NEW LIMITATION CHANGE

TO
Approved for public release, distribution unlimited

FROM
Distribution authorized to U.S. Gov’t. agencies and their contractors; Foreign Government Information; APR 1956. Other requests shall be referred to British Embassy, 3100 Massachusetts Avenue, NW, Washington, DC 20008.

AUTHORITY
AERODYNAMIC DERIVATIVES FOR
TWO CROPPED DELTA WINGS
AND ONE ARROWHEAD WING
OSCILLATING IN DISTORTION MODES

by

O.L. WOODCOCK, M.A.

APRIL, 1956

MIDSTYI 8 
OF SUPPLY

THE SECRETARY, MINISTRY OF SUPPLY, LONDON, W.C.1

UNCLASSIFIED
SUMMARY

Aerodynamic derivatives are given for three particular planforms oscillating with symmetric distortion modes in incompressible flow. The planforms are:

(i) a cropped delta wing of aspect ratio 3 and taper ratio 1/7;
(ii) a cropped delta wing of aspect ratio 1.2 and taper ratio 1/7;
(iii) an arrowhead wing of aspect ratio 1.32, taper ratio 7/18 and angle of sweep of 63.4° at the quarter chord.

The results are for modes of the form $|\eta|^n$ for $n = 0(1)4$ where $\eta$ is a non-dimensional spanwise co-ordinate. They have been determined from intermediate results which D. E. Lehrian had earlier obtained by the vortex lattice method. The results are compared, for some cases, with the corresponding values given by very low aspect ratio theory.
LIST OF CONTENTS

1. List of Symbols
   3

2. Introduction
   4

3. Method
   4

4. Results
   12

5. Conclusions
   13

References
   13

Detachahable Abstract Cards

LIST OF TABLES

<table>
<thead>
<tr>
<th>Table</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Values of ((\pi^{-1})')</td>
<td>1 to 3</td>
</tr>
<tr>
<td>Values of equivalent constant strip derivatives</td>
<td>4 to 27</td>
</tr>
<tr>
<td>Values of overall derivatives</td>
<td>28 to 51</td>
</tr>
<tr>
<td>Comparison with derivatives of very low aspect ratio theory</td>
<td>52 to 56</td>
</tr>
</tbody>
</table>
List of Symbols

\[
C = \frac{X_1 \left( \frac{3v}{2} \right)}{X_0 \left( \frac{3v}{2} \right) + X_1 \left( \frac{3v}{2} \right)}
\]

\( c \) = wing chord
\( \bar{c} \) = mean wing chord
\( (\xi)_{ij} \) etc. = equivalent constant strip derivatives
\( (\xi) \) etc. = matrices of equivalent constant strip derivatives
\( [\xi]_{ij} \) etc. = overall derivatives
\( [\xi] \) etc. = matrices of overall derivatives
\( S \) = wing area
\( s \) = wing semi-span
\( t \) = time
\( V \) = airspeed
\( W \) = matrix of downwash velocities at collocation points due to the assumed doublet distribution
\( x \) = distance aft of mid chord axis
\( y \) = distance spanwise from wing centre line
\( z \) = downward displacement of any point
\( \Gamma \) = bound vorticity
\( \Gamma_n \) = bound vorticity distribution functions
\( \eta \) = \( \frac{V}{s} \)
\( \theta \) = \( \cos^{-1} \left( -\frac{2x}{c} \right) \)
\( \nu \) = \( \frac{\omega c}{V} \)
\( \nu_m \) = \( \frac{\omega m}{V} \)
\( \rho \) = air density
\( \omega \) = circular frequency
1 Introduction

In 1951 D. E. Lehrian published values of the aerodynamic derivatives for a cropped delta wing of aspect ratio 3, taper ratio 1/7 oscillating with rigid modes in incompressible flow. From some of her intermediate results the derivatives for the same wing oscillating in distortion modes of the form $|\eta|^n$ were obtained and published in reference 2.

In reference 1 the first of the chordwise distribution functions for the bound vorticity was taken to be

$$\Gamma_0 = 2 \left[ C(v) \cot \frac{1}{2} \theta + \frac{1}{2} \nu \sin \theta \right]$$

that is, the function which arises in two-dimensional theory. The use of this function was found to give erroneous values of the damping derivatives for small values of $\nu$ because of the presence of a term $\nu \log \nu$ in the limiting value of $C(v)$ as $\nu$ tends to zero. To avoid this error D. E. Lehrian used instead the function

$$\Gamma_0 = 2 \cot \frac{1}{2} \theta$$

in reference 3. In that report she obtained rigid mode derivatives for two cropped delta wings both of taper ratio 1/7 and of aspect ratios 1.2 and 3, and also for an arrowhead wing of aspect ratio 1.32, taper ratio 7/18 and angle of sweep of 63.4° at the quarter chord. The present report gives the derivatives for these three wings oscillating in distortion modes of the form $|\eta|^n$. These have been obtained from the values, given in reference 3, of the matrices of the downwash velocities at the collocation points induced by the assumed doublet distribution functions.

2 Method

The method of determining the derivatives is described in reference 2. It will therefore be sufficient for our present purpose to give only those details which are necessary for the correct understanding of the results.

To obtain the derivatives for modes of the form $|\eta|^n$ for $n = 0(1)4$ the downward displacement of any point on the wing, with the exponential factor omitted is assumed to be given by

$$x = \sum_{i=0}^{4} q_m |\eta|^i \psi_i - \frac{1}{2} \cos \theta \sum_{i=0}^{4} |\eta|^i X_i.$$  

This is not quite the same form as that used in reference 2. The reference length used in defining the flexural displacement has been changed from the semi-span $s$ to the mean chord $q_m$. This modification simplifies some of the expressions which appear later. It should also be noted that the displacement in any particular degree of freedom is either purely flexural or purely torsional. The air forces for degrees of freedom containing both flexure and torsion are considered later.

If $\psi_i$, $X_i$ are the generalised forces corresponding to the degrees of freedom $\psi_i$, $X_i$ then
\[ \Psi = \sum_{j=0}^{L} \Psi_{i,j} \psi_{j} + \sum_{s=0}^{L} \Psi_{i,s} \chi_{s} \]  

\[ \chi = \sum_{j=0}^{L} \chi_{i,j} \psi_{j} + \sum_{s=0}^{L} \chi_{i,s} \chi_{s} \]  

where the matrices \( \Psi(\alpha | \alpha) \) etc. are given by

\[ \Psi = -\pi \nu \mathbf{V}^{2} \mathbf{S} \mathbf{R} \mathbf{z} (\overline{W}^{-1}) \mathbf{S}_{z} \]  

\[ \chi = -\pi \nu \mathbf{V}^{2} \mathbf{S} \mathbf{R} \mathbf{a} (\overline{W}^{-1}) \mathbf{S}_{a} \]  

\( \mathbf{W} \) is the matrix of the downwash velocities at the collocation points due to the assumed doublet distribution (see reference 2). The other matrices \( \mathbf{R}_{z}, \mathbf{S}_{z} \) etc. are given by the following relationships (appropriate to six collocation points situated at the intersection of the lines \( \eta = \eta_{1}, \eta_{2}, \eta_{3} \) and \( \theta = \theta_{1}, \theta_{2} \)):—

\[ \mathbf{R}_{z} = \left[ \begin{array}{c} J, \frac{1}{2}v_{m} \mathbf{K} \\ \frac{1}{16} \end{array} \right] \]  

\[ \mathbf{S}_{z} = \left[ \begin{array}{c} N, N \end{array} \right] \]  

\[ \mathbf{R}_{a} = -\frac{1}{2} \left[ \mathbf{K}, \frac{1}{2} \mathbf{K} + \frac{iv_{m}}{16} \mathbf{G} \right] \]  

and

\[ \mathbf{S}_{a} = \left[ \begin{array}{c} N - \frac{1}{2}iv_{m} \cos \theta_{1} \cdot \mathbf{H} \\ N - \frac{1}{2}iv_{m} \cos \theta_{2} \cdot \mathbf{H} \end{array} \right] \]  

* The matrix used in reference 3 is the transpose of the one used in reference 2 and in this report.
where

\[ N = \begin{bmatrix}
\eta_1 & \eta_1^2 & \eta_1^3 & \eta_1^4 \\
\eta_2 & \eta_2^2 & \eta_2^3 & \eta_2^4 \\
\eta_3 & \eta_3^2 & \eta_3^3 & \eta_3^4
\end{bmatrix} \] (10)

\[
J^{**} = \begin{bmatrix}
J_{00} & J_{02} & J_{04} \\
J_{10} & J_{12} & J_{14} \\
J_{20} & J_{22} & J_{24} \\
J_{30} & J_{32} & J_{34} \\
J_{40} & J_{42} & J_{44} \\
J_{50} & J_{52} & J_{54} \\
J_{60} & J_{62} & J_{64}
\end{bmatrix} \] (11)

\[
J_{rs} = \int_0^1 \eta^{r+s} \sqrt{1 - \eta^2} \, d\eta \] (12)

\[ J^* = \text{first six rows of } J^{**} \] (13)

\[ J = \text{first five rows of } J^{**} \] (14)

\[
\frac{a}{\eta} = a - b \eta \] (15)

\[
L^* = \begin{bmatrix}
a & -b & 0 & 0 & 0 & 0 & 0 \\
0 & a & -b & 0 & 0 & 0 & 0 \\
0 & 0 & a & -b & 0 & 0 & 0 \\
0 & 0 & 0 & a & -b & 0 & 0 \\
0 & 0 & 0 & 0 & a & -b & 0 \\
0 & 0 & 0 & 0 & 0 & a & -b
\end{bmatrix} \] (16)
\[ L = \text{first five rows and six columns of } L^* \]  
\[ K = L J^* \]  
\[ K^* = L^* J^{**} \]  
\[ G = I K^* = I L^* J^{**} \]

and \[ H = \text{diag} \left\{ \frac{\alpha}{\alpha_m} (\eta_1), \frac{\alpha}{\alpha_m} (\eta_2), \frac{\alpha}{\alpha_m} (\eta_3) \right\}. \]

