·17027
0·975	0·00719	0·21501	0·00018	0·14008
0·98125	0·00622	0·18652	0·00016	0·12177
0·990625	0·00438	0·13223	0·00011	0·08658
1·000	0	0	0	0

TABLE 1—*continued*

M Functions

$\eta^* = 0{\cdot}1$ $\cos\phi^* = 0{\cdot}1$ $\sin\phi^* = 0{\cdot}994987$ $\phi^* = 1{\cdot}470629$

η	Centre flaps	Tip flaps	Centre ailerons	Tip ailerons
0	0·25432	0·74568	0	0
0·025	0·25230	0·74739	0·03776	0·03197
0·050	0·24595	0·75280	0·05238	0·06502
0·075	0·23409	0·76309	0·05583	0·10088
0·100	0·21004	0·78495	0·04396	0·14659
0·125	0·18496	0·80720	0·02909	0·19123
0·150	0·17002	0·81867	0·02292	0·22389
0·175	0·15841	0·82616	0·01906	0·25148
0·200	0·14877	0·83103	0·01633	0·27555
0·225	0·14045	0·83391	0·01429	0·29681
0·250	0·13310	0·83515	0·01270	0·31571
0·275	0·12648	0·83496	0·01139	0·33256
0·300	0·12046	0·83348	0·01032	0·34755
0·325	0·11490	0·83081	0·00942	0·36084
0·350	0·10975	0·82700	0·00864	0·37256
0·375	0·10492	0·82211	0·00797	0·38279
0·400	0·10036	0·81615	0·00738	0·39160
0·425	0·09605	0·80914	0·00685	0·39906
0·450	0·09194	0·80109	0·00638	0·40520
0·475	0·08800	0·79199	0·00595	0·41006
0·500	0·08422	0·78181	0·00556	0·41364
0·525	0·08055	0·77055	0·00520	0·41597
0·550	0·07700	0·75816	0·00487	0·41704
0·575	0·07355	0·74460	0·00456	0·41685
0·600	0·07018	0·72982	0·00427	0·41537
0·625	0·06686	0·71376	0·00400	0·41258
0·650	0·06360	0·69633	0·00374	0·40843
0·675	0·06038	0·67744	0·00349	0·40288
0·700	0·05717	0·65697	0·00326	0·39584
0·725	0·05397	0·63478	0·00303	0·38724
0·750	0·05076	0·61068	0·00282	0·37694
0·775	0·04752	0·58444	0·00261	0·36480
0·800	0·04423	0·55577	0·00240	0·35062
0·825	0·04085	0·52428	0·00219	0·33413
0·850	0·03736	0·48942	0·00198	0·31495
0·875	0·03370	0·45042	0·00177	0·29255
0·900	0·02980	0·40609	0·00154	0·26611
0·925	0·02552	0·35445	0·00131	0·23425
0·950	0·02060	0·29165	0·00105	0·19432
0·9625	0·01774	0·25354	0·00089	0·16960
0·975	0·01442	0·20779	0·00072	0·13954
0·98125	0·01245	0·18029	0·00063	0·12130
0·990625	0·00877	0·12784	0·00043	0·08626
1·000	0	0	0	0

TABLE 1—*continued*

M Functions

$\eta^* = 0{\cdot}15$ $\cos\phi^* = 0{\cdot}15$ $\sin\phi^* = 0{\cdot}988686$ $\phi^* = 1{\cdot}420228$

η	Centre flaps	Tip flaps	Centre ailerons	Tip ailerons
0	0·34266	0·65734	0	0
0·025	0·34132	0·65837	0·04426	0·02547
0·050	0·33720	0·66155	0·06601	0·05139
0·075	0·33004	0·66714	0·07842	0·07829
0·100	0·31926	0·67573	0·08358	0·10697
0·125	0·30349	0·68867	0·08137	0·13895
0·150	0·27594	0·71275	0·06565	0·18116
0·175	0·24768	0·73689	0·04792	0·22262
0·200	0·22982	0·74998	0·03956	0·25232
0·225	0·21551	0·75885	0·03393	0·27717
0·250	0·20335	0·76490	0·02977	0·29864
0·275	0·19265	0·76879	0·02651	0·31744
0·300	0·18307	0·77087	0·02388	0·33399
0·325	0·17433	0·77138	0·02169	0·34857
0·350	0·16629	0·77046	0·01984	0·36136
0·375	0·15879	0·76823	0·01825	0·37251
0·400	0·15178	0·76474	0·01685	0·38213
0·425	0·14513	0·76006	0·01562	0·39029
0·450	0·13883	0·75420	0·01452	0·39706
0·475	0·13282	0·74717	0·01353	0·40248
0·500	0·12704	0·73898	0·01262	0·40658
0·525	0·12147	0·72963	0·01180	0·40937
0·550	0·11608	0·71908	0·01104	0·41087
0·575	0·11084	0·70731	0·01033	0·41108
0·600	0·10572	0·69428	0·00967	0·40997
0·625	0·10070	0·67992	0·00906	0·40752
0·650	0·09577	0·66416	0·00846	0·40371
0·675	0·09090	0·64692	0·00791	0·39846
0·700	0·08605	0·62809	0·00737	0·39173
0·725	0·08122	0·60753	0·00686	0·38341
0·750	0·07638	0·58506	0·00637	0·37339
0·775	0·07149	0·56047	0·00589	0·36152
0·800	0·06653	0·53347	0·00542	0·34760
0·825	0·06145	0·50368	0·00495	0·33137
0·850	0·05619	0·47059	0·00447	0·31246
0·875	0·05068	0·43344	0·00399	0·29033
0·900	0·04480	0·39109	0·00349	0·26416
0·925	0·03836	0·34161	0·00296	0·23260
0·950	0·03097	0·28128	0·00237	0·19300
0·9625	0·02667	0·24461	0·00203	0·16846
0·975	0·02166	0·20054	0·00164	0·13862
0·98125	0·01871	0·17403	0·00142	0·12051
0·990625	0·01318	0·12343	0·00099	0·08570
1·000	0	0	0	0

TABLE 1—*continued*

M Functions

$\eta^* = 0{\cdot}2$ $\cos\phi^* = 0{\cdot}2$ $\sin\phi^* = 0{\cdot}979796$ $\phi^* = 1{\cdot}369439$

η	Centre flaps	Tip flaps	Centre ailerons	Tip ailerons
0	0·42007	0·57993	0	0
0·025	0·41905	0·58064	0·04880	0·02093
0·050	0·41597	0·58278	0·07530	0·04210
0·075	0·41071	0·58647	0·09293	0·06378
0·100	0·40309	0·59190	0·10426	0·08629
0·125	0·39276	0·59940	0·11024	0·11008
0·150	0·37907	0·60962	0·11091	0·13590
0·175	0·36059	0·62398	0·10533	0·16521
0·200	0·33052	0·64928	0·08696	0·20492
0·225	0·29990	0·67446	0·06710	0·24401
0·250	0·27981	0·68844	0·05696	0·27145
0·275	0·26338	0·69806	0·04982	0·29413
0·300	0·24920	0·70474	0·04436	0·31351
0·325	0·23657	0·70914	0·03998	0·33028
0·350	0·22513	0·71162	0·03636	0·34484
0·375	0·21460	0·71243	0·03329	0·35747
0·400	0·20480	0·71171	0·03064	0·36834
0·425	0·19561	0·70958	0·02832	0·37759
0·450	0·18694	0·70609	0·02627	0·38531
0·475	0·17869	0·70130	0·02443	0·39158
0·500	0·17080	0·69523	0·02276	0·39644
0·525	0·16320	0·68790	0·02125	0·39992
0·550	0·15588	0·67928	0·01985	0·40206
0·575	0·14877	0·66938	0·01857	0·40284
0·600	0·14184	0·65816	0·01737	0·40227
0·625	0·13506	0·64556	0·01625	0·40033
0·650	0·12840	0·63153	0·01518	0·39699
0·675	0·12183	0·61599	0·01417	0·39220
0·700	0·11530	0·59884	0·01321	0·38589
0·725	0·10881	0·57994	0·01229	0·37798
0·750	0·10230	0·55914	0·01141	0·36835
0·775	0·09573	0·53623	0·01054	0·35687
0·800	0·08907	0·51093	0·00969	0·34333
0·825	0·08225	0·48288	0·00884	0·32748
0·850	0·07520	0·45158	0·00799	0·30894
0·875	0·06782	0·41630	0·00714	0·28718
0·900	0·05995	0·37594	0·00623	0·26142
0·925	0·05132	0·32865	0·00529	0·23027
0·950	0·04143	0·27082	0·00423	0·19114
0·9625	0·03568	0·23560	0·00362	0·16687
0·975	0·02898	0·19323	0·00293	0·13733
0·98125	0·02502	0·16772	0·00253	0·11940
0·990625	0·01763	0·11898	0·00177	0·08492
1·000	0	0	0	0

TABLE 1—*continued*

M Functions

$\eta^* = 0{\cdot}25$ $\cos\phi^* = 0{\cdot}25$ $\sin\phi^* = 0{\cdot}968246$ $\phi^* = 1{\cdot}318116$

η	Centre flaps	Tip flaps	Centre ailerons	Tip ailerons
0	0·48927	0·51073	0	0
0·025	0·48845	0·51124	0·05227	0·01746
0·050	0·48596	0·51279	0·08234	0·03506
0·075	0·48176	0·51542	0·10375	0·05296
0·100	0·47577	0·51922	0·11920	0·07135
0·125	0·46782	0·52434	0·12988	0·09044
0·150	0·45769	0·53100	0·13628	0·11053
0·175	0·44499	0·53958	0·13850	0·13204
0·200	0·42907	0·55073	0·13619	0·15569
0·225	0·40848	0·56588	0·12818	0·18292
0·250	0·37639	0·59186	0·10777	0·22064
0·275	0·34384	0·61760	0·08616	0·25779
0·300	0·32189	0·63205	0·07452	0·28335
0·325	0·30367	0·64204	0·06607	0·30419
0·350	0·28776	0·64899	0·05944	0·32176
0·375	0·27344	0·65358	0·05401	0·33675
0·400	0·26036	0·65616	0·04943	0·34955
0·425	0·24822	0·65697	0·04550	0·36041
0·450	0·23685	0·65618	0·04205	0·36953
0·475	0·22611	0·65388	0·03901	0·37700
0·500	0·21589	0·65013	0·03626	0·38294
0·525	0·20612	0·64498	0·03379	0·38738
0·550	0·19671	0·63845	0·03152	0·39039
0·575	0·18762	0·63053	0·02944	0·39197
0·600	0·17878	0·62122	0·02750	0·39214
0·625	0·17014	0·61048	0·02570	0·39088
0·650	0·16168	0·59825	0·02400	0·38817
0·675	0·15334	0·58448	0·02239	0·38398
0·700	0·14507	0·56907	0·02086	0·37824
0·725	0·13685	0·55190	0·01940	0·37087
0·750	0·12863	0·53281	0·01798	0·36178
0·775	0·12034	0·51162	0·01661	0·35080
0·800	0·11194	0·48806	0·01526	0·33776
0·825	0·10334	0·46179	0·01392	0·32240
0·850	0·09446	0·43232	0·01258	0·30435
0·875	0·08517	0·39895	0·01123	0·28309
0·900	0·07527	0·36062	0·00981	0·25784
0·925	0·06443	0·31554	0·00832	0·22724
0·950	0·05201	0·26024	0·00665	0·18872
0·9625	0·04478	0·22650	0·00570	0·16479
0·975	0·03636	0·18584	0·00461	0·13565
0·98125	0·03141	0·16133	0·00398	0·11795
0·990625	0·02212	0·11449	0·00278	0·08391
1·000	0	0	0	0

TABLE 1—*continued*

M Functions

$\eta^* = 0{\cdot}3$ $\cos\phi^* = 0{\cdot}3$ $\sin\phi^* = 0{\cdot}953939$ $\phi^* = 1{\cdot}266104$

η	Centre flaps	Tip flaps	Centre ailerons	Tip ailerons
0	0·55185	0·44815	0	0
0·025	0·55115	0·44854	0·05507	0·01466
0·050	0·54906	0·44969	0·08799	0·02941
0·075	0·54554	0·45164	0·11235	0·04436
0·100	0·54055	0·45444	0·13093	0·05962
0·125	0·53400	0·45816	0·14499	0·07533
0·150	0·52577	0·46292	0·15518	0·09163
0·175	0·51571	0·46886	0·16181	0·10873
0·200	0·50357	0·47623	0·16497	0·12691
0·225	0·48894	0·48542	0·16452	0·14658
0·250	0·47117	0·49708	0·15997	0·16844
0·275	0·44879	0·51265	0·15001	0·19394
0·300	0·41498	0·53896	0·12793	0·22994
0·325	0·38075	0·56496	0·10484	0·26542
0·350	0·35717	0·57958	0·09187	0·28933
0·375	0·33736	0·58966	0·08223	0·30853
0·400	0·31988	0·59664	0·07451	0·32447
0·425	0·30403	0·60116	0·06809	0·33782
0·450	0·28942	0·60361	0·06260	0·34898
0·475	0·27578	0·60421	0·05783	0·35818
0·500	0·26292	0·60311	0·05358	0·36562
0·525	0·25069	0·60041	0·04979	0·37138
0·550	0·23900	0·59617	0·04635	0·37556
0·575	0·22773	0·59042	0·04321	0·37820
0·600	0·21683	0·58317	0·04030	0·37934
0·625	0·20622	0·57441	0·03761	0·37897
0·650	0·19583	0·56410	0·03508	0·37709
0·675	0·18563	0·55219	0·03270	0·37367
0·700	0·17553	0·53861	0·03043	0·36867
0·725	0·16551	0·52324	0·02827	0·36200
0·750	0·15550	0·50594	0·02620	0·35356
0·775	0·14543	0·48653	0·02418	0·34323
0·800	0·13523	0·46477	0·02220	0·33082
0·825	0·12481	0·44032	0·02025	0·31607
0·850	0·11406	0·41272	0·01829	0·29864
0·875	0·10281	0·38131	0·01631	0·27801
0·900	0·09084	0·34505	0·01425	0·25340
0·925	0·07773	0·30224	0·01208	0·22348
0·950	0·06273	0·24952	0·00966	0·18571
0·9625	0·05402	0·21726	0·00827	0·16222
0·975	0·04386	0·17835	0·00668	0·13358
0·98125	0·03788	0·15486	0·00577	0·11616
0·990625	0·02667	0·10994	0·00404	0·08265
1·000	0	0	0	0

TABLE 1—*continued*

M Functions

$\eta^* = 0{\cdot}35$ $\cos\phi^* = 0{\cdot}35$ $\sin\phi^* = 0{\cdot}936750$ $\phi^* = 1{\cdot}213226$

η	Centre flaps	Tip flaps	Centre ailerons	Tip ailerons
0	0·60884	0·39116	0	0
0·025	0·60824	0·39145	0·05740	0·01233
0·050	0·60642	0·39233	0·09267	0·02473
0·075	0·60336	0·39382	0·11945	0·03726
0·100	0·59905	0·39594	0·14054	0·05001
0·125	0·59343	0·39873	0·15726	0·06306
0·150	0·58643	0·40226	0·17031	0·07650
0·175	0·57795	0·40662	0·18010	0·09044
0·200	0·56788	0·41192	0·18683	0·10505
0·225	0·55604	0·41832	0·19060	0·12050
0·250	0·54217	0·42608	0·19134	0·13707
0·275	0·52588	0·43556	0·18879	0·15516
0·300	0·50648	0·44746	0·18240	0·17547
0·325	0·48252	0·46319	0·17083	0·19943
0·350	0·44716	0·48959	0·14728	0·23392
0·375	0·41140	0·51562	0·12288	0·26788
0·400	0·38632	0·53020	0·10870	0·29028
0·425	0·36502	0·54017	0·09795	0·30796
0·450	0·34607	0·54696	0·08922	0·32236
0·475	0·32877	0·55122	0·08185	0·33416
0·500	0·31269	0·55333	0·07546	0·34374
0·525	0·29759	0·55351	0·06984	0·35133
0·550	0·28326	0·55190	0·06481	0·35710
0·575	0·26956	0·54859	0·06025	0·36116
0·600	0·25638	0·54362	0·05608	0·36356
0·625	0·24359	0·53703	0·05224	0·36434
0·650	0·23113	0·52880	0·04864	0·36353
0·675	0·21893	0·51889	0·04528	0·36109
0·700	0·20689	0·50725	0·04210	0·35700
0·725	0·19497	0·49378	0·03907	0·35120
0·750	0·18308	0·47836	0·03616	0·34360
0·775	0·17114	0·46082	0·03335	0·33406
0·800	0·15907	0·44093	0·03060	0·32242
0·825	0·14676	0·41837	0·02789	0·30843
0·850	0·13407	0·39271	0·02518	0·29175
0·875	0·12081	0·36331	0·02244	0·27188
0·900	0·10671	0·32918	0·01960	0·24805
0·925	0·09129	0·28868	0·01660	0·21896
0·950	0·07365	0·23860	0·01327	0·18210
0·9625	0·06341	0·20787	0·01137	0·15912
0·975	0·05148	0·17072	0·00918	0·13108
0·98125	0·04446	0·14828	0·00792	0·11401
0·990625	0·03130	0·10531	0·00555	0·08114
1·000	0	0	0	0

TABLE 1—*continued*

M Functions

$\eta^* = 0{\cdot}4$ $\cos\phi^* = 0{\cdot}4$ $\sin\phi^* = 0{\cdot}916515$ $\phi^* = 1{\cdot}159279$

η	Centre flaps	Tip flaps	Centre ailerons	Tip ailerons
0	0·66096	0·33904	0	0
0·025	0·66043	0·33926	0·05937	0·01036
0·050	0·65881	0·33994	0·09664	0·02076
0·075	0·65609	0·34109	0·12544	0·03127
0·100	0·65227	0·34272	0·14863	0·04192
0·125	0·64731	0·34485	0·16754	0·05278
0·150	0·64115	0·34754	0·18289	0·06392
0·175	0·63375	0·35082	0·19514	0·07540
0·200	0·62503	0·35477	0·20456	0·08732
0·225	0·61489	0·35947	0·21132	0·09978
0·250	0·60321	0·36504	0·21548	0·11293
0·275	0·58979	0·37165	0·21701	0·12694
0·300	0·57438	0·37956	0·21577	0·14210
0·325	0·55657	0·38914	0·21148	0·15878
0·350	0–53569	0·40106	0·20351	0·17769
0·375	0·51026	0·41676	0·19051	0·20025
0·400	0·47344	0·44308	0–16565	0·23333
0·425	0·43625	0·46894	0·14003	0·26588
0·450	0·40972	0·48331	0·12474	0·28684
0·475	0·38700	0·49299	0·11294	0·30307
0·500	0·36660	0·49942	0·10322	0·31598
0·525	0·34786	0·50324	0·09491	0·32626
0·550	0·33034	0·50483	0·08764	0·33427
0·575	0·31376	0·50439	0·08117	0·34024
0·600	0·29794	0·50206	0·07531	0·34433
0·625	0·28272	0·49791	0·06997	0·34661
0·650	0·26795	0·49198	0·06502	0·34715
0·675	0·25356	0·48426	0·06041	0·34596
0·700	0·23941	0·47473	0·05608	0·34302
0·725	0·22545	0·46330	0·05197	0·33830
0·750	0·21156	0·44988	0·04805	0·33171
0·775	0·19764	0·43432	0·04426	0·32315
0·800	0·18360	0·41640	0·04058	0·31244
0·825	0·16931	0·39582	0·03695	0·29937
0·850	0·15460	0·37218	0·03334	0·28359
0·875	0·13926	0·34486	0·02969	0·26463
0·900	0·12296	0·31293	0·02592	0·24173
0·925	0·10515	0·27482	0·02194	0·21362
0·950	0·08481	0·22744	0·01753	0·17784
0·9625	0·07301	0·19827	0·01501	0·15548
0·975	0·05926	0·16294	0·01213	0·12813
0·98125	0·05117	0·14157	0·01046	0·11147
0·990625	0·03603	0·10058	0·00733	0·07936
1·000	0	0	0	0

TABLE 1—*continued*

M Functions

$\eta^* = 0{\cdot}45$ $\cos\phi^* = 0{\cdot}45$ $\sin\phi^* = 0{\cdot}893029$ $\phi^* = 1{\cdot}104031$

η	Centre flaps	Tip flaps	Centre ailerons	Tip ailerons
0	0·70873	0·29127	0	0
0·025	0·70825	0·29144	0·06107	0·00866
0·050	0·70678	0·29197	0·10005	0·01735
0·075	0·70432	0·29286	0·13059	0·02612
0·100	0·70087	0·29412	0·15556	0·03499
0·125	0·69639	0·29577	0·17630	0·04402
0·150	0·69086	0·29783	0·19358	0·05323
0·175	0·68423	0·30034	0·20784	0·06270
0·200	0·67647	0·30333	0·21942	0·07246
0·225	0·66750	0·30686	0·22850	0·08260
0·250	0·65725	0·31100	0·23521	0·09320
0·275	0·64560	0·31584	0·23960	0·10435
0·300	0·63244	0·32150	0·24167	0·11620
0·325	0·61756	0·32815	0·24134	0·12892
0·350	0·60072	0·33603	0·23842	0·14278
0·375	0·58148	0·34554	0·23259	0·15817
0·400	0·55919	0·35733	0·22321	0·17577
0·425	0·53235	0·37284	0·20890	0·19701
0·450	0·49412	0·39891	0·18282	0·22876
0·475	0·45552	0·42447	0·15607	0·25994
0·500	0·42757	0·43845	0·13969	0·27951
0·525	0·40342	0·44768	0·12687	0·29430
0·550	0·38157	0·45359	0·11617	0·30574
0·575	0·36135	0·45680	0·10693	0·31448
0·600	0·34233	0·45767	0·09876	0·32088
0·625	0·32421	0·45641	0·09140	0·32518
0·650	0·30680	0·45313	0·08468	0·32749
0·675	0·28993	0·44789	0·07849	0·32788
0·700	0·27345	0·44069	0·07270	0·32640
0·725	0·25724	0·43151	0·06726	0·32301
0·750	0·24118	0·42026	0·06208	0·31768
0·775	0·22514	0·40682	0·05711	0·31030
0·800	0·20901	0·39099	0·05229	0·30073
0·825	0·19262	0·37251	0·04757	0·28875
0·850	0·17579	0·35099	0·04288	0·27405
0·875	0·15826	0·32586	0·03816	0·25616
0·900	0·13967	0·29622	0·03329	0·23436
0·925	0·11940	0·26057	0·02816	0·20740
0·950	0·09627	0·21598	0·02248	0·17289
0·9625	0·08285	0·18843	0·01925	0·15124
0·975	0·06724	0·15496	0·01555	0·12471
0·98125	0·05806	0·13468	0·01340	0·10853
0·990625	0·04087	0·09574	0·00939	0·07730
1·000	0	0	0	0

TABLE 1—*continued*

M Functions

$\eta^* = 0{\cdot}5$ $\cos\phi^* = 0{\cdot}5$ $\sin\phi^* = 0{\cdot}866025$ $\phi^* = 1{\cdot}047198$

η	Centre flaps	Tip flaps	Centre ailerons	Tip ailerons
0	0·75253	0·24747	0	0
0·025	0·75208	0·24760	0·06255	0·00718
0·050	0·75074	0·24801	0·10301	0·01439
0·075	0·74848	0·24870	0·13506	0·02165
0·100	0·74531	0·24968	0·16156	0·02899
0·125	0·74120	0·25095	0·18388	0·03644
0·150	0·73614	0·25255	0·20278	0·04403
0·175	0·73010	0·25447	0·21875	0·05179
0·200	0·72304	0·25676	0·23210	0·05978
0·225	0·71492	0·25944	0·24308	0·06802
0·250	0·70568	0·26256	0·25182	0·07659
0·275	0·69527	0·26617	0·25842	0·08553
0·300	0·68360	0·27034	0·26294	0·09493
0·325	0·67055	0·27517	0·26536	0·10490
0·350	0·65599	0·28076	0·26565	0·11555
0·375	0·63972	0·28730	0·26368	0·12708
0·400	0·62149	0·29503	0·25925	0·13973
0·425	0·60087	0·30432	0·25202	0·15389
0·450	0·57718	0·31584	0·24135	0·17023
0·475	0·54895	0·33103	0·22581	0·19020
0·500	0·50931	0·35671	0·19856	0·22064
0·525	0·46928	0·38182	0·17070	0·25047
0·550	0·43989	0·39528	0·15326	0·26865
0·575	0·41425	0·40390	0·13942	0·28199
0·600	0·39089	0·40911	0·12773	0·29191
0·625	0·36911	0·41151	0·11752	0·29906
0·650	0·34847	0·41146	0·10839	0·30378
0·675	0·32867	0·40914	0·10010	0·30627
0·700	0·30950	0·40464	0·09245	0·30665
0·725	0·29076	0·39799	0·08532	0·30495
0·750	0·27229	0·38915	0·07859	0·30117
0·775	0·25393	0·37803	0·07217	0·29524
0·800	0·23552	0·36448	0·06598	0·28704
0·825	0·21689	0·34825	0·05994	0·27638
0·850	0·19780	0·32899	0·05396	0·26297
0·875	0·17796	0·30616	0·04797	0·24635
0·900	0·15696	0·27893	0·04182	0·22583
0·925	0·13411	0·24586	0·03535	0·20021
0·950	0·10808	0·20417	0·02819	0·16718
0·9625	0·09300	0·17828	0·02413	0·14636
0·975	0·07546	0·14675	0·01949	0·12077
0·98125	0·06515	0·12759	0·01679	0·10514
0·990625	0·04585	0·09076	0·01177	0·07492
1·000	0	0	0	0

TABLE 1—*continued*

M Functions

$\eta^* = 0{\cdot}55$ $\cos\phi^* = 0{\cdot}55$ $\sin\phi^* = 0{\cdot}835165$ $\phi^* = 0{\cdot}988432$

η	Centre flaps	Tip flaps	Centre ailerons	Tip ailerons
0	0·79266	0·20734	0	0
0·025	0·79224	0·20745	0·06384	0·00589
0·050	0·79098	0·20777	0·10560	0·01180
0·075	0·78888	0·20830	0·13897	0·01774
0·100	0·78593	0·20906	0·16680	0·02375
0·125	0·78212	0·21004	0·19048	0·02984
0·150	0·77743	0·21126	0·21078	0·03603
0·175	0·77183	0·21274	0·22819	0·04235
0·200	0·76531	0·21449	0·24306	0·04882
0·225	0·75783	0·21653	0·25562	0·05548
0·250	0·74936	0·21889	0·26604	0·06237
0·275	0·73984	0·22160	0·27442	0·06953
0·300	0·72923	0·22471	0·28087	0·07700
0·325	0·71744	0·22827	0·28541	0·08485
0·350	0·70440	0·23235	0·28805	0·09315
0·375	0·68998	0·23704	0·28875	0·10201
0·400	0·67407	0·24245	0·28744	0·11154
0·425	0·65643	0·24876	0·28399	0·12192
0·450	0·63682	0·25621	0·27817	0·13341
0·475	0·61482	0·26517	0·26963	0·14638
0·500	0·58971	0·27631	0·25770	0·16150
0·525	0·56006	0·29104	0·24097	0·18020
0·550	0·51896	0·31620	0·21258	0·20933
0·575	0·47743	0·34072	0·18361	0·23780
0·600	0·44651	0·35349	0·16510	0·25454
0·625	0·41928	0·36134	0·15020	0·26638
0·650	0·39428	0·36565	0·13747	0·27470
0·675	0·37078	0·36704	0·12622	0·28015
0·700	0·34832	0·36582	0·11607	0·28303
0·725	0·32660	0·36215	0·10673	0·28354
0·750	0·30536	0·35608	0·09803	0–28173
0·775	0·28438	0·34758	0·08980	0·27761
0·800	0·26346	0·33654	0·08193	0·27109
0·825	0·24236	0·32277	0·07430	0·26202
0·850	0·22083	0·30595	0·06679	0·25014
0·875	0·19852	0·28560	0·05930	0·23502
0·900	0·17498	0·26091	0·05163	0·21602
0·925	0·14941	0·23056	0·04360	0·19196
0·950	0·12033	0·19192	0·03474	0·16063
0·9625	0·10351	0·16777	0·02973	0·14076
0·975	0·08396	0·13824	0·02399	0·11627
0·98125	0·07248	0·12026	0·02067	0·10126
0·990625	0·05101	0·08560	0·01449	0·07220
1·000	0	0	0	0

TABLE 1—*continued*

M Functions

$\eta^* = 0{\cdot}6$ $\cos\phi^* = 0{\cdot}6$ $\sin\phi^* = 0{\cdot}8$ $\phi^* = 0{\cdot}927296$

η	Centre flaps	Tip flaps	Centre ailerons	Tip ailerons
0	0·82930	0·17070	0	0
0·025	0·82891	0·17078	0·06497	0·00476
0·050	0·82773	0·17102	0·10788	0·00952
0·075	0·82575	0·17143	0·14239	0·01432
0·100	0·82299	0·17200	0·17139	0·01916
0·125	0·81941	0·17275	0·19626	0·02406
0·150	0·81500	0·17369	0·21777	0·02904
0·175	0·80976	0·17481	0·23643	0·03411
0·200	0·80367	0·17613	0·25259	0·03929
0·225	0·79668	0·17768	0·26649	0·04461
0·250	0·78880	0·17945	0·27832	0·05009
0·275	0·77995	0·18149	0·28819	0·05576
0·300	0·77013	0·18381	0·29622	0·06165
0·325	0·75927	0·18644	0·30246	0·06780
0·350	0·74731	0·18944	0·30693	0·07427
0·375	0·73418	0·19284	0·30967	0·08109
0·400	0·71980	0·19672	0·31062	0·08836
0·425	0·70402	0·20117	0·30975	0·09616
0·450	0·68673	0·20630	0·30697	0·10461
0·475	0·66771	0·21228	0·30213	0·11388
0·500	0·64668	0·21934	0·29497	0·12423
0·525	0·62325	0·22785	0·28515	0·13602
0·550	0·59668	0·23848	0·27200	0·14991
0·575	0·56551	0·25264	0·25407	0·16734
0·600	0·52285	0·27715	0·22452	0·19512
0·625	0·47972	0·30091	0·19440	0·22218
0·650	0·44710	0·31283	0·17475	0·23742
0·675	0·41811	0·31971	0·15873	0·24764
0·700	0·39124	0·32290	0·14486	0·25424
0·725	0·36574	0·32301	0·13247	0·25780
0·750	0·34115	0·32029	0·12115	0·25861
0·775	0·31709	0·31487	0·11060	0·25681
0·800	0·29328	0·30672	0·10062	0·25240
0·825	0·26942	0·29571	0·09103	0·24529
0·850	0·24519	0·28159	0·08167	0·23526
0·875	0·22019	0·26393	0·07238	0·22194
0·900	0·19389	0·24200	0·06293	0·20472
0·925	0·16542	0·21455	0·05306	0·18250
0·950	0·13313	0·17912	0·04224	0·15313
0·9625	0·11449	0·15679	0·03612	0·13437
0·975	0·09284	0·12936	0·02914	0·11112
0·98125	0·08013	0·11261	0·02509	0·09684
0·990625	0·05638	0·08023	0·01758	0·06911
1·000	0	0	0	0