The matrices \( \mathbf{y}^* \) etc., when made non-dimensional are divided up into matrices of the overall derivatives. Thus

\[
\begin{align*}
\mathbf{y}^* &= -\rho v^2 S \alpha_m \left[ [\ell_z] + i\nu_m [\ell_z] \right] \\
\mathbf{x}^* &= -\rho v^2 S \alpha_m \left[ [\ell_a] + i\nu_m [\ell_a] \right] \\
\mathbf{y}^t &= -\rho v^2 S \alpha_m \left[ [-m_z] + i\nu_m [-m_z] \right] \\
\mathbf{x}^t &= -\rho v^2 S \alpha_m \left[ [-m_a] + i\nu_m [-m_a] \right]
\end{align*}
\]

where \( [\ell_z] = \left[ [\ell_z]_{ij} \right] \) etc.  

and so

\[
\begin{align*}
[\ell_z] &= \pi \frac{\alpha}{\alpha_m} \text{Re} \left\{ R_z (\bar{W}^{-1}) \right\} S_z \\
[\ell_a] &= \pi \frac{\alpha}{\alpha_m} \text{Re} \left\{ R_a (\bar{W}^{-1}) \right\} S_a \\
[-m_z] &= \pi \frac{\alpha}{\alpha_m} \text{Re} \left\{ R_a (\bar{W}^{-1}) \right\} S_z \\
[-m_a] &= \pi \frac{\alpha}{\alpha_m} \text{Re} \left\{ R_a (\bar{W}^{-1}) \right\} S_a
\end{align*}
\]
and

\[
\begin{align*}
[\epsilon_n] &= \pi \frac{s}{\alpha_n \nu_n} \sum_m R_n \left( \tilde{\omega}^{-1} \right)^i S_n \\
[\epsilon_a] &= \pi \frac{s}{\alpha_n \nu_n} \sum_m R_n \left( \tilde{\omega}^{-1} \right)^i S_n \\
[-\epsilon_z] &= \pi \frac{s}{\alpha_n \nu_n} \sum_m R_n \left( \tilde{\omega}^{-1} \right)^i S_n \\
[-m_z] &= \pi \frac{s}{\alpha_n \nu_n} \sum_m R_a \left( \tilde{\omega}^{-1} \right)^i S_a \\
[-m_a] &= \pi \frac{s}{\alpha_n \nu_n} \sum_m R_a \left( \tilde{\omega}^{-1} \right)^i S_a.
\end{align*}
\]

The stiffness derivatives thus include the virtual inertia contribution.

The equivalent constant strip derivatives \( [\epsilon_n]_{i,j} \) etc. are related to the overall derivatives by the formulae:

\[
\begin{align*}
[\epsilon_n]_{i,j} &= (\epsilon_n)_{i,j} \int_0^1 \eta^{i+j} d\eta \\
[\epsilon_a]_{i,s} &= (\epsilon_a)_{i,s} \int_0^1 \eta^{i+s} d\eta \\
[-\epsilon_z]_{x,j} &= (-\epsilon_z)_{x,j} \int_0^1 \eta^{x+j} d\eta \\
[-m_z]_{x,s} &= (-m_z)_{x,s} \int_0^1 \eta^{x+s} d\eta \\
[-m_a]_{x,s} &= (-m_a)_{x,s} \int \left( \frac{\alpha}{\alpha_n} \right)^2 \eta^{x+s} d\eta
\end{align*}
\]
$$\begin{align*}
[\varepsilon^*_{z}]_{ij} &= (\varepsilon^*_{z})_{ij} \int_{0}^{1} \frac{c_{\eta}}{a_{\eta}} \eta^{i+j} d\eta \\
[\varepsilon^*_{a}]_{is} &= (\varepsilon^*_{a})_{is} \int_{0}^{1} \left(\frac{c_{\eta}}{a_{\eta}}\right)^2 \eta^{i+s} d\eta \\
[-e^*_{z}]_{rj} &= (-e^*_{z})_{rj} \int_{0}^{1} \left(\frac{c_{\eta}}{a_{\eta}}\right)^2 \eta^{r+j} d\eta \\
[-e^*_{a}]_{rs} &= (-e^*_{a})_{rs} \int_{0}^{1} \left(\frac{c_{\eta}}{a_{\eta}}\right)^3 \eta^{r+s} d\eta.
\end{align*}$$

(27)

These equivalent constant strip derivatives are the same as the equivalent constant derivatives of reference 2.

The generalised forces for a set of degrees of freedom whose modes of displacement can be expressed as linear combinations of the above modes (equation (3)) can be obtained from the overall derivatives for the above modes. Thus if the displacement in the \( u^{th} \) degree of freedom is

$$z = \left\{ c_{a} f_{u}(\eta) - \frac{1}{2} \cos 0 \cdot F_{u}(\eta) \right\} q_{u}$$

(28)

where

$$f_{u}(\eta) = \sum_{i=0}^{4} c_{ui} |\eta|^i$$

(29)

$$F_{u}(\eta) = \sum_{r=0}^{4} c_{ur} |\eta|^r$$

then the corresponding generalised force is \( Q_{u} \), where

$$Q_{u} = \sum_{r} Q_{ur} q_{r}$$

(30)

* \( f_{u}, F_{u} \) are coupled flexural and torsional modal functions, i.e. they describe the displacement in the same degree of freedom.
\[ Q = [q_{uv}] = [x, g] \begin{bmatrix} x & \chi \\ \chi & \chi \end{bmatrix} g' \]

\[ = -\rho v^2 s c m [x, g] \left( \begin{bmatrix} [\varepsilon_s^2][\varepsilon_s^1] \\ [-\varepsilon_s^2][-\varepsilon_s^1] \end{bmatrix} + iv_m \left( \begin{bmatrix} [\varepsilon_s^2][\varepsilon_s^1] \\ [-\varepsilon_s^2][-\varepsilon_s^1] \end{bmatrix} \right) \right) \begin{bmatrix} g' \end{bmatrix} \]  
(31)

\[ x = [x_{ui}] \]
(32)

\[ g = [g_{ui}] \]
(33)

Alternatively the generalised forces for degrees of freedom whose modes of displacement are distinct from those of equation (3) can be obtained directly from the reciprocal matrix \((\bar{W}^{-1})^t\). If the displacement in the \(u\)th degree of freedom is given by equation (28) though with \(F_u\) not necessarily given by equation (29) then the matrix \(Q\) of the generalised force coefficients \(Q_{uv}\) is given by

\[ Q = -\pi \rho v^2 s s (\hat{S}_z + \hat{S}_a) (\bar{W}^{-1})^t (\hat{S}_z + \hat{S}_a) \]
(34)

where

\[ \hat{R}_z = \begin{bmatrix} 3 \__, \frac{i v_m}{8} \hat{k} \end{bmatrix} \]
(35)

\[ \hat{S}_z = iv_m \{\hat{n}, \hat{n}\} \]
(36)

\[ \hat{R}_a = -\frac{1}{2} \begin{bmatrix} \hat{R}_s \, \frac{1}{2} \hat{k} + \frac{i v_m}{16} \hat{c} \end{bmatrix} \]
(37)

\[ \hat{S}_a = \begin{bmatrix} \hat{N} - \frac{1}{2} iv_m \cos \theta_s \hat{N} \\ \hat{N} - \frac{1}{2} iv_m \cos \theta_s \hat{N} \end{bmatrix} \]
(38)

and, for \((1 + a)\) degrees of freedom, where

\[ j = \begin{bmatrix} \hat{j}_{00} & \hat{j}_{02} & \hat{j}_{04} \\ \hat{j}_{10} & \hat{j}_{12} & \hat{j}_{14} \\ \cdots & \cdots & \cdots \\ \hat{j}_{a0} & \hat{j}_{a2} & \hat{j}_{a4} \end{bmatrix} \]
(39)
\[ \hat{\mathbf{I}}_{rs} = \int_0^1 \mathbf{f}_r(\eta) \eta^s \sqrt{1 - \eta^2} \, d\eta \]  