TABLE 1—*continued*

M Functions

$\eta^* = 0{\cdot}65$ $\cos\phi^* = 0{\cdot}65$ $\sin\phi^* = 0{\cdot}759934$ $\phi^* = 0{\cdot}863212$

η	Centre flaps	Tip flaps	Centre ailerons	Tip ailerons
0	0·86263	0·13737	0	0
0·025	0·86226	0·13743	0·06597	0·00376
0·050	0·86114	0·13761	0·10987	0·00753
0·075	0·85926	0·13792	0·14539	0·01132
0·100	0·85664	0·13835	0·17541	0·01514
0·125	0·85324	0·13892	0·20131	0·01901
0·150	0·84908	0·13961	0·22388	0·02293
0·175	0·84411	0·14046	0·24362	0·02692
0·200	0·83835	0·14145	0·26089	0·03099
0·225	0·83176	0·14260	0·27594	0·03516
0·250	0·82433	0·14392	0·28897	0·03944
0·275	0·81602	0·14542	0·30009	0·04386
0·300	0·80681	0·14713	0·30944	0·04843
0·325	0·79664	0·14907	0·31708	0·05318
0·350	0·78550	0·15125	0·32305	0·05815
0·375	0·77330	0·15372	0·32740	0·06336
0·400	0·76001	0·15651	0·33011	0·06887
0·425	0·74552	0·15967	0·33119	0·07472
0·450	0·72976	0·16327	0·33059	0·08099
0·475	0·71261	0·16738	0·32825	0·08776
0·500	0·69388	0·17214	0·32404	0·09516
0·525	0·67342	0·17768	0·31783	0·10334
0·550	0·65091	0·18425	0·30937	0·11254
0·575	0·62594	0·19221	0·29827	0·12314
0·600	0·59779	0·20221	0·28386	0·13578
0·625	0·56496	0·21566	0·26469	0·15189
0·650	0·52058	0·23935	0·23391	0·17826
0·675	0·47563	0·26219	0·20256	0·20381
0·700	0·44108	0·27306	0·18168	0·21742
0·725	0·41003	0·27872	0·16439	0·22588
0·750	0·38093	0·28051	0·14924	0·23052
0·775	0·35299	0·27897	0·13551	0·23190
0·800	0·32570	0·27430	0·12275	0·23027
0·825	0·29861	0·26652	0·11068	0·22564
0·850	0·27130	0·25548	0·09902	0·21791
0·875	0·24330	0·24082	0·08755	0·20677
0·900	0·21398	0·22191	0·07597	0·19168
0·925	0·18236	0·19761	0·06395	0·17161
0·950	0·14663	0·16562	0·05082	0·14455
0·9625	0·12604	0·14524	0·04344	0·12705
0·975	0·10216	0·12004	0·03502	0·10524
0·98125	0·08816	0·10458	0·03015	0·09178
0·990625	0·06201	0·07460	0·02111	0·06558
1·000	0	0	0	0

TABLE 1—*continued*

M Functions

$\eta^* = 0{\cdot}7$ $\cos\phi^* = 0{\cdot}7$ $\sin\phi^* = 0{\cdot}714143$ $\phi^* = 0{\cdot}795399$

η	Centre flaps	Tip flaps	Centre ailerons	Tip ailerons
0	0·89274	0·10726	0	0
0·025	0·89238	0·10731	0·06684	0·00289
0·050	0·89131	0·10744	0·11161	0·00579
0·075	0·88951	0·10767	0·14801	0·00870
0·100	0·88701	0·10798	0·17892	0·01163
0·125	0·88376	0·10840	0·20572	0·01460
0·150	0·87978	0·10891	0·22921	0·01760
0·175	0·87505	0·10952	0·24989	0·02065
0·200	0·86955	0·11025	0·26812	0·02376
0·225	0·86327	0·11109	0·28416	0·02694
0·250	0·85620	0·11205	0·29821	0·03020
0·275	0·84830	0·11314	0·31040	0·03355
0·300	0·83956	0·11438	0·32086	0·03701
0·325	0·82994	0·11577	0·32966	0·04060
0·350	0·81941	0·11734	0·33687	0·04433
0·375	0·80792	0·11910	0·34253	0·04823
0·400	0·79544	0·12107	0·34666	0·05232
0·425	0·78189	0·12330	0·34926	0·05665
0·450	0·76723	0·12580	0·35034	0·06124
0·475	0·75135	0·12864	0·34985	0·06616
0·500	0·73414	0·13188	0·34775	0·07145
0·525	0·71552	0·13558	0·34395	0·07722
0·550	0·69530	0·13986	0·33835	0·08356
0·575	0·67327	0·14488	0·33077	0·09064
0·600	0·64914	0·15086	0·32096	0·09868
0·625	0·62248	0·15814	0·30853	0·10805
0·650	0·59255	0·16738	0·29278	0·11939
0·675	0·55786	0·17996	0·27228	0·13409
0·700	0·51147	0·20267	0·24015	0·15895
0·725	0·46437	0·22438	0·20743	0·18284
0·750	0·42751	0·23393	0·18512	0·19464
0·775	0·39391	0·23805	0·16635	0·20106
0·800	0·36198	0·23802	0·14961	0·20341
0·825	0·33084	0·23429	0·13417	0·20215
0·850	0·29985	0·22693	0·11954	0·19739
0·875	0·26836	0·21576	0·10533	0·18899
0·900	0·23561	0·20028	0·09115	0·17650
0·925	0·20051	0·17946	0·07654	0·15902
0·950	0·16101	0·15124	0·06071	0·13466
0·9625	0·13833	0·13295	0·05185	0·11864
0·975	0·11206	0·11014	0·04176	0·09850
0·98125	0·09668	0·09606	0·03594	0·08599
0·990625	0·06797	0·06864	0·02515	0·06154
1·000	0	0	0	0

TABLE 1—*continued*

M Functions

$\eta^* = 0{\cdot}75$ $\cos\phi^* = 0{\cdot}75$ $\sin\phi^* = 0{\cdot}661438$ $\phi^* = 0{\cdot}722734$

η	Centre flaps	Tip flaps	Centre ailerons	Tip ailerons
0	0·91965	0·08035	0	0
0·025	0·91931	0·08038	0·06760	0·00213
0·050	0·91828	0·08047	0·11313	0·00427
0·075	0·91654	0·08064	0·15029	0·00642
0·100	0·91413	0·08086	0·18197	0·00858
0·125	0·91101	0·08115	0·20955	0·01077
0·150	0·90718	0·08151	0·23383	0·01298
0·175	0·90262	0·08195	0·25532	0·01522
0·200	0·89734	0·08246	0·27437	0·01751
0·225	0·89131	0·08305	0·29126	0·01984
0·250	0·88453	0·08372	0·30619	0·02222
0·275	0·87695	0·08449	0·31928	0·02467
0·300	0·86859	0·08535	0·33067	0·02720
0·325	0·85939	0·08632	0·34046	0·02980
0·350	0·84934	0·08741	0·34869	0·03251
0·375	0·83840	0·08862	0·35544	0·03532
0·400	0·82654	0·08998	0·36071	0·03827
0·425	0·81368	0·09151	0·36455	0·04136
0·450	0·79982	0·09321	0·36695	0·04463
0·475	0·78486	0·09513	0·36791	0·04810
0·500	0·76873	0·09729	0·36739	0·05181
0·525	0·75136	0·09974	0·36537	0·05580
0·550	0·73263	0·10253	0·36177	0·06014
0·575	0·71241	0·10574	0·35652	0·06489
0·600	0·69053	0·10947	0·34946	0·07018
0·625	0·66676	0·11386	0·34045	0·07613
0·650	0·64080	0·11913	0·32920	0·08297
0·675	0·61220	0·12562	0·31531	0·09106
0·700	0·58019	0·13395	0·29810	0·10100
0·725	0·54327	0·14548	0·27609	0·11418
0·750	0·49447	0·16697	0·24240	0·13736
0·775	0·44470	0·18726	0·20803	0·15938
0·800	0·40486	0·19514	0·18397	0·16905
0·825	0·36787	0·19726	0·16330	0·17302
0·850	0·33202	0·19476	0·14445	0·17248
0·875	0·29621	0·18791	0·12660	0·16772
0·900	0·25941	0·17648	0·10910	0·15855
0·925	0·22030	0·15967	0·09131	0·14425
0·950	0·17659	0·13566	0·07222	0·12315
0·9625	0·15160	0·11968	0·06160	0·10889
0·975	0·12272	0·09948	0·04956	0·09070
0·98125	0·10584	0·08690	0·04262	0·07931
0·990625	0·07438	0·06223	0·02981	0·05688
1·000	0	0	0	0

TABLE 1—*continued*

M Functions

$\eta^* = 0{\cdot}8$ $\cos\phi^* = 0{\cdot}8$ $\sin\phi^* = 0{\cdot}6$ $\phi^* = 0{\cdot}643501$

η	Centre flaps	Tip flaps	Centre ailerons	Tip ailerons
0	0·94335	0·05665	0	0
0·025	0·94302	0·05667	0·06825	0·00148
0·050	0·94202	0·05673	0·11443	0·00297
0·075	0·94034	0·05684	0·15225	0·00446
0·100	0·93800	0·05699	0·18458	0·00597
0·125	0·93497	0·05719	0·21284	0·00748
0·150	0·93126	0·05743	0·23779	0·00902
0·175	0·92685	0·05772	0·25996	0·01058
0·200	0·92174	0·05806	0·27972	0·01216
0·225	0·91591	0·05845	0·29733	0·01377
0·250	0·90935	0·05890	0·31299	0·01542
0·275	0·90204	0·05940	0·32684	0·01711
0·300	0·89396	0·05998	0·33903	0·01884
0·325	0·88509	0·06062	0·34962	0·02064
0·350	0·87542	0·06133	0·35871	0·02249
0·375	0·86490	0·06213	0·36635	0·02441
0·400	0·85350	0·06302	0·37256	0·02642
0·425	0·84118	0·06401	0·37740	0·02851
0·450	0·82791	0·06512	0·38086	0·03072
0·475	0·81364	0·06635	0·38296	0·03305
0·500	0·79828	0·06774	0·38368	0·03552
0·525	0·78181	0·06929	0·38300	0·03817
0·550	0·76412	0·07105	0·38089	0·04102
0·575	0·74511	0·07304	0·37731	0·04410
0·600	0·72467	0·07533	0·37216	0·04748
0·625	0·70266	0·07797	0·36535	0·05123
0·650	0·67888	0·08105	0·35675	0·05542
0·675	0·65310	0·08472	0·34616	0·06021
0·700	0·62499	0·08915	0·33330	0·06580
0·725	0·59406	0·09469	0·31777	0·07250
0·750	0·55952	0·10192	0·29884	0·08092
0·775	0·51979	0·11217	0·27501	0·09240
0·800	0·46785	0·13215	0·23937	0·11365
0·825	0·41450	0·15063	0·20288	0·13344
0·850	0·37050	0·15628	0·17645	0·14048
0·875	0·32853	0·15559	0·15306	0·14126
0·900	0·28647	0·14942	0·13096	0·13669
0·925	0·24248	0·13749	0·10901	0·12655
0·950	0·19387	0·11838	0·08586	0·10951
0·9625	0·16623	0·10505	0·07310	0·09739
0·975	0·13444	0·08777	0·05872	0·08154
0·98125	0·11588	0·07686	0·05046	0·07147
0·990625	0·08138	0·05523	0·03526	0·05143
1·000	0	0	0	0

TABLE 1—*continued*

M Functions

$\eta^* = 0{\cdot}85$ $\cos\phi^* = 0{\cdot}85$ $\sin\phi^* = 0{\cdot}526783$ $\phi^* = 0{\cdot}554811$

η	Centre flaps	Tip flaps	Centre ailerons	Tip ailerons
0	0·96372	0·03628	0	0
0·025	0·96340	0·03629	0·06879	0·00094
0·050	0·96242	0·03633	0·11552	0·00188
0·075	0·96079	0·03639	0·15389	0·00282
0·100	0·95851	0·03648	0·18678	0·00377
0·125	0·95556	0·03660	0·21559	0·00473
0·150	0·95194	0·03675	0·24111	0·00570
0·175	0·94764	0·03693	0·26386	0·00668
0·200	0·94267	0·03713	0·28420	0·00768
0·225	0·93699	0·03737	0·30241	0·00869
0·250	0·93061	0·03764	0·31868	0·00973
0·275	0·92349	0·03795	0·33316	0·01079
0·300	0·91565	0·03829	0·34599	0·01188
0·325	0·90703	0·03868	0·35726	0·01300
0·350	0·89764	0·03911	0·36704	0·01416
0·375	0·88743	0·03959	0·37541	0·01535
0·400	0·87640	0·04012	0·38238	0·01660
0·425	0·86448	0·04071	0·38801	0·01790
0·450	0·85166	0·04137	0·39232	0·01926
0·475	0·83789	0·04210	0·39532	0·02069
0·500	0·82310	0·04292	0·39700	0·02220
0·525	0·80727	0·04383	0·39736	0·02381
0·550	0·79031	0·04485	0·39638	0·02553
0·575	0·77215	0·04600	0·39403	0·02738
0·600	0·75270	0·04730	0·39025	0·02939
0·625	0·73183	0·04879	0·38500	0·03158
0·650	0·70943	0·05050	0·37816	0·03401
0·675	0·68533	0·05249	0·36964	0·03673
0·700	0·65930	0·05484	0·35929	0·03981
0·725	0·63108	0·05767	0·34689	0·04338
0·750	0·60030	0·06114	0·33214	0·04762
0·775	0·56641	0·06555	0·31459	0·05282
0·800	0·52856	0·07144	0·29350	0·05952
0·825	0·48503	0·08010	0·26729	0·06903
0·850	0·42866	0·09812	0·22899	0·08794
0·875	0·36999	0·11413	0·18942	0·10490
0·900	0·31933	0·11656	0·15929	0·10836
0·925	0·26856	0·11141	0·13120	0·10436
0·950	0·21374	0·09851	0·10258	0·09279
0·9625	0·18294	0·08834	0·08708	0·08341
0·975	0·14770	0·07450	0·06977	0·07049
0·98125	0·12722	0·06552	0·05989	0·06204
0·990625	0·08925	0·04736	0·04178	0·04491
1·000	0	0	0	0

TABLE 1—*continued*

M Functions

$\eta^* = 0{\cdot}9$ $\cos\phi^* = 0{\cdot}9$ $\sin\phi^* = 0{\cdot}435890$ $\phi^* = 0{\cdot}451027$

η	Centre flaps	Tip flaps	Centre ailerons	Tip ailerons
0	0·98052	0–01948	0	0
0·025	0·98021	0·01948	0·06923	0·00050
0·050	0·97925	0·01950	0·11640	0·00100
0·075	0·97764	0·01954	0·15521	0·00150
0·100	0·97541	0·01958	0·18855	0·00200
0·125	0·97251	0·01965	0·21781	0·00251
0·150	0·96897	0·01972	0·24379	0·00302
0·175	0·96476	0·01981	0·26700	0·00354
0·200	0·95988	0·01992	0·28781	0·00407
0·225	0·95432	0·02004	0·30649	0–00461
0·250	0·94807	0·02018	0·32326	0·00515
0·275	0·94111	0·02033	0·33824	0·00571
0·300	0·93343	0·02051	0·35158	0·00629
0·325	0·92501	0·02070	0·36339	0·00687
0·350	0·91583	0·02092	0·37372	0·00748
0·375	0·90586	0·02117	0·38265	0·00811
0·400	0·89508	0·02143	0·39022	0·00876
0·425	0·88346	0·02173	0·39647	0·00944
0·450	0·87097	0·02206	0·40144	0·01014
0·475	0·85756	0·02243	0·40512	0·01089
0·500	0·84320	0·02283	0·40753	0·01167
0·525	0·82782	0·02328	0·40868	0·01249
0·550	0·81138	0·02379	0·40854	0·01337
0·575	0·79380	0·02435	0·40710	0·01431
0·600	0·77501	0·02499	0·40431	0·01533
0·625	0·75492	0·02570	0·40016	0·01642
0·650	0·73341	0·02652	0·39454	0·01763
0·675	0·71036	0·02746	0·38741	0·01896
0·700	0·68559	0·02855	0·37866	0·02044
0·725	0·65891	0·02984	0·36814	0·02213
0·750	0·63007	0·03137	0·35569	0·02407
0·775	0·59872	0·03324	0·34104	0·02637
0·800	0·56441	0·03559	0·32387	0·02915
0·825	0·52648	0·03865	0·30365	0·03267
0·850	0·48388	0·04290	0·27953	0·03740
0·875	0·43464	0·04948	0·24982	0·04450
0·900	0·37110	0·06479	0·20728	0·06037
0·925	0·30291	0·07706	0·16230	0·07326
0·950	0·23840	0·07385	0·12460	0·07077
0·9625	0·20326	0·06802	0·10514	0·06535
0·975	0·16360	0·05861	0·08382	0·05644
0·98125	0·14072	0·05202	0·07179	0·05014
0·990625	0·09853	0·03808	0·04994	0·03675
1·000	0	0	0	0

TABLE 1—*continued*

M Functions

$\eta^* = 0{\cdot}95$ $\cos\phi^* = 0{\cdot}95$ $\sin\phi^* = 0{\cdot}312250$ $\phi^* = 0{\cdot}317560$

η	Centre flaps	Tip flaps	Centre ailerons	Tip ailerons
0	0·99320	0·00680	0	0
0·025	0·99289	0·00680	0·06956	0·00017
0·050	0·99194	0·00681	0·11706	0·00034
0·075	0·99036	0·00682	0·15619	0·00052
0·100	0·98816	0·00683	0·18986	0·00069
0·125	0·98531	0·00685	0·21946	0·00086
0·150	0·98181	0·00688	0·24577	0·00104
0·175	0·97766	0·00691	0·26932	0·00122
0·200	0·97286	0·00694	0·29048	0·00140
0·225	0·96738	0·00698	0·30951	0·00159
0·250	0·96122	0·00703	0·32663	0·00178
0·275	0·95436	0·00708	0·34198	0·00197
0·300	0·94680	0·00714	0·35571	0·00216
0·325	0·93851	0·00720	0·36789	0·00237
0·350	0·92947	0·00728	0·37863	0·00257
0·375	0·91966	0·00736	0·38797	0·00279
0·400	0·90908	0·00744	0·39597	0·00301
0·425	0·89765	0·00754	0·40267	0·00324
0·450	0·88538	0·00765	0·40810	0·00348
0·475	0·87222	0·00777	0·41228	0·00373
0·500	0·85812	0·00790	0·41521	0·00399
0·525	0·84305	0·00805	0·41690	0·00427
0·550	0·82695	0·00821	0·41735	0·00456
0·575	0·80975	0·00840	0·41653	0·00488
0·600	0·79140	0·00860	0·41443	0·00521
0·625	0·77179	0·00883	0·41100	0·00558
0·650	0·75084	0·00909	0·40620	0·00597
0·675	0·72844	0·00938	0·39997	0·00640
0·700	0·70442	0·00972	0·39222	0·00688
0·725	0·67864	0·01011	0·38286	0·00741
0·750	0·65087	0·01057	0·37175	0·00801
0·775	0·62084	0·01112	0·35870	0·00871
0·800	0·58821	0·01179	0·34349	0·00953
0·825	0·55251	0·01262	0·32579	0·01053
0·850	0·51307	0·01371	0·30515	0·01178
0·875	0·46894	0·01518	0·28089	0·01343
0·900	0·41853	0·01736	0·25185	0·01580
0·925	0·35889	0·02108	0·21582	0·01974
0·950	0·28015	0·03210	0·16435	0·03102
0·9625	0·23300	0·03828	0·13314	0·03735
0·975	0·18547	0·03673	0·10429	0·03597
0·098125	0·15890	0·03384	0·08875	0·03318
0·990625	0·11072	0·02589	0·06126	0·02543
1·000	0	0	0	0

TABLE 1—*continued*

M Functions

$\eta^* = 1$ $\cos \phi^* = 1$ $\sin \phi^* = 0$ $\phi^* = 0$

η	Centre flaps	Centre ailerons	η	Centre flaps	Centre ailerons
0	1·00000	0	0·550	0·83516	0·42191
0·025	0·99969	0·06973	0·575	0·81815	0·42141
0·050	0·99875	0·11740	0·600	0·80000	0·41964
0·075	0·99718	0·15671	0·625	0·78062	0·41658
0·100	0·99499	0·19055	0·650	0·75993	0·41217
0·125	0·99216	0·22032	0·675	0·73782	0·40637
0·150	0·98869	0·24681	0·700	0·71414	0·39910
0·175	0·98457	0·27054	0·725	0·68875	0·39027
0·200	0·97980	0·29188	0·750	0·66144	0·37976
0·225	0·97436	0·31110	0·775	0·63196	0·36741
0·250	0·96825	0·32841	0·800	0·60000	0·35302
0·275	0·96144	0·34395	0·825	0·56513	0·33632
0·300	0·95394	0·35787	0·850	0·52678	0·31693
0·325	0·94571	0·37026	0·875	0·48412	0·29432
0·350	0·93675	0·38120	0·900	0·43589	0·26765
0·375	0·92702	0·39076	0·925	0·37997	0·23556
0·400	0·91652	0·39898	0·950	0·31225	0·19537
0·425	0·90519	0·40591	0·9625	0·27128	0·17049
0·450	0·89303	0·41158	0·975	0·22220	0·14026
0·475	0·87999	0·41601	0·98125	0·19274	0·12193
0·500	0·86602	0·41920	0·990625	0·13661	0·08669
0·525	0·85110	0·42117	1·000	0	0

Tip flaps M is 0 for all values of η above
Tip ailerons M ,, ,, ,, ,, ,,

TABLE 2

Constants for use with Multhopp Functions: Lift

η	Centre flaps		Tip flaps		Centre ailerons		Tip ailerons	
	T_1	T_2	T_3	T_4	T_5	T_6	T_7	T_8
0	0	0	1·57080	8·00000	0	0	1·33333	0·84883
0·05	0·09996	0·50908	1·47084	7·49092	0·00500	0·00318	1·32834	0·84565
0·10	0·19967	1·01689	1·37113	6·98311	0·01995	0·01270	1·31338	0·83613
0·15	0·29887	1·52214	1·27193	6·47786	0·04475	0·02849	1·28859	0·82034
0·20	0·39732	2·02352	1·17348	5·97648	0·07919	0·05042	1·25414	0·79841
0·25	0·49474	2·51970	1·07605	5·48030	0·12303	0·07832	1·21031	0·77051
0·30	0·59087	3·00930	0·97992	4·99070	0·17589	0·11198	1·15745	0·73685
0·35	0·68543	3·49088	0·88536	4·50912	0·23734	0·15110	1·09600	0·69773
0·40	0·77812	3·96295	0·79267	4·03705	0·30684	0·19534	1·02650	0·65349
0·45	0·86863	4·42389	0·70217	3·57611	0·38375	0·24430	0·94959	0·60453
0·50	0·95661	4·87198	0·61418	3·12802	0·46731	0·29750	0·86603	0·55133
0·55	1·04170	5·30536	0·52909	2·69464	0·55663	0·35437	0·77670	0·49446
0·60	1·12350	5·72194	0·44730	2·27806	0·65067	0·41423	0·68267	0·43460
0·65	1·20154	6·11940	0·36925	1·88060	0·74818	0·47631	0·58515	0·37252
0·70	1·27530	6·49505	0·29550	1·50495	0·84772	0·53968	0·48562	0·30915
0·75	1·34414	6·84565	0·22666	1·15435	0·94749	0·60320	0·38584	0·24563
0·80	1·40730	7·16729	0·16350	0·83271	1·04533	0·66548	0·28800	0·18335
0·85	1·46375	7·45482	0·10705	0·54518	1·13842	0·72475	0·19491	0·12408
0·90	1·51207	7·70091	0·05873	0·29909	1·22291	0·77853	0·11043	0·07030
0·95	1·54987	7·89344	0·02092	0·10656	1·29274	0·82299	0·04059	0·02584
1·0	1·57080	8·00000	0	0	1·33333	0·84883	0	0

TABLE 3

Constants for use with Multhopp Functions.
Centre of Pressure of Half Wing Loading

η	T_9	T_{10}
0	0	0·33333
0·05	0·01596	0·31737
0·10	0·03213	0·30120
0·15	0·04861	0·28472
0·20	0·06546	0·26787
0·25	0·08272	0·25061
0·30	0·10039	0·23294
0·35	0·11845	0·21488
0·40	0·13686	0·19647
0·45	0·15558	0·17775
0·50	0·17452	0·15881
0·55	0·19359	0·13974
0·60	0·21266	0·12067
0·65	0·23159	0·10174
0·70	0·25018	0·08315
0·75	0·26820	0·06513
0·80	0·28536	0·04797
0·85	0·30127	0·03206
0·90	0·31538	0·01795
0·95	0·32680	0·00653
1·00	0·33333	0

TABLE 4

Limit of Multhopp Functions as $\eta \to 1$

$M \to T_n\sqrt{(1 - \eta^2)}$, where $T_{11} \equiv$ centre flaps, $T_{12} \equiv$ tip flaps, $T_{13} \equiv$ centre ailerons, $T_{14} \equiv$ tip ailerons

η^*	T_{11}	T_{12}	T_{13}	T_{14}
0	0	1·00000	0	0·63662
0·05	0·03184	0·96816	0·00080	0·63582
0·10	0·06377	0·93623	0·00319	0·63343
0·15	0·09585	0·90415	0·00720	0·62942
0·20	0·12819	0·87181	0·01286	0·62376
0·25	0·16086	0·83914	0·02022	0·61640
0·30	0·19397	0·80603	0·02932	0·60730
0·35	0·22764	0·77236	0·04027	0·59635
0·40	0·26198	0·73802	0·05315	0·58347
0·45	0·29715	0·70285	0·06810	0·56852
0·50	0·33333	0·66667	0·08529	0·55133
0·55	0·37074	0·62926	0·10494	0·53168
0·60	0·40967	0·59033	0·12732	0·50930
0·65	0·45046	0·54954	0·15283	0·48379
0·70	0·49363	0·50637	0·18198	0·45464
0·75	0·53989	0·46011	0·21554	0·42108
0·80	0·59033	0·40967	0·25465	0·38197
0·85	0·64680	0·35320	0·30126	0·33536
0·90	0·71287	0·28713	0·35912	0·27750
0·95	0·79783	0·20217	0·43784	0·19878
1·00	1·00000	0	0·63662	0

TABLE 5

M Functions

$\phi^* = 0$ $\cos \phi^* = 1{\cdot}000000$ $\phi^* = 0$ $\sin \phi^* = 0$ $\sin 3\phi^* = 0$

ϕ	Centre flaps	Centre ailerons	ϕ	Centre flaps	Centre ailerons
0	0	0	60	0·86602	0·41920
10	0·17365	0·10998	65	0·90631	0·40531
15	0·25882	0·16286	67·5	0·92388	0·39343
20	0·34202	0·21320	68	0·92718	0·39062
22·5	0·38268	0·23715	70	0·93969	0·37786
30	0·50000	0·30285	74	0·96126	0·34433
40	0·64279	0·37206	78	0·97815	0·29818
42	0·66913	0·38282	80	0·98481	0·26932
45	0·70711	0·39676	84	0·99452	0·19622
50	0·76604	0·41358	85	0·99619	0·17374
52	0·78801	0·41787	90	1·00000	0

Tip flap M is 0 for all values of ϕ above

Tip ailerons M ,, ,, ,, ,, ,,

$\phi^* = 54$ deg $\cos \phi^* = 0{\cdot}587785$ $\phi^* = 0{\cdot}942478$ $\sin \phi^* = 0{\cdot}809017$

$\sin 3\phi^* = 0{\cdot}309017$

ϕ	Centre flaps	Tip flaps	Centre ailerons	Tip ailerons
10	0·10336	0·07028	0·02149	0·08849
20	0·19848	0·14354	0·04473	0·16847
30	0·27637	0·22363	0·07217	0·23068
40	0·32564	0·31714	0·10867	0·26339
42	0·33059	0·33854	0·11794	0·26488
50	0·32444	0·44160	0·16925	0·24433
52	0·31227	0·47574	0·18948	0·22839
54	0·28656	0·52245	0·22182	0·19884
60	0·23218	0·63385	0·28680	0·13240
65	0·21169	0·69461	0·30413	0·10118
68	0·20308	0·72410	0·30486	0·08576
70	0·19838	0·74131	0·30149	0·07637
74	0·19096	0·77030	0·28523	0·05910
78	0·18566	0·79249	0·25491	0·04327
80	0·18367	0·80114	0·23359	0·03573
84	0·18087	0·81365	0·17506	0·02116
90	0·17934	0·82066	0	0

TABLE 5—*continued*

M Functions

$\phi^* = 60$ deg $\cos\phi^* = 0{\cdot}500000$ $\phi^* = 1{\cdot}047198$ $\sin\phi^* = 0{\cdot}866025$