(40)

\[ \hat{\mathbf{k}} = \begin{bmatrix} \hat{k}_{00} & \hat{k}_{02} & \hat{k}_{04} \\ \hat{k}_{10} & \hat{k}_{12} & \hat{k}_{14} \\ \hat{k}_{a0} & \hat{k}_{a2} & \hat{k}_{a4} \end{bmatrix} \]  

(41)

\[ \hat{\mathbf{f}}_{rs} = \int_0^1 \frac{\mathbf{f}_r(\eta)}{\alpha_m(\eta)} \eta^s \sqrt{1 - \eta^2} \, d\eta \]  

(42)

\[ \hat{\mathbf{n}} = \begin{bmatrix} \mathbf{f}_o(\eta_1) & \mathbf{f}_1(\eta_1) & \ldots & \mathbf{f}_n(\eta_1) \\ \mathbf{f}_o(\eta_2) & \ldots \\ \mathbf{f}_o(\eta_3) & \ldots \end{bmatrix} \]  

(43)

\[ \hat{\mathbf{K}} = \begin{bmatrix} \hat{k}_{00} & \hat{k}_{02} & \hat{k}_{04} \\ \hat{k}_{10} & \hat{k}_{12} & \hat{k}_{14} \\ \hat{k}_{a0} & \hat{k}_{a2} & \hat{k}_{a4} \end{bmatrix} \]  

(44)

\[ \hat{\mathbf{f}}_{rs} = \int_0^1 \frac{\mathbf{f}_r(\eta)}{\alpha_m(\eta)} \eta^s \sqrt{1 - \eta^2} \, d\eta \]  

(45)

\[ \hat{\mathbf{G}} = \begin{bmatrix} \hat{G}_{00} & \hat{G}_{02} & \hat{G}_{04} \\ \hat{G}_{10} & \hat{G}_{12} & \hat{G}_{14} \\ \hat{G}_{a0} & \hat{G}_{a2} & \hat{G}_{a4} \end{bmatrix} \]  

(46)
\[ \xi_{rs} = \int_{0}^{1} \left( \frac{a}{c_m} \right)^2 F_k(\eta) \eta^2 \sqrt{1 - \eta^2} d\eta \] (47)

and

\[ \hat{N} = \begin{bmatrix} F_0(\eta_1) & F_1(\eta_1) & \cdots & F_n(\eta_4) \\ F_0(\eta_2) & \cdots \\ F_0(\eta_3) & \cdots \end{bmatrix} \] (48)

3 Results

Derivatives for the particular set of modes of equation (3) have been obtained from D. E. Lebrian's values of the matrix of the downwash velocities induced by the assumed doublet distribution functions for the following cases:

(i) cropped delta wing, aspect ratio = 3, taper ratio = 1/7
\[ \nu_m = 0.26, 0.4 \]

(ii) cropped delta wing, aspect ratio = 1.2, taper ratio = 1/7
\[ \nu_m = 0.5, 0.6 \]

(iii) arrowhead wing, aspect ratio = 1.32, taper ratio = 7/18, quarter chord sweep = 63.4°
\[ \nu_m = 0.303, 0.606 \]

The results are presented (Tables 4 to 51) as matrices \([\xi_a]\) etc. of the overall derivatives and also as matrices \([\xi_s]\) etc. of the equivalent constant strip derivatives (see equations (22) to (27)).

The overall derivatives for the delta wings have also been compared with the corresponding values given by very low aspect ratio theory. The ratios of the values from the two theories are given in Tables 52 to 56. The derivatives \([\xi_a]_{rs}, [-m_a]_{rs}\) were not compared because their very low aspect ratio theory form consists only of the virtual inertia contribution, which is proportional to \(\nu_m^2\). The other two stiffness derivatives, as given by very low aspect ratio theory, only differ from two damping derivatives \([\xi_a]_{rs}\) from \([\xi_s]_{rs}\) and \([-m_a]_{rs}\) from \([-m_s]_{rs}\) in the virtual inertia contribution. It has therefore been considered sufficient to perform the comparison for only one of the stiffness derivatives, i.e. \([-m_a]_{rs}\) in addition to the comparison for the damping derivatives.

\[ \xi_s \] has also been obtained for \(\nu_m = 0.53\).
The matrices \((A^{-1})\) from which the generalised force for any mode* can be obtained by using equation (34) are given in Tables 1 to 3 for each of the three planforms. The generalised force for any such mode can alternatively be obtained, as is shown earlier, from the derivative for the modes \([n]\) by expressing this new mode as a linear combination of such modes.

4 Conclusions

Comparison of the present results, for the wing of aspect ratio 3 at \(\nu_m = 0.26\), with those of reference 2 shows very close agreement except for \(\ell_2^*\) and \(\ell_2^*\). \(\ell_2^*\) is small in any case and of no importance. The two derivatives \(\ell_2^*\) and \(\ell_2^*\) tend to infinity as the frequency approaches zero when the method of reference 1 (and hence of reference 2) is used. Thus some difference in the values of these two derivatives is more to be expected than for the others. The difference in the \(\ell_2^*\) is in no case greater than about 10%. It is suggested that, for this wing, the derivatives for any intermediate value of the frequency parameter should be obtained by interpolation between the values given in this report for \(\nu_m = 0.26, 0.4\) and those given in reference 2 for \(\nu_m = 0.8\).

The comparison of the values of the derivatives for the cropped delta wings with those given by very low aspect ratio theory does not indicate any simple rule for finding the effect of aspect ratio variation. However, the Tables 52 to 56 should be of use when interpolating for the derivatives for wings of other aspect ratios.

**REFERENCES**

<table>
<thead>
<tr>
<th>No.</th>
<th>Author</th>
<th>Title, etc.</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>D.E. Lehrian</td>
<td>Calculation of flutter derivatives for wings of general planform. AEC No. 16,445 0.1094, January 1954.</td>
</tr>
</tbody>
</table>

* A finer lattice and a greater number of collocation points would however be necessary to ensure accuracy for modes containing more than two nodes in flexure or two nodes in torsion.
Attached: Tables 1 - 56
Detachable Abstract Cards

Advance Distribution

This paper has been selected for inclusion in the A.R.C. Current Paper Series.

CA
DC(A)
DGTD(A)
DGSR(A)
DGSS
DGAP
DAGS
DB
DF
DNA
DAC
ADR Structures Action
AIR (Research)
ADSR Records
Secretary ARC
TIL

Director, RAE
LDRAE(A)
Aero Dept
GW Dept
Naval Air Dept
Pats 1/RAE
Library RAE
" Bedford
<table>
<thead>
<tr>
<th>Values of (( \tilde{w}^{1/2} ) )</th>
<th>Collocation points ( \eta = 0.2, 0.6, 0.8; \theta = \pi/2, \cos^{-1}\left(\sqrt{2}/3\right) )</th>
</tr>
</thead>
</table>
| (1) \( v = 0.26 \) | \[
\begin{align*}
\tilde{w}^{1/2} & = \\
&= 0.023592 + 0.003029 \phi + 0.004186 \phi^2 + 0.000939 + 0.002164 \phi + 0.318277 + 0.243038 \phi + 0.012219 + 0.032978 \phi + 0.015896 + 0.0124943 \phi
\end{align*}
\]
| (II) \( v = 0.4 \) | \[
\begin{align*}
\tilde{w}^{1/2} & = \\
&= 0.021468 + 0.003781 \phi + 0.006410 \phi^2 + 0.005282 + 0.007249 \phi + 0.000183 \phi + 0.030352 \phi + 0.001445 \phi + 0.014341 \phi + 0.067585 \phi + 0.016451 \phi + 0.015863 \phi + 0.027994 \phi + 0.017558 \phi + 0.029193 \phi + 0.000808 \phi + 0.015923 \phi + 0.026154 \phi + 0.005593 \phi
\end{align*}
\]
| (III) \( v = 0.53 \) | \[
\begin{align*}
\tilde{w}^{1/2} & = \\
&= 0.020148 + 0.004557 \phi + 0.008454 \phi + 0.008659 \phi + 0.000006 \phi + 0.287322 + 0.031038 \phi + 0.000809 \phi + 0.009209 \phi + 0.016795 + 0.001234 \phi + 0.005939 + 0.002092 \phi + 0.004272 \phi + 0.005725 \phi + 0.016379 \phi + 0.019258 \phi + 0.019098 \phi + 0.063754 \phi + 0.133534 \phi + 0.132047 \phi + 0.345843 \phi + 0.795282 \phi + 0.105736 \phi + 0.041913 \phi + 0.004084 \phi + 0.004742 \phi
\end{align*}
\]
TABLE 2
Cropped delta wing, aspect ratio 1.2, taper ratio 1/7

<table>
<thead>
<tr>
<th>Values of $\Psi$</th>
<th>Collocation points $\eta = 0.2, 0.4, 0.8; \beta = \pi/2, \cos^{-1}(-2/3)$</th>
</tr>
</thead>
</table>