$\sin 3\phi^* = 0$

ϕ	Centre flaps	Tip flaps	Centre ailerons	Tip ailerons
0	0	0	0	0
10	0·05854	0·11511	0·01506	0·09492
20	0·11933	0·22269	0·03126	0·18194
30	0·18519	0·31481	0·05013	0·25272
40	0·26050	0·38228	0·07444	0·29762
42	0·27733	0·39180	0·08040	0·30242
50	0·35433	0·41172	0·11093	0·30265
52	0·37710	0·41092	0·12119	0·29668
60	0·50931	0·35671	0·19856	0·22064
65	0·60296	0·30335	0·25285	0·15246
68	0·64000	0·28719	0·26373	0·12689
70	0·66081	0·27888	0·26579	0·11207
74	0·69499	0·26627	0·25857	0·08576
78	0·72058	0·25756	0·23582	0·06236
80	0·73045	0·25436	0·21795	0·05137
84	0·74463	0·24989	0·16589	0·03033
90	0·75253	0·24747	0	0

$\phi^* = 78$ deg $\cos\phi^* = 0{\cdot}207912$ $\phi^* = 1{\cdot}361357$ $\sin\phi^* = 0{\cdot}978148$

$\sin 3\phi^* = -0{\cdot}809017$

ϕ	Centre flaps	Tip flaps	Centre ailerons	Tip ailerons
0	0	0	0	0
10	0·02339	0·15025	0·00245	0·10753
20	0·04755	0·29447	0·00507	0·20813
30	0·07336	0·42664	0·00805	0·29480
40	0·10206	0·54073	0·01174	0·36032
42	0·10918	0·55995	0·01260	0·37022
50	0·13561	0·63043	0·01676	0·39682
52	0·14319	0·64482	0·01803	0·39984
60	0·17783	0·68820	0·02466	0·39454
65	0·20467	0·70164	0·03095	0·37436
68	0·22384	0·70335	0·03621	0·35441
70	0·23846	0·70123	0·04073	0·33713
74	0·27482	0·68644	0·05431	0·29002
78	0·33831	0·63984	0·09029	0·20789
80	0·37643	0·60838	0·11210	0·15722
84	0·41364	0·58088	0·10853	0·08769
90	0·43152	0·56848	0	0

TABLE 5—*continued*

M Functions

$\phi^* = 90$ deg $\cos\phi^* = 0$ $\phi^* = 1{\cdot}570796$ $\sin\phi^* = 1{\cdot}000000$

$\sin 3\phi^* = -1{\cdot}000000$

ϕ	Tip flaps	Tip ailerons	ϕ	Tip flaps	Tip ailerons
0	0	0	60	0·86602	0·41920
10	0·17365	0·10998	65	0·90631	0·40531
15	0·25882	0·16286	67·5	0·92388	0·39343
20	0·34202	0·21320	68	0·92718	0·39062
22·5	0·38268	0·23715	70	0·93969	0·37786
30	0·50000	0·30285	74	0·96126	0·34433
40	0·64279	0·37206	78	0·97815	0·29818
42	0·66913	0·38282	80	0·98481	0·26932
45	0·70711	0·39676	84	0·99452	0·19622
50	0·76604	0·41358	85	0·99619	0·17374
52	0·78801	0·41787	90	1·00000	0

Centre flaps M is zero for all values of ϕ above

Centre ailerons ,, ,, ,, ,, ,,

TABLE 6

Constants for use with Multhopp Functions

ϕ^* deg	ϕ^* radn	Centre flaps		Tip flaps		Centre ailerons		Tip ailerons	
		T_1	T_2	T_3	T_4	T_5	T_6	T_7	T_8
0	0	1·57080	8·00000	0	0	1·33333	0·84883	0	0
54	0·942478	1·10385	5·62184	0·46695	2·37816	0·62733	0·39937	0·70600	0·44946
60	1·047198	0·95661	4·87198	0·61418	3·12802	0·46731	0·29750	0·86603	0·55133
78	1·361357	0·41281	2·10241	1·15799	5·89759	0·08551	0·05444	1·24782	0·79439
90	1·570796	0	0	1·57080	8·00000	0	0	1·33333	0·84883

TABLE 7

P Functions

	$\eta^* = 0$		$\eta^* = 0{\cdot}05$	
η	Symmetrical	Antisymmetrical	Symmetrical	Antisymmetrical
0	0·31831	0	0·28678	0
0·025	0·31908	0·01250	0·28715	0·01010
0·050	0·32085	0·02497	0·28835	0·02043
0·075	0·32329	0·03739	0·29061	0·03131
0·100	0·32624	0·04975	0·29357	0·04248
0·125	0·32958	0·06201	0·29704	0·05379
0·150	0·33322	0·07415	0·30090	0·06516
0·175	0·33707	0·08615	0·30503	0·07652
0·200	0·34107	0·09798	0·30938	0·08784
0·225	0·34515	0·10962	0·31385	0·09907
0·250	0·34925	0·12103	0·31841	0·11017
0·275	0·35333	0·13220	0·32297	0·12110
0·300	0·35733	0·14309	0·32750	0·13183
0·325	0·36120	0·15368	0·33194	0·14232
0·350	0·36489	0·16393	0·33622	0·15253
0·375	0·36835	0·17382	0·34032	0·16243
0·400	0·37153	0·18330	0·34416	0·17198
0·425	0·37439	0·19235	0·34771	0·18114
0·450	0·37687	0·20093	0·35090	0·18987
0·475	0·37891	0·20900	0·35369	0·19813
0·500	0·38046	0·21651	0·35601	0·20586
0·525	0·38147	0·22341	0·35781	0·21303
0·550	0·38187	0·22967	0·35902	0·21957
0·575	0·38158	0·23522	0·35957	0·22544
0·600	0·38054	0·24000	0·35938	0·23056
0·625	0·37866	0·24395	0·35838	0·23488
0·650	0·37585	0·26498	0·35647	0·23830
0·675	0·37201	0·24901	0·35355	0·24075
0·700	0·36700	0·24995	0·34949	0·24212
0·725	0·36071	0·24967	0·34415	0·24228
0·750	0·35295	0·24804	0·33738	0·24112
0·775	0·34353	0·24488	0·32897	0·23845
0·800	0·33219	0·24000	0·31868	0·23406
0·825	0·31862	0·23312	0·30618	0·22770
0·850	0·30238	0·22388	0·29106	0·21900
0·875	0·28286	0·21180	0·27272	0·20747
0·900	0·25919	0·19615	0·25028	0·19240
0·925	0·22990	0·17573	0·22233	0·17259
0·950	0·19219	0·14832	0·18614	0·14585
0·9625	0·16840	0·13055	0·16322	0·12846
0·975	0·13911	0·10832	0·13492	0·10665
0·98125	0·12117	0·09456	0·11757	0·09312
0·990625	0·08642	0·06766	0·08390	0·06666
1·000	0	0	0	0

TABLE 7—*continued*

P Functions

	$\eta^* = 0{\cdot}1$		$\eta^* = 0{\cdot}15$	
η	Symmetrical	Antisymmetrical	Symmetrical	Antisymmetrical
0	0·25846	0	0·23247	0
0·025	0·25872	0·00860	0·23266	0·00743
0·050	0·25950	0·01730	0·23324	0·01492
0·075	0·26086	0·02619	0·23424	0·02252
0·100	0·26292	0·03546	0·23568	0·03031
0·125	0·26598	0·04543	0·23764	0·03838
0·150	0·26967	0·05578	0·24028	0·04690
0·175	0·27382	0·06635	0·24388	0·05621
0·200	0·27828	0·07703	0·24811	0·06597
0·225	0·28298	0·08775	0·25275	0·07598
0·250	0·28782	0·09845	0·25767	0·08614
0·275	0·29275	0·10909	0·26278	0·09635
0·300	0·29770	0·11961	0·26801	0·10656
0·325	0·30261	0·12996	0·27327	0·11671
0·350	0·30742	0·14011	0·27851	0·12674
0·375	0·31208	0·15001	0·28366	0·13659
0·400	0·31654	0·15961	0·28865	0·14622
0·425	0·32073	0·16888	0·29344	0·15558
0·450	0·32461	0·17776	0·29795	0·16460
0·475	0·32811	0·18622	0·30214	0·17326
0·500	0·33118	0·19419	0·30593	0·18147
0·525	0·33376	0·20163	0·30926	0·18921
0·550	0·33577	0·20849	0·31207	0·19639
0·575	0·33715	0·21470	0·31428	0·20297
0·600	0·33782	0·22020	0·31581	0·20886
0·625	0·33771	0·22491	0·31658	0·21401
0·650	0·33670	0·22876	0·31649	0·21832
0·675	0·33471	0·23166	0·31544	0·22171
0·700	0·33161	0·23350	0·31332	0·22406
0·725	0·32726	0·23416	0·30996	0·22526
0·750	0·32149	0·23351	0·30523	0·22517
0·775	0·31412	0·23137	0·29892	0·22361
0·800	0·30489	0·22753	0·29079	0·22037
0·825	0·29349	0·22173	0·28052	0·21520
0·850	0·27951	0·21362	0·26772	0·20772
0·875	0·26237	0·20270	0·25181	0·19748
0·900	0·24121	0·18826	0·23196	0·18374
0·925	0·21464	0·16914	0·20679	0·16535
0·950	0·18000	0·14313	0·17373	0·14016
0·9625	0·15796	0·12615	0·15260	0·12362
0·975	0·13068	0·10480	0·12635	0·10278
0·98125	0·11391	0·09154	0·11019	0·08982
0·990625	0·08134	0·06557	0·07873	0·06436
1·000	0	0	0	0

TABLE 7—*continued*

P Function

	$\eta^* = 0{\cdot}2$		$\eta^* = 0{\cdot}25$	
η	Symmetrical	Antisymmetrical	Symmetrical	Antisymmetrical
0	0·20838	0	0·18596	0
0·025	0·20853	0·00646	0·18608	0·00561
0·050	0·20899	0·01295	0·18644	0·01125
0·075	0·20976	0·01952	0·18706	0·01694
0·100	0·21087	0·02621	0·18794	0·02272
0·125	0·21234	0·03307	0·18910	0·02862
0·150	0·21423	0·04016	0·19057	0–03468
0·175	0·21661	0·04760	0·19237	0·04094
0·200	0·21965	0·05554	0·19457	0·04748
0·225	0·22368	0·06434	0·19726	0·05440
0·250	0·22831	0·07364	0·20060	0·06187
0·275	0·23334	0·08321	0·20496	0·07026
0·300	0·23862	0·09295	0·20992	0·07918
0·325	0·24407	0·10276	0·21527	0·08841
0·350	0·24959	0·11256	0·22085	0·09780
0·375	0·25510	0·12229	0·22656	0·10727
0·400	0·26054	0·13189	0·23230	0·11672
0·425	0·26584	0·14128	0·23800	0·12607
0·450	0·27094	0·15042	0·24358	0·13527
0·475	0·27575	0·15925	0·24895	0·14423
0·500	0·28023	0·16771	0·25405	0·15289
0·525	0·28429	0·17572	0·25880	0·16118
0·550	0·28787	0·18325	0·26313	0·16903
0·575	0·29090	0·19020	0·26695	0·17638
0·600	0·29328	0·19652	0·27018	0·18313
0·625	0·29494	0·20213	0·27273	0·18922
0·650	0·29578	0·20694	0·27450	0·19455
0·675	0·29569	0·21085	0·27538	0·19902
0·700	0·29455	0·21376	0·27526	0·20252
0·725	0·29223	0·21554	0·27398	0·20494
0·750	0·28855	0·21605	0·27139	0·20611
0·775	0·28333	0·21513	0·26729	0·20587
0·800	0·27632	0·21255	0·26144	0·20401
0·825	0·26722	0·20805	0·25355	0·20025
0·850	0·25563	0·20128	0·24321	0·19426
0·875	0·24099	0·19177	0·22988	0·18554
0·900	0·22248	0·17879	0·21276	0·17340
0·925	0·19877	0·16122	0·19054	0·15671
0·950	0·16734	0·13691	0·16079	0·13337
0·9625	0·14713	0·12087	0·14153	0·11787
0·975	0·12194	0·10058	0·11744	0·09819
0·98125	0·10640	0·08793	0·10252	0·08588
0·990625	0·07607	0·06305	0·07336	0·06163
1·000	0	0	0	0

TABLE 7—*continued*

P Functions

	$\eta^* = 0{\cdot}3$		$\eta^* = 0{\cdot}35$	
η	Symmetrical	Antisymmetrical	Symmetrical	Antisymmetrical
0	0·16503	0	0·14548	0
0·025	0·16513	0·00487	0·14556	0·00421
0·050	0·16542	0·00976	0·14580	0·00843
0·075	0·16592	0·01469	0·14621	0·01269
0·100	0·16663	0·01968	0·14678	0·01699
0·125	0·16756	0·02476	0·14754	0·02136
0·150	0·16873	0·02996	0·14848	0·02582
0·175	0·17016	0·03531	0·14962	0·03039
0·200	0·17187	0·04084	0·15098	0·03509
0·225	0·17391	0·04660	0·15259	0·03996
0·250	0·17633	0·05267	0·15447	0·04503
0·275	0·17924	0·05914	0·15668	0·05036
0·300	0·18282	0·06622	0·15926	0·05602
0·325	0·18744	0·07428	0·16233	0·06210
0·350	0·19269	0·08290	0·16609	0·06884
0·375	0·19830	0·09183	0·17094	0·07661
0·400	0·20412	0·10094	0·17642	0·08499
0·425	0·21004	0·11011	0·18226	0·09368
0·450	0·21596	0·11924	0·18829	0·10254
0·475	0·22179	0·12824	0·19438	0·11144
0·500	0·22743	0·13705	0·20042	0·12028
0·525	0·23280	0·14557	0·20631	0·12894
0·550	0·23782	0·15373	0·21195	0·13735
0·575	0·24240	0·16145	0·21723	0·14541
0·600	0·24646	0·16864	0·22207	0·15302
0·625	0·24989	0·17522	0·22635	0·16010
0·650	0·25259	0·18110	0·22998	0·16653
0·675	0·25445	0·18616	0·23282	0·17221
0·700	0·25535	0·19030	0·23476	0·17702
0·725	0·25515	0·19339	0·23565	0·18082
0·750	0·25367	0·19528	0·23532	0·18347
0·775	0·25073	0·19578	0·23358	0·18478
0·800	0·24608	0·19469	0·23018	0·18454
0·825	0·23944	0·19174	0·22483	0·18247
0·850	0·23040	0·18659	0·21714	0·17822
0·875	0·21844	0·17874	0·20660	0·17134
0·900	0·20275	0·16752	0·19242	0·16111
0·925	0·18209	0·15180	0·17337	0·14646
0·950	0·15407	0·12952	0·14715	0·12533
0·9625	0·13579	0·11461	0·12988	0·11106
0·975	0·11282	0·09558	0·10807	0·09275
0·98125	0·09855	0·08365	0·09447	0·08123
0·990625	0·07059	0·06008	0·06774	0·05840
1·000	0	0	0	0