(1) \( \nu = 0.3 \)

| \( W^{-1} \) | 
|------------------|----------------------------------------------------------|
| \(-0.037776 \) | \(-0.0033154 \) | \(-0.0216512 \) | \( 0.00564601 \) | \( 0.00563599 \) | \( 0.424736 \) | \(+0.105432 \) | \(+0.0574129 \) | \(+0.0143263 \) | \(+0.021675 \) | \(+0.0015288 \) |
| \( 0.172376 \) | \(+0.0402881 \) | \(-0.295908 \) | \( 0.0564460 \) | \( 0.0060560 \) | \(-0.36051 \) | \(+0.367094 \) | \(+0.164947 \) | \(+0.15345 \) | \(+0.035132 \) | \(+0.001657 \) |
| \(-0.168277 \) | \(+0.039077 \) | \(-0.097397 \) | \( 0.073097 \) | \( 0.0248401 \) | \(+0.75759 \) | \(+0.342908 \) | \(-0.1695324 \) | \(+0.39553 \) | \(+0.93271 \) | \(+0.068920 \) |
| \( 2.027422 \) | \(+0.019805 \) | \(-0.492477 \) | \(-0.0101682 \) | \(-0.0125134 \) | \(-0.2275494 \) | \(+0.270222 \) | \(+0.3870905 \) | \(+0.0211572 \) | \(+0.13829 \) | \(+0.0729890 \) |
| \(-7.996914 \) | \(+0.122282 \) | \( 7.041952 \) | \(+0.156887 \) | \(-1.240687 \) | \(+0.024330 \) | \(+0.112414 \) | \(+0.965350 \) | \(+0.327578 \) | \(+0.45844 \) | \(+0.555150 \) | \(+0.089998 \) |
| \( 7.149522 \) | \(+0.143942 \) | \( -11.76680 \) | \(+0.207068 \) | \(+5.468166 \) | \(+0.0671786 \) | \(-6.500334 \) | \(-0.994395 \) | \(+0.976531 \) | \(+0.389544 \) | \(-1.601928 \) | \(+0.242145 \) |

(11) \( \nu = 0.5 \)

<p>| ( W^{-1} ) |
|------------------|----------------------------------------------------------|
| (-0.020590 ) | (-0.019848 ) | (-0.018906 ) | (+0.010549 ) | (+0.011127 ) | (+0.371729 ) | (+0.263579 ) | (+0.050587 ) | (+0.024577 ) | (+0.012547 ) | (+0.0032278 ) |
| ( 0.122323 ) | (+0.031033 ) | (-0.240223 ) | (-0.107755 ) | (-0.114852 ) | (-0.013282 ) | (-0.751489 ) | (-0.77724 ) | (+1.15255 ) | (+0.34116 ) | (-0.257324 ) | (-0.019172 ) |
| (-0.127313 ) | (+0.082289 ) | (+0.265302 ) | (+0.14647 ) | (-0.125444 ) | (+0.041214 ) | (+0.589478 ) | (+0.693009 ) | (-1.624750 ) | (+0.59045 ) | (+0.098129 ) | (+0.165304 ) |
| ( 2.197788 ) | (+0.034718 ) | (+0.167382 ) | (+0.03320 ) | (+0.008462 ) | (-0.025358 ) | (-0.060404 ) | (+0.54146 ) | (+0.38382 ) | (+0.044523 ) | (+0.13200 ) | (+0.015407 ) |
| (-7.57955 ) | (+0.24855 ) | (+0.08847 ) | (+0.12995 ) | (-0.04623 ) | ( 6.92744 ) | (+1.94245 ) | (+0.26091 ) | (-0.83905 ) | (+0.540932 ) | (+0.062770 ) | (+0.1 ) |
| ( 7.125444 ) | (+0.287511 ) | (-11.72692 ) | (+0.413313 ) | (+5.452463 ) | (+0.133712 ) | (-6.344251 ) | (+1.99470 ) | (+9.866868 ) | (+1.070286 ) | (-3.572220 ) | (+0.403819 ) |</p>
<table>
<thead>
<tr>
<th>(\phi^{-1})</th>
<th>(v_{+} = 0.303)</th>
<th>(v_{+} = 0.608)</th>
</tr>
</thead>
<tbody>
<tr>
<td>(-0.0097635 \div 0.00195258\ i \div 0.06495690 + 0.01114611 \div 0.01937099 + 0.00346436 \div 0.035154 \div 0.069186 \div 0.00001259 + 0.00111327 \div 0.0056535 \div 0.00163308 \div 1)</td>
<td>(-0.0051643 \div 0.00227317\ i \div 0.0593230 + 0.02267141 \div 0.01797288 + 0.00790472 \div 0.035802 + 0.132652 \div 0.00071755 + 0.00300725 \div 0.00568230 + 0.00303711 \div 1)</td>
<td></td>
</tr>
<tr>
<td>(0.079884 + 0.01986561 \div 0.0780175 \div 0.08508471 \div 0.039389 \div 0.0429393 \div 0.077509 \div 0.293932 \div 1.319743 + 0.0030015 \div 0.0004021 \div 0.0004039 \div 1)</td>
<td>(0.0460342 \div 0.0221481 \div 0.039186 + 0.162543 \div 0.306341 + 0.086771 \div 0.0067054 \div 0.024097 \div 1.293368 + 0.3095314 \div 0.0392372 \div 0.0031211 \div 1)</td>
<td></td>
</tr>
<tr>
<td>(-0.018848 + 0.0184323 \div 0.021846 + 0.178284 \div 0.328324 \div 0.123825 \div 0.054675 \div 0.439851 \div 1.558814 \div 0.623117 \div 1.002874 \div 0.896682 \div 1)</td>
<td>(0.019171 \div 0.0141417 \div 0.019296 + 0.192886 + 0.147924 \div 0.320594 \div 0.189295 \div 0.054675 \div 0.439851 \div 1.558814 \div 0.623117 \div 1.002874 \div 0.896682 \div 1)</td>
<td></td>
</tr>
<tr>
<td>(1.83024 \div 0.0562200 \div 0.046007 \div 0.0587909 \div 0.048027 \div 0.017832 \div 0.563860 \div 0.340177 \div 0.013349 \div 0.0030977 \div 0.0034068 \div 0.0009859 \div 0.000408 \div 1)</td>
<td>(-6.171489 \div 0.0571077 \div 0.142300 \div 0.409263 \div 1.840379 \div 0.216303 \div 5.048464 \div 1.275270 \div 5.186276 \div 1.03690 \div 0.957777 \div 0.21351 \div 1)</td>
<td></td>
</tr>
<tr>
<td>(6.07898 \div 0.0353613 \div 1.1191368 \div 0.4277599 \div 6.537315 \div 0.336006 \div 5.777516 \div 1.321041 \div 9.124675 \div 1.659394 \div 4.761732 \div 0.745514 \div 1)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
**TABLE 4**

Cropped delta wing, aspect ratio 3, taper ratio 1/7

Values of \((\epsilon_{\infty})\)

(1) \(u_m = 0.26\)

\[
\begin{bmatrix}
-0.01588 & -0.007684 & -0.003288 & -0.001816 & -0.001310 \\
-0.003725 & -0.003129 & -0.003227 & -0.003475 & -0.003546 \\
0.002134 & -0.001024 & -0.002560 & -0.003336 & -0.003675 \\
0.005004 & 0.000225 & -0.001932 & -0.003003 & -0.003504 \\
0.006474 & 0.001044 & -0.001435 & -0.002688 & -0.003294
\end{bmatrix}
\]

(11) \(u_m = 0.4\)

\[
\begin{bmatrix}
-0.04775 & -0.02489 & -0.01351 & -0.009325 & -0.007509 \\
-0.01718 & -0.01217 & -0.01102 & -0.01075 & -0.01041 \\
-0.003217 & -0.006464 & -0.008537 & -0.009640 & -0.009997 \\
0.003864 & -0.003089 & -0.006656 & -0.008490 & -0.009253 \\
0.007686 & -0.0008700 & -0.005244 & -0.007526 & -0.008549
\end{bmatrix}
\]
### Table 5

Cropped delta wing, aspect ratio 3, taper ratio $1/7$

**Values of $(\ell_a)$**

<table>
<thead>
<tr>
<th>$(\ell_a)$</th>
<th>( \nu_m = 0.26 )</th>
<th>( \nu_m = 0.4 )</th>
</tr>
</thead>
<tbody>
<tr>
<td>( \ell_a )</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.501</td>
<td>1.628</td>
<td>1.590</td>
</tr>
<tr>
<td>1.676</td>
<td>1.448</td>
<td>1.611</td>
</tr>
<tr>
<td>1.764</td>
<td>1.403</td>
<td>1.619</td>
</tr>
<tr>
<td>1.806</td>
<td>1.379</td>
<td>1.619</td>
</tr>
<tr>
<td>1.822</td>
<td>1.358</td>
<td>1.619</td>
</tr>
</tbody>
</table>

| \( v = 0.26 \) | 1.647 | 1.613 | 1.586 |
| \( v = 0.4 \)  | 1.378 | 1.326 | 1.275 |

| \( v = 0.26 \) | 1.276 | 1.219 | 1.154 |
| \( v = 0.4 \)  | 1.230 | 1.158 | 1.084 |

| \( v = 0.26 \) | 1.197 | 1.115 | 1.036 |
| \( v = 0.4 \)  | 1.338 | 1.197 | 1.036 |
### TABLE 6

Cropped delta wing, aspect ratio $\gamma$, taper ratio $1/7$

Values of $(-m_2)$

1. $\gamma_a = 0.26$

\[
\begin{array}{cccccc}
-0.008716 & -0.008335 & -0.007933 & -0.007628 & -0.007318 \\
-0.008272 & -0.005692 & -0.004604 & -0.003507 & -0.002573 \\
-0.007832 & -0.004617 & -0.003451 & -0.002926 & -0.002573 \\
-0.007420 & -0.003994 & -0.002837 & -0.002331 & -0.002008 \\
-0.007045 & -0.003565 & -0.002445 & -0.001966 & -0.001670 \\
\end{array}
\]

2. $\gamma_a = 0.4$

\[
\begin{array}{cccccc}
-0.01760 & -0.01706 & -0.01574 & -0.01508 & -0.01440 \\
-0.01642 & -0.01126 & -0.009097 & -0.008092 & -0.007357 \\
-0.01543 & -0.009102 & -0.006819 & -0.005799 & -0.005115 \\
-0.01459 & -0.007867 & -0.005614 & -0.004635 & -0.004011 \\
-0.01385 & -0.007025 & -0.004843 & -0.003921 & -0.003350 \\
\end{array}
\]

- 19 -
\textbf{TABLE 7}

\begin{center}
Cropped delta wing, aspect ratio 3, taper ratio $\frac{1}{7}$
\end{center}

Values of $(-\alpha)$

\begin{center}
\begin{tabular}{c c c c c c}
(i) $v_m = 0.26$ & & & & \\
0.3460 & -0.3862 & -0.3769 & -0.3756 & -0.3708 \\
-0.4029 & -0.3589 & -0.3430 & -0.3366 & -0.3258 \\
(-\alpha) = & -0.4415 & -0.3628 & -0.3370 & -0.3240 & -0.3092 \\
-0.4673 & -0.3684 & -0.3351 & -0.3172 & -0.2994 \\
-0.4841 & -0.3721 & -0.3338 & -0.3123 & -0.2922 \\
\end{tabular}
\end{center}

\begin{center}
(ii) $v_m = 0.4$ & & & & \\
-0.3435 & -0.3807 & -0.3687 & -0.3656 & -0.3598 \\
-0.3977 & -0.3538 & -0.3378 & -0.3313 & -0.3203 \\
(-\alpha) = & -0.4344 & -0.3576 & -0.3325 & -0.3198 & -0.3054 \\
-0.4590 & -0.3631 & -0.3311 & -0.3137 & -0.2963 \\
-0.4749 & -0.3668 & -0.3300 & -0.3092 & -0.2896 \\
\end{tabular}
\end{center}
**TABLE 8**

Cropped delta wing, aspect ratio 3, taper ratio $1/7$

<table>
<thead>
<tr>
<th>Values of $(t_3)$</th>
</tr>
</thead>
<tbody>
<tr>
<td>$(t_3)$ =</td>
</tr>
<tr>
<td>(i) $v_m = 0.26$</td>
</tr>
<tr>
<td>1.490             1.619</td>
</tr>
<tr>
<td>1.665             1.440</td>
</tr>
<tr>
<td>$(t_3') = $</td>
</tr>
<tr>
<td>1.752             1.397</td>
</tr>
<tr>
<td>1.794             1.373</td>
</tr>
<tr>
<td>1.810             1.352</td>
</tr>
<tr>
<td>(ii) $v_m = 0.4$</td>
</tr>
<tr>
<td>1.452             1.581</td>
</tr>
<tr>
<td>1.618             1.410</td>
</tr>
<tr>
<td>$(t_3') = $</td>
</tr>
<tr>
<td>1.701             1.368</td>
</tr>
<tr>
<td>1.739             1.345</td>
</tr>
<tr>
<td>1.754             1.325</td>
</tr>
<tr>
<td>(iii) $v_m = 0.53$</td>
</tr>
<tr>
<td>1.413             1.543</td>
</tr>
<tr>
<td>1.569             1.378</td>
</tr>
<tr>
<td>$(t_3') = $</td>
</tr>
<tr>
<td>1.646             1.339</td>
</tr>
<tr>
<td>1.682             1.317</td>
</tr>
<tr>
<td>1.694             1.299</td>
</tr>
</tbody>
</table>
**Table 9**

Cropped delta wing, aspect ratio 3, taper ratio \( 1/7 \)

Values of \( e_a \)

(i) \( \nu_m = 0.26 \)

\[
\begin{bmatrix}
0.6072 & 0.6036 & 0.5948 & 0.5922 & 0.5225 \\
0.5962 & 0.5188 & 0.5240 & 0.5641 & 0.5994 \\
0.5433 & 0.4789 & 0.5155 & 0.5734 & 0.6173 \\
0.4807 & 0.4425 & 0.5041 & 0.5749 & 0.6245 \\
0.4205 & 0.4056 & 0.4901 & 0.5736 & 0.6284 \\
\end{bmatrix}
\]

(ii) \( \nu_m = 0.4 \)

\[
\begin{bmatrix}
0.6478 & 0.6618 & 0.6055 & 0.6002 & 0.6100 \\
0.6585 & 0.5753 & 0.5794 & 0.6198 & 0.6543 \\
0.6251 & 0.5389 & 0.5674 & 0.6213 & 0.6620 \\
0.5791 & 0.5064 & 0.5550 & 0.6194 & 0.6641 \\
0.5327 & 0.4730 & 0.5409 & 0.6160 & 0.6644 \\
\end{bmatrix}
\]
TABLE 10

Cropped delta wing, aspect ratio 3, taper ratio \(\frac{1}{7}\)

<table>
<thead>
<tr>
<th>Values of (-m_2)</th>
<th>(\nu_m = 0.26)</th>
<th>(\nu_m = 0.4)</th>
</tr>
</thead>
<tbody>
<tr>
<td>((-m))</td>
<td></td>
<td></td>
</tr>
<tr>
<td>-0.3409</td>
<td>-0.3814</td>
<td>-0.326</td>
</tr>
<tr>
<td>-0.3980</td>
<td>-0.3556</td>
<td>-0.3706</td>
</tr>
<tr>
<td>-0.4366</td>
<td>-0.3599</td>
<td>-0.3608</td>
</tr>
<tr>
<td>-0.4623</td>
<td>-0.3659</td>
<td>-0.3326</td>
</tr>
<tr>
<td>-0.4792</td>
<td>-0.3698</td>
<td>-0.3269</td>
</tr>
</tbody>
</table>

\[\begin{array}{cccc}
-0.3731 & -0.3723 & -0.3677 \\
-0.3405 & -0.3345 & -0.3239 \\
-0.3350 & -0.3223 & -0.3077 \\
-0.3334 & -0.3158 & -0.2982 \\
-0.3323 & -0.3111 & -0.2911 \\
\end{array}\]

\[\begin{array}{cccc}
-0.3587 & -0.3587 & -0.3535 \\
-0.3268 & -0.3268 & -0.3163 \\
-0.3284 & -0.3164 & -0.3023 \\
-0.3276 & -0.3108 & -0.2938 \\
-0.3268 & -0.3067 & -0.2973 \\
\end{array}\]
<table>
<thead>
<tr>
<th>Values of (-m_a)</th>
</tr>
</thead>
<tbody>
<tr>
<td>(i) ( v_m = 0.26 )</td>
</tr>
</tbody>
</table>
| \[ \begin{array}{cccccc}
0.1443 & 0.2078 & 0.2545 & 0.3082 & 0.3587 \\
0.1783 & 0.1811 & 0.1980 & 0.2226 & 0.2444 \\
0.2096 & 0.1805 & 0.1829 & 0.1957 & 0.2072 \\
0.2399 & 0.1840 & 0.1763 & 0.1826 & 0.1891 \\
0.2692 & 0.1876 & 0.1723 & 0.1748 & 0.1785 \\
\end{array} \] |
| (ii) \( v_m = 0.4 \) |
| \[ \begin{array}{cccccc}
0.1383 & 0.1967 & 0.2380 & 0.2860 & 0.3314 \\
0.1676 & 0.1694 & 0.1867 & 0.2075 & 0.2277 \\
0.1941 & 0.1676 & 0.1703 & 0.1829 & 0.1941 \\
0.2200 & 0.1698 & 0.1640 & 0.1709 & 0.1779 \\
0.2455 & 0.1723 & 0.1600 & 0.1638 & 0.1634 \\
\end{array} \] |
### TABLE 12

Cropped delta wing, aspect ratio 1.2, taper ratio $1/7$

**Values of $(t_2)$**

(i) $v_m = 0.3$

\[
(t_2) = \begin{bmatrix}
-0.03550 & -0.02319 & -0.01612 & -0.01277 & -0.01068 \\
-0.02223 & -0.01416 & -0.01118 & -0.009750 & -0.008700 \\
-0.01544 & -0.01032 & -0.008756 & -0.008008 & -0.007365 \\
-0.01146 & -0.008062 & -0.007237 & -0.006856 & -0.006441 \\
-0.008968 & -0.006556 & -0.006178 & -0.006030 & -0.005763
\end{bmatrix}
\]