TABLE 7—*continued*

P Functions

	$\eta^* = 0{\cdot}4$		$\eta^* = 0{\cdot}45$	
η	Symmetrical	Antisymmetrical	Symmetrical	Antisymmetrical
0	0·12721	0	0·11015	0
0·025	0·12727	0·00362	0·11021	0·00308
0·050	0·12747	0·00724	0·11037	0·00617
0·075	0·12780	0·01090	0·11064	0·00928
0·100	0·12827	0·01459	0·11102	0·01242
0·125	0·12888	0·01833	0·11151	0·01560
0·150	0·12964	0·02214	0·11213	0·01884
0·175	0·13057	0·02603	0·11288	0·02213
0·200	0·13166	0·03002	0·11376	0·02551
0·225	0·13295	0·03414	0·11479	0·02898
0·250	0·13444	0·03841	0·11598	0·03256
0·275	0·13616	0·04286	0·11735	0·03627
0·300	0·13816	0·04752	0·11891	0·04015
0·325	0·14047	0·05246	0·12071	0·04421
0·350	0·14316	0·05775	0·12277	0·04851
0·375	0·14635	0·06349	0·12514	0·05309
0·400	0·15025	0·06991	0·12790	0·05803
0·425	0·15530	0·07746	0·13116	0·06346
0·450	0·16099	0·08562	0·13517	0·06961
0·475	0·16702	0·09412	0·14039	0·07695
0·500	0·17322	0·10276	0·14627	0·08495
0·525	0·17944	0·11142	0·15248	0·09327
0·550	0·18555	0·11996	0·15882	0·10172
0·575	0·19144	0·12827	0·16512	0·11013
0·600	0·19699	0·13625	0·17125	0·11837
0·625	0·20208	0·14379	0·17705	0·12630
0·650	0·20660	0·15077	0·18240	0·13379
0·675	0·21042	0·15708	0·18716	0·14071
0·700	0·21340	0·16258	0·19118	0·14692
0·725	0·21540	0·16715	0·19430	0·15226
0·750	0·21625	0·17061	0·19634	0·15658
0·775	0·21574	0·17278	0·19711	0·15968
0·800	0·21363	0·17345	0·19634	0·16133
0·825	0·20963	0·17234	0·19376	0·16126
0·850	0·20336	0·16910	0·18897	0·15911
0·875	0·19430	0·16325	0·18147	0·15441
0·900	0·18169	0·15413	0·17052	0·14649
0·925	0·16433	0·14063	0·15493	0·13427
0·950	0·13999	0·12077	0·13256	0·11581
0·9625	0·12378	0·10720	0·11746	0·10300
0·975	0·10317	0·08968	0·09810	0·08634
0·98125	0·09026	0·07860	0·08591	0·07574
0·990625	0·06480	0·05658	0·06177	0·05460
1·000	0	0	0	0

TABLE 7—*continued*

P Functions

	$\eta^* = 0{\cdot}5$		$\eta^* = 0{\cdot}55$	
η	Symmetrical	Antisymmetrical	Symmetrical	Antisymmetrical
0	0·09426	0	0·07950	0
0·025	0·09430	0·00260	0·07954	0·00216
0·050	0·09444	0·00521	0·07964	0·00433
0·075	0·09465	0·00783	0·07982	0·00652
0·100	0·09496	0·01047	0·08006	0·00872
0·125	0·09536	0·01315	0·08038	0·01094
0·150	0·09586	0·01587	0·08078	0·01319
0·175	0·09646	0·01864	0·08126	0·01549
0·200	0·09717	0·02146	0·08182	0·01783
0·225	0·09799	0·02436	0·08248	0·02022
0·250	0·09894	0·02735	0·08323	0·02268
0·275	0·10002	0·03043	0·08408	0·02522
0·300	0·10126	0·03364	0·08506	0·02785
0·325	0·10267	0·03698	0·08616	0·03058
0·350	0·10427	0·04049	0·08740	0·03343
0·375	0·10609	0·04420	0·08881	0·03643
0·400	0·10817	0·04815	0·09041	0·03959
0·425	0·11057	0·05239	0·09222	0·04296
0·450	0·11336	0·05701	0·09429	0·04658
0·475	0·11666	0·06214	0·09667	0·05050
0·500	0·12075	0·06804	0·09945	0·05481
0·525	0·12612	0·07522	0·10277	0·05965
0·550	0·13218	0·08308	0·10691	0·06531
0·575	0·13854	0·09125	0·11243	0·07236
0·600	0·14499	0·09951	0·11864	0·08011
0·625	0·15133	0·10767	0·12514	0·08814
0·650	0·15738	0·11556	0·13165	0·09621
0·675	0·16300	0·12304	0·13796	0·10408
0·700	0·16801	0·12993	0·14385	0·11156
0·725	0·17224	0·13607	0·14912	0·11846
0·750	0·17549	0·14128	0·15357	0·12456
0·775	0·17756	0·14535	0·15696	0·12965
0·800	0·17820	0·14806	0·15903	0·13348
0·825	0·17709	0·14911	0·15948	0·13575
0·850	0·17386	0·14816	0·15790	0·13609
0·875	0·16801	0·14472	0·15380	0·13404
0·900	0·15881	0·13812	0·14645	0·12890
0·925	0·14510	0·12731	0·13475	0·11966
0·950	0·12480	0·11038	0·11666	0·10442
0·9625	0·11086	0·09842	0·10396	0·09340
0·975	0·09282	0·08269	0·08730	0·07870
0·98125	0·08139	0·07263	0·07666	0·06923
0·990625	0·05862	0·05244	0·05534	0·05010
1·000	0	0	0	0

TABLE 7—*continued*

P Functions

	$\eta^* = 0{\cdot}6$		$\eta^* = 0{\cdot}65$	
η	Symmetrical	Antisymmetrical	Symmetrical	Antisymmetrical
0	0·06585	0	0·05329	0
0·025	0·06587	0·00177	0·05331	0·00142
0·050	0·06596	0·00355	0·05337	0·00284
0·075	0·06609	0·00533	0·05348	0·00426
0·100	0·06629	0·00713	0·05363	0·00570
0·125	0·06654	0·00894	0·05383	0·00715
0·150	0·06686	0·01079	0·05407	0·00862
0·175	0·06723	0·01266	0·05436	0·01012
0·200	0·06767	0·01456	0·05470	0·01164
0·225	0·06819	0·01651	0·05510	0·01319
0·250	0·06878	0·01851	0·05555	0·01478
0·275	0·06944	0·02057	0·05606	0·01641
0·300	0·07020	0·02269	0·05664	0·01809
0·325	0·07106	0·02489	0·05730	0·01983
0·350	0·07202	0·02718	0·05803	0·02163
0·375	0·07310	0·02958	0·05885	0·02352
0·400	0·07432	0·03209	0·05977	0·02548
0·425	0·07569	0·03475	0·06080	0·02756
0·450	0·07725	0·03759	0·06196	0·02975
0·475	0·07901	0·04063	0·06326	0·03209
0·500	0·08104	0·04392	0·06474	0·03459
0·525	0·08337	0·04752	0·06643	0·03730
0·550	0·08612	0·05152	0·06837	0·04027
0·575	0·08941	0·05608	0·07062	0·04355
0·600	0·09358	0·06152	0·07329	0·04724
0·625	0·09923	0·06845	0·07653	0·05152
0·650	0·10560	0·07611	0·08070	0·05673
0·675	0·11221	0·08402	0·08649	0·06358
0·700	0·11873	0·09186	0·09301	0·07117
0·725	0·12490	0·09938	0·09968	0·07894
0·750	0·13046	0·10632	0·10612	0·08650
0·775	0·13515	0·11242	0·11200	0·09351
0·800	0·13869	0·11742	0·11696	0·09966
0·825	0·14074	0·12098	0·12065	0·10459
0·850	0·14090	0·12274	0·12264	0·10788
0·875	0·13866	0·12221	0·12240	0·10902
0·900	0·13332	0·11871	0·11921	0·10733
0·925	0·12376	0·11120	0·11199	0·10177
0·950	0·10804	0·09785	0·09884	0·09056
0·9625	0·09666	0·08786	0·08889	0·08173
0·975	0·08148	0·07432	0·07530	0·06948
0·98125	0·07168	0·06550	0·06640	0·06137
0·990625	0·05188	0·04752	0·04823	0·04468
1·000	0	0	0	0

TABLE 7—*continued*

P Functions

	$\eta^* = 0{\cdot}7$		$\eta^* = 0{\cdot}75$	
η	Symmetrical	Antisymmetrical	Symmetrical	Antisymmetrical
0	0·04183	0	0·03149	0
0·025	0·04184	0·00110	0·03150	0·00082
0·050	0·04189	0·00220	0·03153	0·00164
0·075	0·04197	0·00331	0·03159	0·00247
0·100	0·04209	0·00443	0·03167	0·00330
0·125	0·04223	0·00556	0·03178	0·00414
0·150	0·04242	0·00670	0·03191	0·00499
0·175	0·04263	0·00785	0·03207	0·00585
0·200	0·04289	0·00903	0·03226	0·00672
0·225	0·04319	0·01023	0·03247	0·00761
0·250	0·04353	0·01146	0·03271	0·00852
0·275	0·04391	0·01271	0·03299	0·00946
0·300	0·04434	0·01401	0·03330	0·01041
0·325	0·04483	0·01534	0·03365	0·01140
0·350	0·04537	0·01673	0·03404	0·01242
0·375	0·04598	0·01817	0·03447	0·01348
0·400	0·04666	0·01967	0·03496	0·01458
0·425	0·04742	0·02125	0·03550	0·01574
0·450	0·04827	0·02291	0·03610	0·01695
0·475	0·04922	0·02466	0·03676	0·01822
0·500	0·05028	0·02654	0·03751	0·01958
0·525	0·05149	0·02855	0·03835	0·02103
0·550	0·05286	0·03073	0·03930	0·02258
0·575	0·05444	0·03310	0·04038	0·02426
0·600	0·05626	0·03573	0·04161	0·02610
0·625	0·05839	0·03868	0·04303	0·02814
0·650	0·06094	0·04205	0·04468	0·03041
0·675	0·06408	0·04602	0·04665	0·03300
0·700	0·06823	0·05101	0·04904	0·03603
0·725	0·07416	0·05781	0·05204	0·03968
0·750	0·08081	0·06534	0·05612	0·04442
0·775	0·08749	0·07292	0·06220	0·05119
0·800	0·09370	0·08006	0·06897	0·05866
0·825	0·09897	0·08631	0·07551	0·06594
0·850	0·10284	0·09120	0·08116	0·07236
0·875	0·10472	0·09417	0·08524	0·07726
0·900	0·10387	0·09450	0·08693	0·07984
0·925	0·09922	0·09116	0·08512	0·07902
0·950	0·08890	0·08236	0·07797	0·07302
0·9625	0·08051	0·07486	0·07132	0·06706
0·975	0·06866	0·06407	0·06142	0·05794
0·98125	0·06074	0·05677	0·05459	0·05158
0·990625	0·04433	0·04153	0·04010	0·03798
1·000	0	0	0	0

TABLE 7—*continued*

P Functions

	$\eta^* = 0{\cdot}8$		$\eta^* = 0{\cdot}85$	
η	Symmetrical	Antisymmetrical	Symmetrical	Antisymmetrical
0	0·02230	0	0·01434	0
0·025	0·02231	0·00058	0·01435	0·00037
0·050	0·02233	0·00115	0·01436	0·00074
0·075	0·02237	0·00173	0·01439	0·00110
0·100	0·02243	0·00232	0·01442	0·00148
0·125	0·02250	0·00290	0·01447	0·00185
0·150	0·02259	0·00350	0·01452	0·00223
0·175	0·02270	0·00410	0·01459	0·00261
0·200	0·02282	0·00471	0·01467	0·00300
0·225	0·02297	0·00534	0·01476	0·00340
0·250	0·02314	0·00597	0·01486	0·00380
0·275	0·02332	0·00662	0·01498	0·00422
0·300	0·02353	0·00729	0·01511	0·00464
0·325	0·02377	0·00798	0·01526	0·00508
0·350	0·02404	0·00869	0·01542	0·00552
0·375	0·02433	0·00942	0·01560	0·00599
0·400	0·02465	0·01019	0·01580	0·00647
0·425	0·02502	0·01098	0·01602	0·00697
0·450	0·02542	0·01182	0·01626	0·00749
0·475	0·02586	0·01270	0·01654	0·00804
0·500	0·02636	0·01362	0·01684	0·00862
0·525	0·02692	0·01461	0·01718	0·00923
0·550	0·02754	0·01566	0·01756	0·00989
0·575	0·02825	0·01680	0·01798	0·01059
0·600	0·02904	0·01803	0·01845	0·01134
0·625	0·02996	0·01937	0·01899	0·01216
0·650	0·03100	0·02086	0·01961	0·01306
0·675	0·03223	0·02253	0·02032	0·01406
0·700	0·03367	0·02443	0·02114	0·01517
0·725	0·03541	0·02663	0·02212	0·01645
0·750	0·03757	0·02926	0·02329	0·01793
0·775	0·04037	0·03254	0·02474	0–01969
0·800	0·04434	0·03702	0·02659	0·02186
0·825	0·05060	0·04379	0·02908	0·02468
0·850	0·05739	0·05113	0·03287	0·02883
0·875	0·06349	0·05782	0·03931	0·03564
0·900	0·06784	0·06280	0·04590	0·04264
0·925	0·06918	0·06485	0·05062	0·04782
0·950	0·06566	0·06214	0·05130	0·04903
0·9625	0·06103	0·05800	0·04907	0·04711
0·975	0·05334	0·05087	0·04402	0·04242
0·98125	0·04774	0·04560	0·03988	0·03850
0·990625	0·03543	0·03392	0·03011	0·02914
1·000	0	0	0	0