(ii) $v_m = 0.6$

\[
(t_2) = \begin{bmatrix}
-0.1461 & -0.09629 & -0.06754 & -0.05382 & -0.04520 \\
-0.09320 & -0.05940 & -0.04681 & -0.04074 & -0.03627 \\
-0.06585 & -0.04370 & -0.03676 & -0.03340 & -0.03057 \\
-0.04989 & -0.03446 & -0.03046 & -0.02858 & -0.02668 \\
-0.03973 & -0.02827 & -0.02608 & -0.02514 & -0.02385
\end{bmatrix}
\]
### TABLE 13

Cropped delta wing, aspect ratio 1.2, taper ratio 1/7

Values of \((\ell_a)\)

<table>
<thead>
<tr>
<th>(v_m = 0.3)</th>
<th>(\ell_a)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.8107</td>
<td>0.9020</td>
</tr>
<tr>
<td>0.9136</td>
<td>0.7818</td>
</tr>
<tr>
<td>(\ell_a) =</td>
<td>0.9667</td>
</tr>
<tr>
<td>0.9931</td>
<td>0.7300</td>
</tr>
<tr>
<td>1.004</td>
<td>0.7154</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>(v_m = 0.6)</th>
<th>(\ell_a)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.8075</td>
<td>0.9016</td>
</tr>
<tr>
<td>0.8950</td>
<td>0.7744</td>
</tr>
<tr>
<td>(\ell_a) =</td>
<td>0.9603</td>
</tr>
<tr>
<td>0.9620</td>
<td>0.7202</td>
</tr>
<tr>
<td>0.9698</td>
<td>0.7054</td>
</tr>
<tr>
<td>Values of (-(m_z))</td>
<td>(y_m = 0.3)</td>
</tr>
<tr>
<td>------------------------</td>
<td>----------------</td>
</tr>
<tr>
<td>((-M))</td>
<td></td>
</tr>
<tr>
<td>(-0.003802)</td>
<td>-0.005200</td>
</tr>
<tr>
<td>-0.004144</td>
<td>-0.003042</td>
</tr>
<tr>
<td>(-0.003815)</td>
<td>-0.002305</td>
</tr>
<tr>
<td>-0.003627</td>
<td>-0.001923</td>
</tr>
<tr>
<td>(-0.003503)</td>
<td>-0.001663</td>
</tr>
<tr>
<td>((-m_1))</td>
<td></td>
</tr>
<tr>
<td>-0.003815</td>
<td>-0.002305</td>
</tr>
<tr>
<td>-0.003627</td>
<td>-0.001923</td>
</tr>
<tr>
<td>(-0.003503)</td>
<td>-0.001663</td>
</tr>
</tbody>
</table>
**TABLE 15**

Cropped delta wing, aspect ratio 1.2, taper ratio \(1/7\)

<table>
<thead>
<tr>
<th>Values of ((-m_a))</th>
</tr>
</thead>
</table>

(i) \(v_m = 0.3\)

\[
(-m_a) = \begin{bmatrix}
-0.1620 & -0.1630 & -0.1352 & -0.1119 & -0.09064 \\
-0.2050 & -0.1736 & -0.1576 & -0.1479 & -0.1375 \\
-0.2392 & -0.1886 & -0.1697 & -0.1595 & -0.1495 \\
-0.2657 & -0.2006 & -0.1774 & -0.1650 & -0.1538 \\
-0.2359 & -0.2096 & -0.1826 & -0.1679 & -0.1552 
\end{bmatrix}
\]

(ii) \(v_m = 0.6\)

\[
(-m_a) = \begin{bmatrix}
-0.1731 & -0.1716 & -0.1403 & -0.1154 & -0.09352 \\
-0.2121 & -0.1772 & -0.1595 & -0.1493 & -0.1388 \\
-0.2435 & -0.1902 & -0.1704 & -0.1600 & -0.1502 \\
-0.2684 & -0.2010 & -0.1774 & -0.1651 & -0.1541 \\
-0.2869 & -0.2091 & -0.1820 & -0.1677 & -0.1553 
\end{bmatrix}
\]
### TABLE 16

Cropped delta wing, aspect ratio 1.2, taper ratio $\frac{1}{7}$

Values of $(\ell_2)$

#### (i) $v_m = 0.3$

\[
\begin{bmatrix}
0.8055 & 0.8966 & 0.9197 & 0.9334 & 0.9201 \\
0.9100 & 0.7787 & 0.7377 & 0.7176 & 0.6889 \\
0.9637 & 0.7460 & 0.6762 & 0.6398 & 0.6027 \\
0.9905 & 0.7279 & 0.6425 & 0.5968 & 0.5545 \\
1.0017 & 0.7134 & 0.6191 & 0.5678 & 0.5221
\end{bmatrix}
\]

#### (ii) $v_m = 0.6$

\[
\begin{bmatrix}
0.7880 & 0.8814 & 0.9064 & 0.9205 & 0.9072 \\
0.8827 & 0.7635 & 0.7271 & 0.7084 & 0.6802 \\
0.9309 & 0.7309 & 0.6667 & 0.6321 & 0.5958 \\
0.9581 & 0.7131 & 0.6338 & 0.5900 & 0.5486 \\
0.9628 & 0.6988 & 0.6111 & 0.5617 & 0.5168
\end{bmatrix}
\]
### TABLE 17

Cropped delta wing, aspect ratio 1.2, taper ratio $^{1/7}$

Values of $\phi_i$

(i) $v_m = 0.3$

<table>
<thead>
<tr>
<th>$\phi_i$</th>
<th>0.5175</th>
<th>0.5799</th>
<th>0.5777</th>
<th>0.5940</th>
<th>0.6066</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\phi_{\lambda}$</td>
<td>0.6206</td>
<td>0.5334</td>
<td>0.5187</td>
<td>0.5348</td>
<td>0.5472</td>
</tr>
<tr>
<td>$\phi_{\lambda}$</td>
<td>0.6866</td>
<td>0.5314</td>
<td>0.5049</td>
<td>0.5147</td>
<td>0.5224</td>
</tr>
<tr>
<td>$\phi_{\lambda}$</td>
<td>0.7317</td>
<td>0.5325</td>
<td>0.4989</td>
<td>0.5047</td>
<td>0.5087</td>
</tr>
<tr>
<td>$\phi_{\lambda}$</td>
<td>0.7637</td>
<td>0.5314</td>
<td>0.4941</td>
<td>0.4983</td>
<td>0.4998</td>
</tr>
</tbody>
</table>

(ii) $v_m = 0.6$

<table>
<thead>
<tr>
<th>$\phi_i$</th>
<th>0.5190</th>
<th>0.5863</th>
<th>0.5885</th>
<th>0.6079</th>
<th>0.6223</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\phi_{\lambda}$</td>
<td>0.6217</td>
<td>0.5400</td>
<td>0.5285</td>
<td>0.5457</td>
<td>0.5584</td>
</tr>
<tr>
<td>$\phi_{\lambda}$</td>
<td>0.6877</td>
<td>0.5391</td>
<td>0.5149</td>
<td>0.5250</td>
<td>0.5320</td>
</tr>
<tr>
<td>$\phi_{\lambda}$</td>
<td>0.7326</td>
<td>0.5443</td>
<td>0.5093</td>
<td>0.5148</td>
<td>0.5177</td>
</tr>
<tr>
<td>$\phi_{\lambda}$</td>
<td>0.7639</td>
<td>0.5410</td>
<td>0.5051</td>
<td>0.5084</td>
<td>0.5083</td>
</tr>
<tr>
<td>(-n)</td>
<td>(-n)</td>
<td>(-n)</td>
<td>(-n)</td>
<td>(-n)</td>
<td></td>
</tr>
<tr>
<td>------</td>
<td>------</td>
<td>------</td>
<td>------</td>
<td>------</td>
<td></td>
</tr>
<tr>
<td>-0.1576</td>
<td>-0.1556</td>
<td>-0.1969</td>
<td>-0.2296</td>
<td>-0.2739</td>
<td></td>
</tr>
<tr>
<td>-0.2011</td>
<td>-0.1588</td>
<td>-0.1670</td>
<td>-0.1823</td>
<td>-0.2033</td>
<td></td>
</tr>
<tr>
<td>-0.2356</td>
<td>-0.1317</td>
<td>-0.1515</td>
<td>-0.1646</td>
<td>-0.1782</td>
<td></td>
</tr>
<tr>
<td>-0.2622</td>
<td>-0.1087</td>
<td>-0.1420</td>
<td>-0.1549</td>
<td>-0.1643</td>
<td></td>
</tr>
<tr>
<td>-0.2924</td>
<td>-0.0874</td>
<td>-0.1358</td>
<td>-0.1502</td>
<td>-0.1521</td>
<td></td>
</tr>
<tr>
<td>-0.2080</td>
<td>-0.1710</td>
<td>-0.1463</td>
<td>-0.1610</td>
<td>-0.1728</td>
<td></td>
</tr>
<tr>
<td>-0.1315</td>
<td>-0.1555</td>
<td>-0.1528</td>
<td>-0.1544</td>
<td>-0.1521</td>
<td></td>
</tr>
</tbody>
</table>