TABLE 7—*continued*

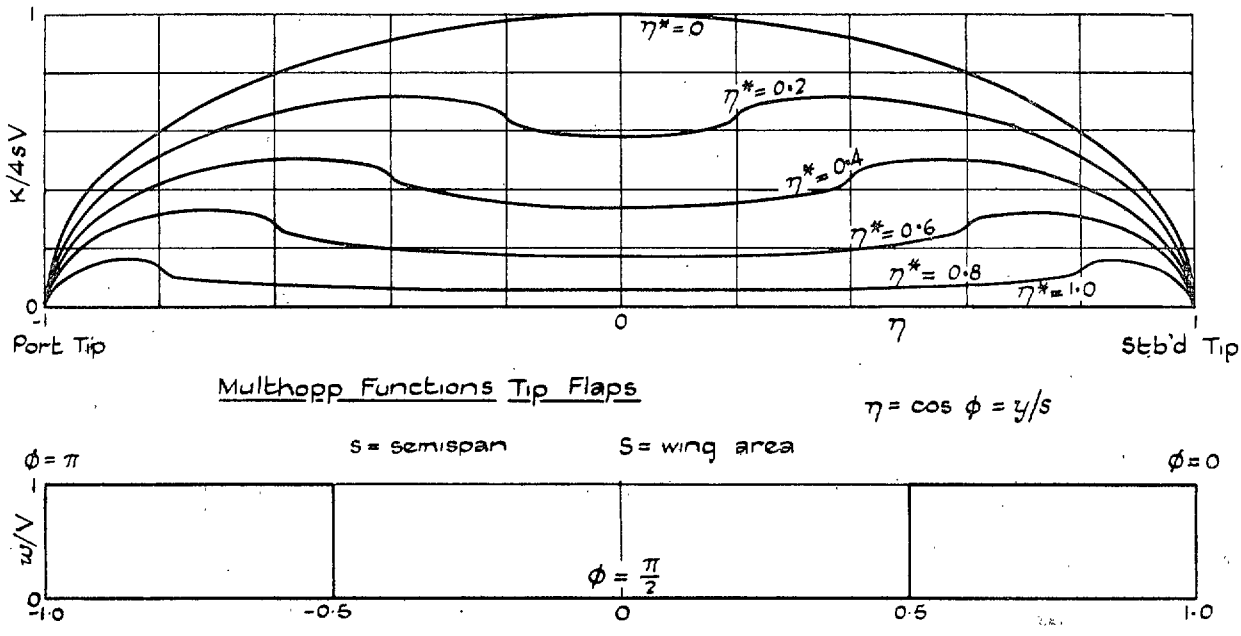
P Functions

	$\eta^* = 0{\cdot}9$		$\eta^* = 0{\cdot}95$	
η	Symmetrical	Antisymmetrical	Symmetrical	Antisymmetrical
0	0·00773	0	0·00272	0
0·025	0·00774	0·00020	0·00272	0·00007
0·050	0·00774	0·00039	0·00272	0·00014
0·075	0·00776	0·00059	0·00273	0·00021
0·100	0·00778	0·00079	0·00273	0·00027
0·125	0·00780	0·00099	0·00274	0·00034
0·150	0·00783	0·00119	0·00274	0·00041
0·175	0·00786	0·00140	0·00276	0·00048
0·200	0·00790	0·00160	0·00277	0·00056
0·225	0·00795	0·00182	0·00279	0·00063
0·250	0·00800	0·00203	0·00281	0·00070
0·275	0·00806	0·00225	0·00283	0·00078
0·300	0·00813	0·00248	0·00285	0·00086
0·325	0·00821	0·00271	0·00287	0·00094
0·350	0·00829	0·00294	0·00290	0·00102
0·375	0·00838	0·00319	0·00294	0·00110
0·400	0·00849	0·00345	0·00297	0·00119
0·425	0·00860	0·00371	0·00301	0·00128
0·450	0·00873	0·00399	0·00305	0·00138
0·475	0·00887	0·00428	0·00310	0·00148
0·500	0·00902	0·00458	0·00315	0·00158
0·525	0·00920	0·00490	0·00321	0·00169
0·550	0·00939	0·00524	0·00327	0·00181
0·575	0·00960	0·00560	0·00334	0·00193
0·600	0·00984	0·00600	0·00342	0·00206
0·625	0·01011	0·00642	0·00350	0·00221
0·650	0·01042	0·00688	0·00361	0·00236
0·675	0·01077	0·00738	0·00372	0·00252
0·700	0·01117	0·00795	0·00385	0·00271
0·725	0·01165	0·00858	0·00400	0·00292
0·750	0·01221	0·00930	0·00418	0·00315
0·775	0·01288	0·01014	0·00440	0·00342
0·800	0·01371	0·01115	0·00464	0·00374
0·825	0·01477	0·01239	0·00497	0·00412
0·850	0·01618	0·01399	0·00536	0·00459
0·875	0·01821	0·01623	0·00590	0·00520
0·900	0·02167	0·01991	0·00668	0·00606
0·925	0·02828	0·02676	0·00794	0·00741
0·950	0·03358	0·03236	0·01072	0·01029
0·9625	0·03430	0·03325	0·01404	0·01366
0·975	0·03260	0·03174	0·01671	0·01641
0·98125	0·03032	0·02957	0·01709	0·01683
0·990625	0·02373	0·02321	0·01511	0·01492
1·000	0	0	0	0

TABLE 8

Constants for use with P Functions

η^*	T_{15}	T_{16}	T_{17}	T_{18}	T_{19}	T_{20}	T_{21}
0	0·66667	3·39531	0·78540	0·50000	0·15916	0·63662	0·50000
0·05	0·62171	3·16635	0·75665	0·48170	0·15041	0·61833	0·49282
0·10	0·57731	2·94022	0·72526	0·46171	0·14158	0·59978	0·48494
0·15	0·53354	2·71727	0·69134	0·44012	0·13267	0·58094	0·47631
0·20	0·49047	2·49793	0·65504	0·41701	0·12369	0·56174	0·46691
0·25	0·44819	2·28260	0·61651	0·39248	0·11466	0·54216	0·45669
0·30	0·40678	2·07172	0·57593	0·36665	0·10557	0·52213	0·44560
0·35	0·36634	1·86576	0·53351	0·33964	0·09647	0·50158	0·43357
0·40	0·32696	1·66522	0·48948	0·31161	0·08736	0·48044	0·42053
0·45	0·28876	1·47064	0·44410	0·28272	0·07830	0·45862	0·40638
0·50	0·25184	1·28262	0·39768	0·25317	0·06930	0·43599	0·39100
0·55	0·21634	1·10179	0·35055	0·22317	0·06041	0·41243	0·37426
0·60	0·18239	0·92891	0·30312	0·19297	0·05168	0·38774	0·35595
0·65	0·15017	0·76480	0·25583	0·16287	0·04318	0·36168	0·33582
0·70	0·11986	0·61047	0·20922	0·13319	0·03498	0·33394	0·31353
0·75	0·09171	0·46708	0·16393	0·10436	0·02716	0·30402	0·28859
0·80	0·06600	0·33611	0·12075	0·07687	0·01983	0·27120	0·26022
0·85	0·04311	0·21955	0·08070	0·05137	0·01314	0·23425	0·22716
0·90	0·02359	0·12016	0·04517	0·02876	0·00730	0·19077	0·18693
0·95	0·00840	0·04278	0·01641	0·01045	0·00263	0·13456	0·13320
1·00	0	0	0	0	0	0	0



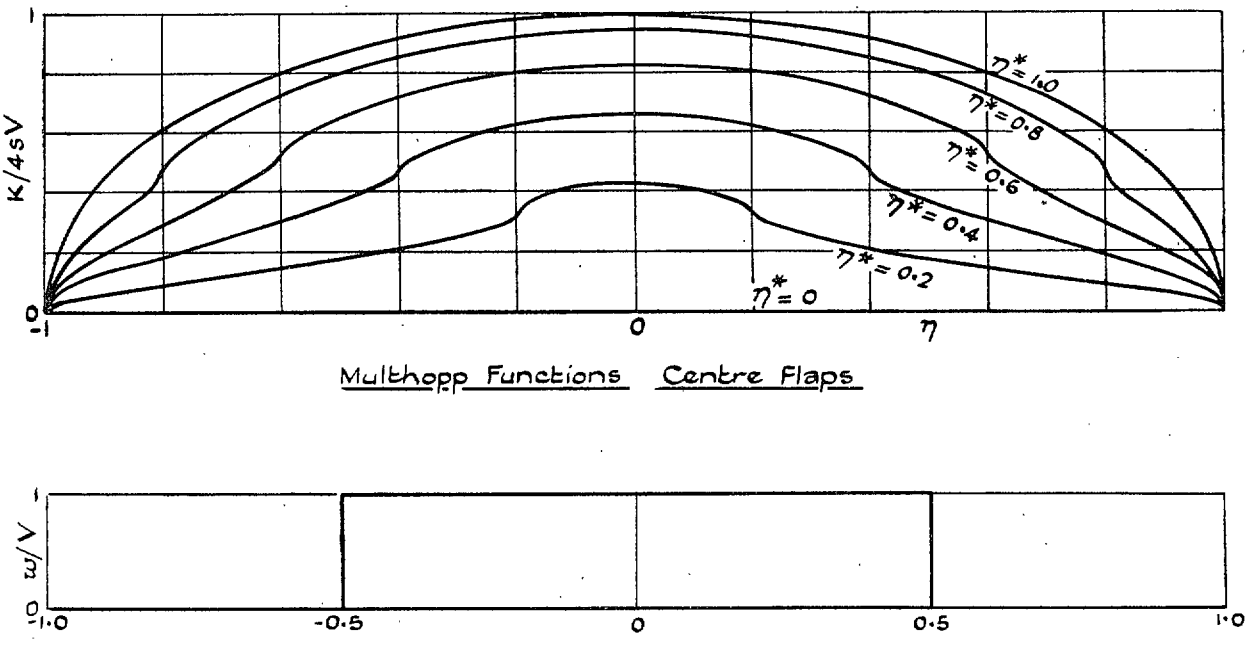
Multhopp Functions Tip Flaps

$\eta = \cos\phi = y/s$

s = semispan S = wing area

Corresponding Downwash Function for Example $\eta^* = 0{\cdot}5$

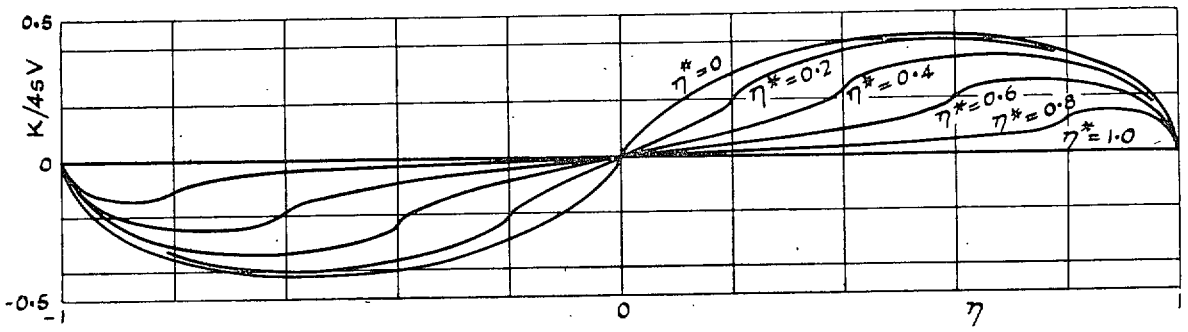
FIG. 1.



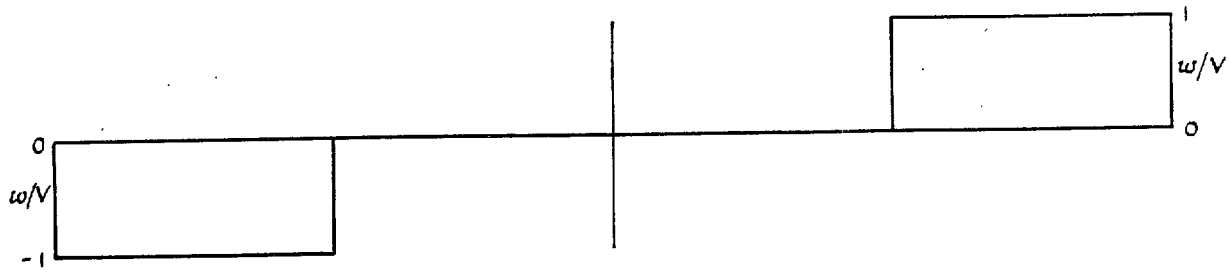
Multhopp Functions Centre Flaps

Corresponding Downwash Function for Example $\eta^* = 0{\cdot}5$

FIG. 2.

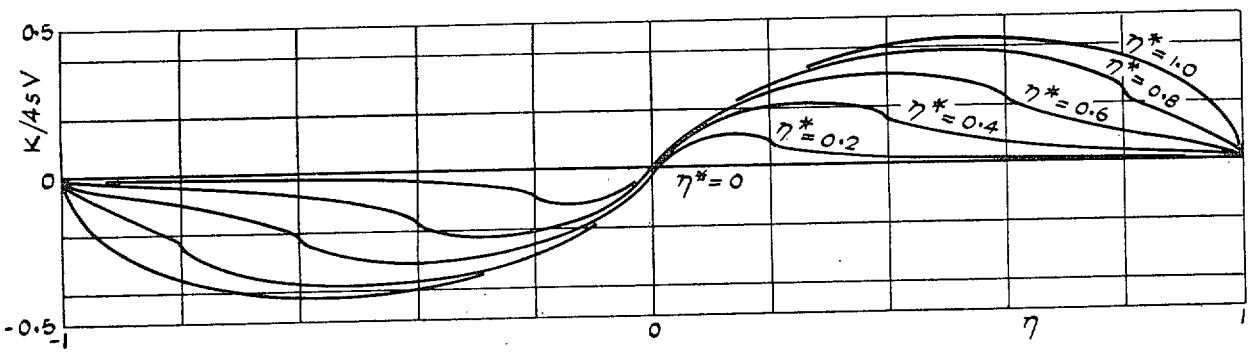


Multhopp Functions Tip Ailerons

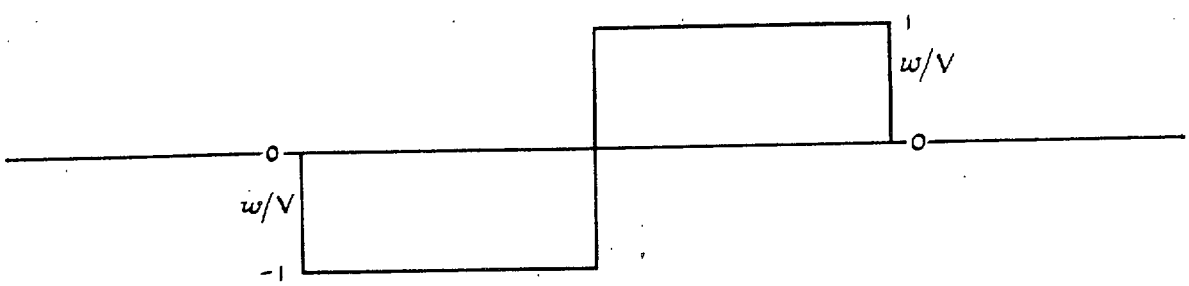


Corresponding Downwash Function for Example $\eta^* = 0.5$

FIG. 3.



Multhopp Functions Centre Ailerons



Corresponding Downwash Function For Example $\eta^* = 0.6$

FIG. 4.