**TABLE 18**

*Cropped delta wing, aspect ratio 1.2, taper ratio 1/7*

Values of (-n)

(i) $\gamma_m = 0.3$

(ii) $\gamma_m = 0.6$
<table>
<thead>
<tr>
<th>$v_0$</th>
<th>0.3</th>
<th>0.6</th>
</tr>
</thead>
<tbody>
<tr>
<td>$v_m$</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(i)</td>
<td>(ii)</td>
</tr>
<tr>
<td>$\mu_m$</td>
<td>$0.09106$</td>
<td>$0.09171$</td>
</tr>
<tr>
<td></td>
<td>$0.09904$</td>
<td>$0.10047$</td>
</tr>
<tr>
<td>$\langle -\mu_0 \rangle$</td>
<td>$0.1030$</td>
<td>$0.1039$</td>
</tr>
<tr>
<td></td>
<td>$0.1058$</td>
<td>$0.1076$</td>
</tr>
<tr>
<td></td>
<td>$0.1067$</td>
<td>$0.1087$</td>
</tr>
<tr>
<td></td>
<td>$0.09170$</td>
<td>$0.09271$</td>
</tr>
<tr>
<td></td>
<td>$0.1202$</td>
<td>$0.1093$</td>
</tr>
<tr>
<td></td>
<td>$0.1243$</td>
<td>$0.1104$</td>
</tr>
<tr>
<td></td>
<td>$0.08415$</td>
<td>$0.07941$</td>
</tr>
<tr>
<td></td>
<td>$0.08239$</td>
<td>$0.08257$</td>
</tr>
<tr>
<td></td>
<td>$0.07941$</td>
<td>$0.07941$</td>
</tr>
<tr>
<td></td>
<td>$0.07941$</td>
<td>$0.07941$</td>
</tr>
<tr>
<td></td>
<td>$0.07941$</td>
<td>$0.07941$</td>
</tr>
</tbody>
</table>

**TABLE 19**

Cropped delta wing, aspect ratio 1.2, taper ratio 1/7

Values of $(-\mu_0)$
### TABLE 20

**Arrowhead wing, aspect ratio 1.32, taper ratio 7/48, quarter chord sweep 63.4°**

Values of \( \epsilon_m \)

(1) \( y_m = 0.303 \)

\[
\begin{bmatrix}
-0.02406 & 0.01875 & -0.01535 & -0.01348 & -0.01202 \\
-0.01621 & -0.01342 & -0.01227 & -0.01143 & -0.01053 \\
-0.01201 & -0.01096 & -0.01054 & -0.01005 & -0.009386 \\
-0.009483 & -0.009357 & -0.009350 & -0.009059 & -0.008532 \\
-0.007834 & -0.008265 & -0.008464 & -0.008305 & -0.007868
\end{bmatrix}
\]

(2) \( y_m = 0.606 \)

\[
\begin{bmatrix}
-0.1013 & -0.07912 & -0.06469 & -0.05665 & -0.05035 \\
-0.06999 & -0.05706 & -0.05155 & -0.04762 & -0.04363 \\
-0.05295 & -0.04689 & -0.04433 & -0.04183 & -0.03879 \\
-0.04254 & -0.04041 & -0.03940 & -0.03770 & -0.03522 \\
-0.03563 & -0.03577 & -0.03574 & -0.03458 & -0.03247
\end{bmatrix}
\]
### TABLE 21

**Arrowhead wing, aspect ratio 1.32, taper ratio 7/18, quarter chord sweep 63.4°**

Values of \( \ell_a \)

<table>
<thead>
<tr>
<th>( \ell_a )</th>
<th>( \ell_a )</th>
<th>( \ell_a )</th>
<th>( \ell_a )</th>
<th>( \ell_a )</th>
</tr>
</thead>
<tbody>
<tr>
<td>( v_m = 0.303 )</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0.8271</td>
<td>0.7985</td>
<td>0.7383</td>
<td>0.6935</td>
<td>0.6437</td>
</tr>
<tr>
<td>0.8430</td>
<td>0.6569</td>
<td>0.5794</td>
<td>0.5328</td>
<td>0.4888</td>
</tr>
<tr>
<td>( v_m = 0.606 )</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0.8133</td>
<td>0.7888</td>
<td>0.7320</td>
<td>0.6891</td>
<td>0.6406</td>
</tr>
<tr>
<td>0.8222</td>
<td>0.6457</td>
<td>0.5728</td>
<td>0.5286</td>
<td>0.4861</td>
</tr>
</tbody>
</table>

- 34 -
TABLE 22

Arrowhead wing, aspect ratio 1.32, taper ratio 7/16,
quarter chord sweep 63.4°

Values of \((-\alpha_2)\)

(i) \(\alpha = 0.303\)

\[
\begin{bmatrix}
-0.003742 & -0.003389 & -0.003105 & -0.002999 & -0.002889 \\
-0.004045 & -0.001994 & -0.001302 & -0.001260 & -0.001240 \\
-0.003575 & -0.001725 & -0.001211 & -0.001067 & -0.0009967 \\
-0.002869 & -0.001240 & -0.0008435 & -0.0007491 & -0.0007090 \\
-0.003529 & -0.001332 & -0.0008045 & -0.0006738 & -0.0006208
\end{bmatrix}
\]

(ii) \(\alpha = 0.606\)

\[
\begin{bmatrix}
-0.01377 & -0.01282 & -0.01196 & -0.01163 & -0.01123 \\
-0.01421 & -0.007190 & -0.005162 & -0.004817 & -0.004786 \\
-0.01192 & -0.006082 & -0.004502 & -0.004069 & -0.003844 \\
-0.008849 & -0.004140 & -0.003057 & -0.002827 & -0.002719 \\
-0.01140 & -0.004538 & -0.002935 & -0.002554 & -0.002392
\end{bmatrix}
\]
**TABLE 23**

*Arrowhead wing, aspect ratio 1.32, taper ratio 7/18, quarter chord sweep 65.4°*

**Values of \((-\alpha_\text{a})\)**

(i) \(v_\text{m} = 0.303\)

\[
(-\alpha_\text{a}) = \begin{bmatrix}
-0.1906 & -0.1778 & -0.1527 & -0.1372 & -0.1242 \\
-0.2220 & -0.1755 & -0.1561 & -0.1456 & -0.1355 \\
-0.2452 & -0.1823 & -0.1578 & -0.1433 & -0.1304 \\
-0.2567 & -0.1857 & -0.1587 & -0.1426 & -0.1287 \\
-0.2552 & -0.1800 & -0.1524 & -0.1362 & -0.1225
\end{bmatrix}
\]

(ii) \(v_\text{m} = 0.606\)

\[
(-\alpha_\text{a}) = \begin{bmatrix}
-0.1936 & -0.1795 & -0.1531 & -0.1367 & -0.1232 \\
-0.2239 & -0.1761 & -0.1560 & -0.1451 & -0.1348 \\
-0.2450 & -0.1826 & -0.1581 & -0.1434 & -0.1303 \\
-0.2545 & -0.1854 & -0.1588 & -0.1426 & -0.1285 \\
-0.2542 & -0.1804 & -0.1526 & -0.1363 & -0.1224
\end{bmatrix}
\]

- 36 -
### TABLE 24

**Arrowhead wing, aspect ratio 1.32, taper ratio 7/18,**

**quarter chord sweep 63.4°**

Values of $(\ell_2)$

<table>
<thead>
<tr>
<th>$(\ell_2)$</th>
<th>$v_m = 0.303$</th>
<th>(0.8239)</th>
<th>(0.7957)</th>
<th>(0.7359)</th>
<th>(0.6913)</th>
<th>(0.6418)</th>
</tr>
</thead>
<tbody>
<tr>
<td>(0.8402)</td>
<td>(0.6553)</td>
<td>(0.5783)</td>
<td>(0.5318)</td>
<td>(0.4879)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$(\ell_2)$</td>
<td>(0.8239)</td>
<td>(0.5968)</td>
<td>(0.5127)</td>
<td>(0.4641)</td>
<td>(0.4215)</td>
<td></td>
</tr>
<tr>
<td>(0.7977)</td>
<td>(0.5577)</td>
<td>(0.4717)</td>
<td>(0.4226)</td>
<td>(0.3808)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(0.7692)</td>
<td>(0.5270)</td>
<td>(0.4417)</td>
<td>(0.3929)</td>
<td>(0.3520)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>$(\ell_2)$</th>
<th>$v_m = 0.606$</th>
<th>(0.8024)</th>
<th>(0.7790)</th>
<th>(0.7233)</th>
<th>(0.6810)</th>
<th>(0.6332)</th>
</tr>
</thead>
<tbody>
<tr>
<td>(0.8129)</td>
<td>(0.6403)</td>
<td>(0.5687)</td>
<td>(0.5250)</td>
<td>(0.4827)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$(\ell_2)$</td>
<td>(0.7939)</td>
<td>(0.5825)</td>
<td>(0.5084)</td>
<td>(0.4587)</td>
<td>(0.4177)</td>
<td></td>
</tr>
<tr>
<td>(0.7664)</td>
<td>(0.5438)</td>
<td>(0.4641)</td>
<td>(0.4179)</td>
<td>(0.3778)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(0.7373)</td>
<td>(0.5135)</td>
<td>(0.4346)</td>
<td>(0.3887)</td>
<td>(0.3494)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### TABLE 25