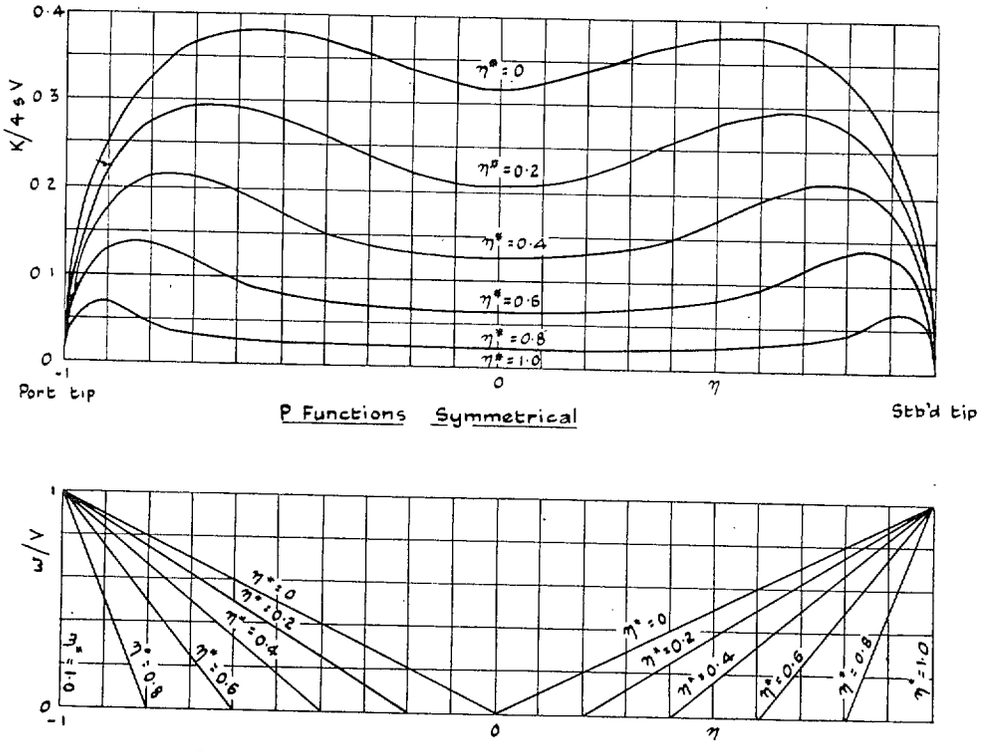

K/4sV
0·4
0·3
0·2
0·1
0
-1
0
η
η* = 0
η* = 0·2
η* = 0·4
η* = 0·6
η* = 0·8
η* = 1·0
Port tip
Stb'd tip
P Functions Symmetrical
w/V
1
0
-1
η* = 0
η* = 0·2
η* = 0·4
η* = 0·6
η* = 0·8
η* = 1·0
Corresponding distribution of induced downwash

FIG. 5.

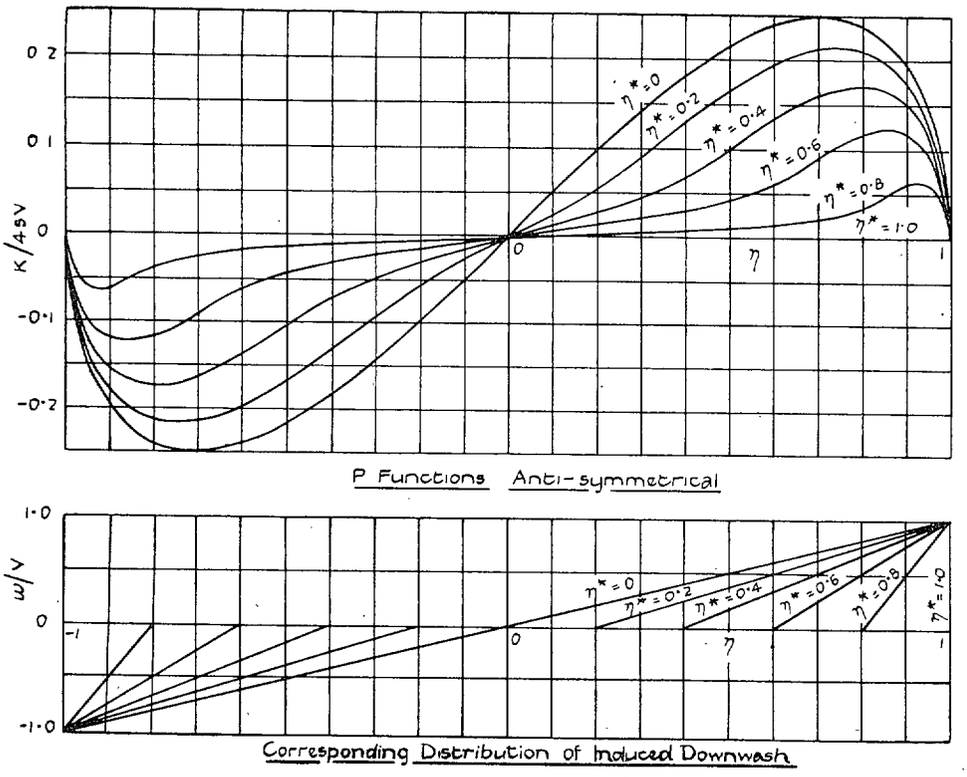

K/4sV
0·2
0·1
0
-0·1
-0·2
0
η
1
η* = 0
η* = 0·2
η* = 0·4
η* = 0·6
η* = 0·8
η* = 1·0
P Functions Anti-symmetrical
w/V
1·0
0
-1·0
-1
0
η
1
η* = 0
η* = 0·2
η* = 0·4
η* = 0·6
η* = 0·8
η* = 1·0
Corresponding Distribution of Induced Downwash

FIG. 6.

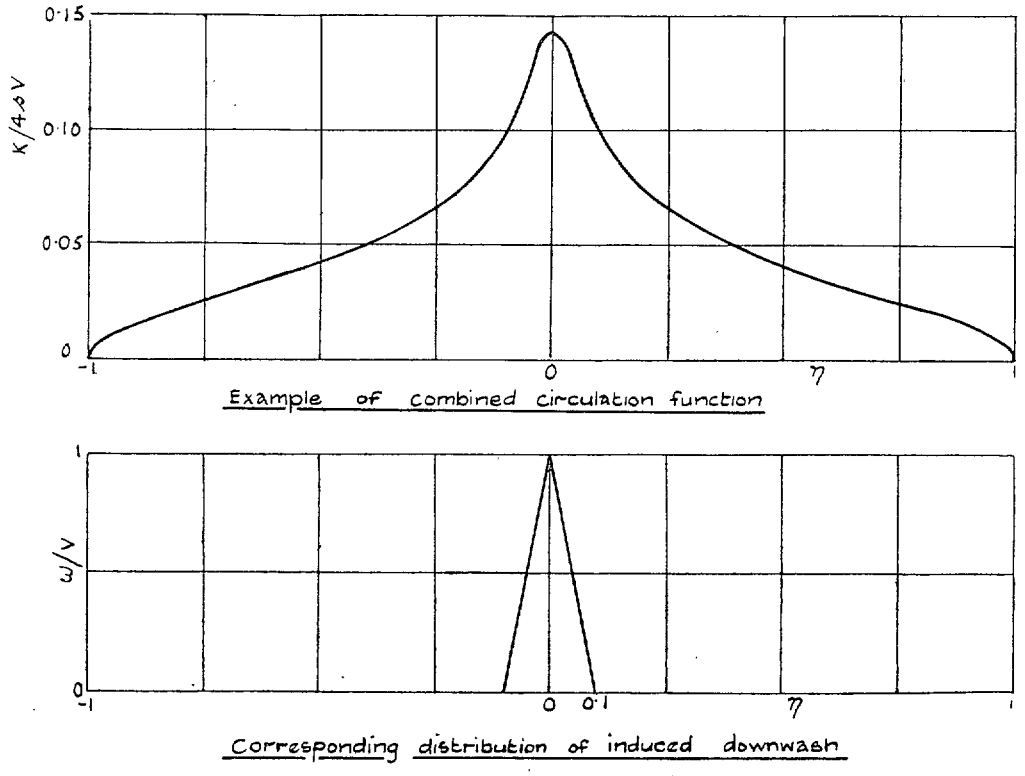

0·15
0·10
0·05
0
K/4sV
-1
0
η
1
Example of combined circulation function
1
0
w/V
-1
0
0·1
η
1
Corresponding distribution of induced downwash

FIG. 7.

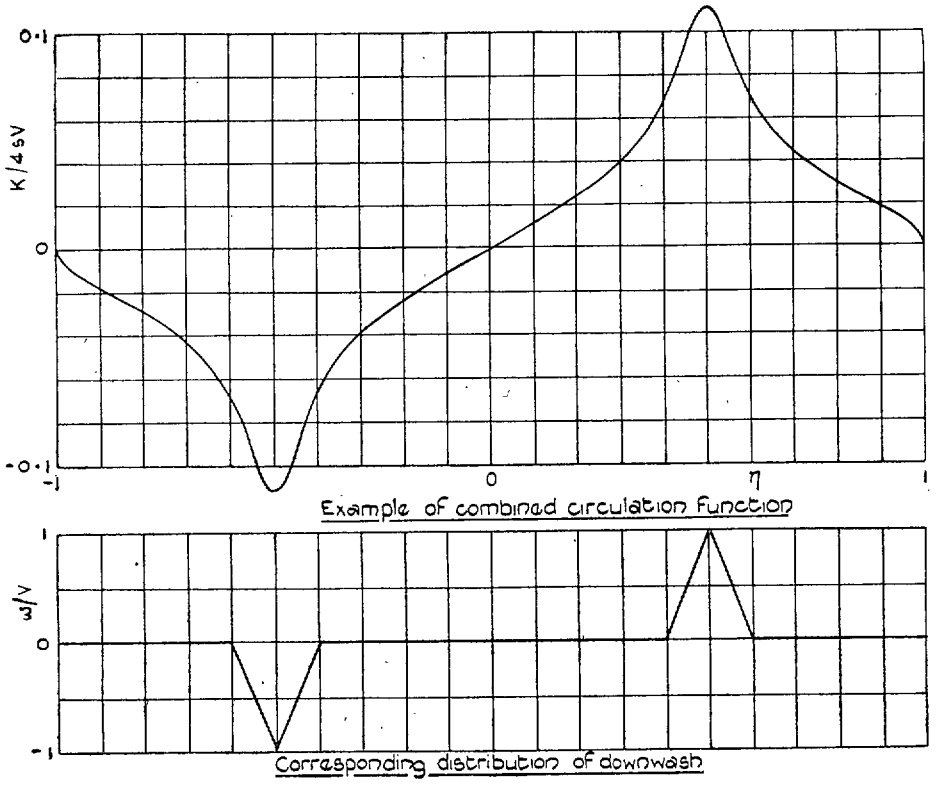
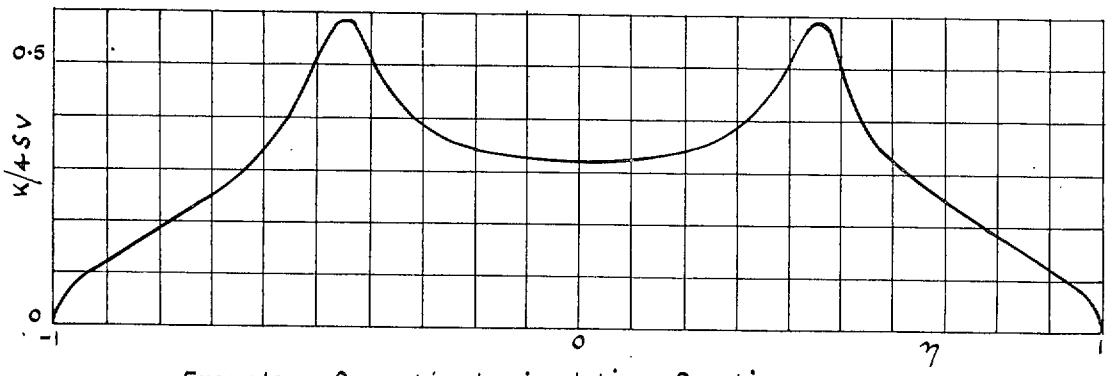
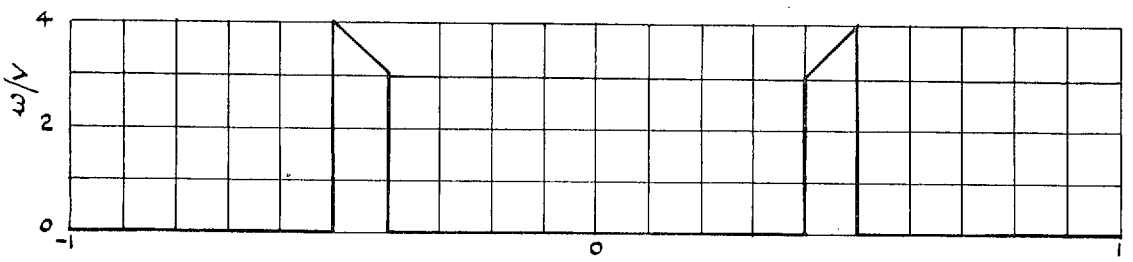

0·1
0
-0·1
K/4sV
-1
0
η
1
Example of combined circulation function
1
0
-1
w/V
Corresponding distribution of downwash

FIG. 8.

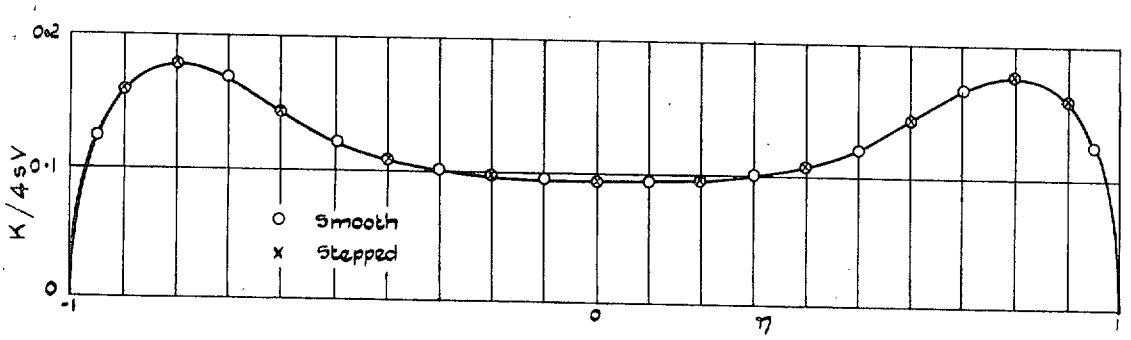


Example of combined circulation function

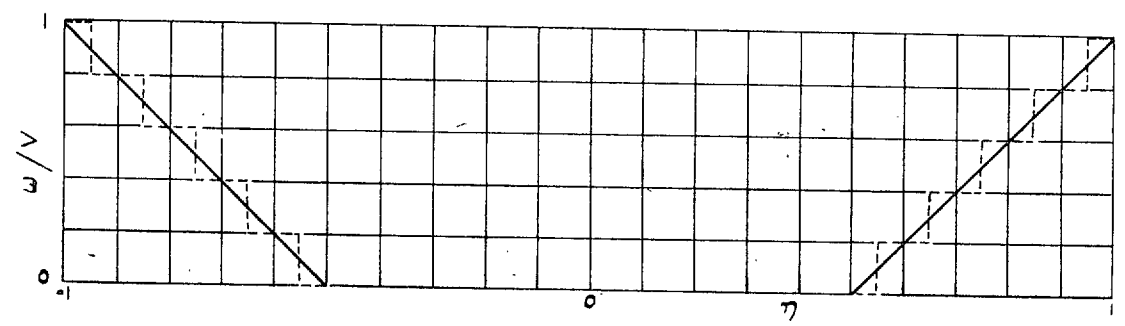


Corresponding distribution of induced downwash

FIG. 9.



Comparison of circulation for smooth and stepped downwash distribution



Distribution of induced downwash

FIG. 10.

(22303) Wt. 15-680 K9 5/52 F. M. & S.

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