Arrowhead wing, aspect ratio 1.32, taper ratio 7/18, quarter chord sweep 63.4°

Values of \( \ell_q \)

<table>
<thead>
<tr>
<th>( \ell_q )</th>
<th>( v_m = 0.303 )</th>
<th>( \ell_q )</th>
<th>( v_m = 0.606 )</th>
</tr>
</thead>
<tbody>
<tr>
<td>( 0.4968 )</td>
<td>( 0.4884 )</td>
<td>( 0.4460 )</td>
<td>( 0.4217 )</td>
</tr>
<tr>
<td>( 0.5196 )</td>
<td>( 0.4334 )</td>
<td>( 0.4030 )</td>
<td>( 0.3875 )</td>
</tr>
<tr>
<td>( 0.5147 )</td>
<td>( 0.4108 )</td>
<td>( 0.3810 )</td>
<td>( 0.3655 )</td>
</tr>
<tr>
<td>( 0.5010 )</td>
<td>( 0.3930 )</td>
<td>( 0.3641 )</td>
<td>( 0.3485 )</td>
</tr>
<tr>
<td>( 0.4849 )</td>
<td>( 0.3766 )</td>
<td>( 0.3496 )</td>
<td>( 0.3344 )</td>
</tr>
<tr>
<td>( 0.5021 )</td>
<td>( 0.4994 )</td>
<td>( 0.4590 )</td>
<td>( 0.4345 )</td>
</tr>
<tr>
<td>( 0.5254 )</td>
<td>( 0.4447 )</td>
<td>( 0.4150 )</td>
<td>( 0.3982 )</td>
</tr>
<tr>
<td>( 0.5199 )</td>
<td>( 0.4230 )</td>
<td>( 0.3933 )</td>
<td>( 0.3757 )</td>
</tr>
<tr>
<td>( 0.5058 )</td>
<td>( 0.4059 )</td>
<td>( 0.3767 )</td>
<td>( 0.3585 )</td>
</tr>
<tr>
<td>( \ell_q )</td>
<td>( 0.4872 )</td>
<td>( 0.3902 )</td>
<td>( 0.3623 )</td>
</tr>
</tbody>
</table>
TABLE 26

Arrowhead wing, aspect ratio 1.32, taper ratio 7/18,
quarter chord sweep 63.4°

Values of \(-m_k\)

<table>
<thead>
<tr>
<th></th>
<th>(v_m = 0.303)</th>
<th>(v_m = 0.606)</th>
</tr>
</thead>
<tbody>
<tr>
<td>(-m_k)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>0.1880 0.1757 0.1511 0.1358 0.1229</td>
<td>0.1834 0.1711 0.1465 0.1310 0.1179</td>
</tr>
<tr>
<td>2</td>
<td>0.2193 0.1741 0.1551 0.1447 0.1346</td>
<td>0.2138 0.1705 0.1520 0.1415 0.1313</td>
</tr>
<tr>
<td>3</td>
<td>0.2427 0.1810 0.1569 0.1425 0.1297</td>
<td>0.2362 0.1778 0.1544 0.1404 0.1272</td>
</tr>
<tr>
<td>4</td>
<td>0.2545 0.1846 0.1579 0.1449 0.1280</td>
<td>0.2473 0.1815 0.1557 0.1397 0.1258</td>
</tr>
<tr>
<td>5</td>
<td>0.2527 0.1790 0.1518 0.1356 0.1219</td>
<td>0.2459 0.1763 0.1498 0.1337 0.1199</td>
</tr>
</tbody>
</table>
**TABLE 27**

Arrowhead wing, aspect ratio 1.32, taper ratio 7/18, quarter chord sweep 63.4°

Values of \( \mu_a \)

(i) \( \mu_m = 0.303 \)

\[ (-\mu_a) = \begin{bmatrix}
0.07849 & 0.05906 & 0.1148 & 0.1262 & 0.1325 \\
0.05297 & 0.06823 & 0.06671 & 0.07349 & 0.07991 \\
0.07889 & 0.06307 & 0.06444 & 0.06913 & 0.07205 \\
0.05453 & 0.06698 & 0.05200 & 0.05780 & 0.06104 \\
0.08237 & 0.05151 & 0.05050 & 0.05436 & 0.05672
\end{bmatrix} \]

(ii) \( \mu_m = 0.606 \)

\[ (-\mu_a) = \begin{bmatrix}
0.07669 & 0.05873 & 0.1150 & 0.1265 & 0.1324 \\
0.04980 & 0.06713 & 0.06724 & 0.07419 & 0.08029 \\
0.07055 & 0.06153 & 0.06484 & 0.06971 & 0.07236 \\
0.04365 & 0.06523 & 0.05248 & 0.05844 & 0.06140 \\
0.06930 & 0.06970 & 0.05113 & 0.05515 & 0.05718
\end{bmatrix} \]
# Table 28

Cropped delta wing, aspect ratio 3, taper ratio 1/7

Values of $[\epsilon_2]$

(i) $\nu_m = 0.26$

$$
\begin{bmatrix}
-0.016877 & -0.003842 & -0.001096 & -0.000454 & -0.000262 \\
-0.001383 & -0.001043 & -0.000518 & -0.000295 & -0.000591 \\
0.0007115 & -0.000256 & -0.000512 & -0.000556 & -0.000525 \\
0.001251 & 0.000045 & -0.000322 & -0.000429 & -0.000438 \\
0.001295 & 0.000174 & -0.000205 & -0.000336 & -0.000366
\end{bmatrix}
$$

(ii) $\nu_m = 0.4$

$$
\begin{bmatrix}
-0.04775 & -0.01245 & -0.004504 & -0.002331 & -0.001502 \\
-0.008588 & -0.004056 & -0.002755 & -0.002150 & -0.001736 \\
-0.001072 & -0.001616 & -0.001707 & -0.001607 & -0.001428 \\
0.0009661 & -0.0006178 & -0.001109 & -0.001213 & -0.001157 \\
0.001537 & -0.0001450 & -0.0007491 & -0.0009408 & -0.0009499
\end{bmatrix}
$$
### Table 29

Cropped delta wing, aspect ratio 3, taper ratio 1/7

Values of $[e_a]$

(1) $\nu_m = 0.26$

$[e_a] = \begin{bmatrix}
1.501 & 0.6106 & 0.3415 & 0.2264 & 0.1613 \\
0.6285 & 0.3016 & 0.1895 & 0.1344 & 0.09989 \\
0.3675 & 0.1929 & 0.1292 & 0.09537 & 0.07291 \\
0.2483 & 0.1379 & 0.09628 & 0.07399 & 0.05701 \\
0.1822 & 0.1051 & 0.07562 & 0.05863 & 0.04642
\end{bmatrix}$

(ii) $\nu_m = 0.4$

$[e_a] = \begin{bmatrix}
1.473 & 0.5961 & 0.3357 & 0.2226 & 0.1586 \\
0.6148 & 0.2966 & 0.1869 & 0.1326 & 0.09865 \\
0.3588 & 0.1899 & 0.1276 & 0.09432 & 0.07215 \\
0.2422 & 0.1358 & 0.09519 & 0.07237 & 0.05648 \\
0.1775 & 0.1035 & 0.07482 & 0.05809 & 0.04603
\end{bmatrix}$
TABLE 30

Cropped delta wing, aspect ratio 3, taper ratio 1/7

Values of $[-m_2]$ 

(i) $v_m = 0.26$

$$
\begin{bmatrix}
-0.008716 & -0.003201 & -0.001653 & -0.001049 & -0.0007293 \\
-0.003102 & -0.001186 & -0.0006330 & -0.0004093 & -0.0002377 \\
-0.001632 & -0.0006348 & -0.0003651 & -0.0002264 & -0.000168 \\
-0.001020 & -0.0003994 & -0.0002195 & -0.0001457 & -0.0001046 \\
-0.0007045 & -0.0002759 & -0.0001528 & -0.0001024 & -0.0000742 
\end{bmatrix}
$$

(ii) $v_m = 0.4$

$$
\begin{bmatrix}
-0.01760 & -0.006398 & -0.003279 & -0.002074 & -0.001440 \\
-0.006158 & -0.002347 & -0.001251 & -0.0008092 & -0.0005693 \\
-0.003216 & -0.001252 & -0.0006819 & -0.0004487 & -0.0003197 \\
-0.002006 & -0.0007867 & -0.0004344 & -0.0002897 & -0.0002089 \\
-0.001385 & -0.0005836 & -0.0003027 & -0.0002042 & -0.0001489 
\end{bmatrix}
$$
TABLE 31
Cropped delta wing, aspect ratio $3$, taper ratio $1/7$

Values of $[-m_a]$

(1) $v_m = 0.26$

$$[-m_a] = \begin{bmatrix}
-0.4108 & -0.1327 & -0.05968 & -0.03404 & -0.02185 \\
-0.1385 & -0.05682 & -0.03108 & -0.01984 & -0.01357 \\
-0.06991 & -0.03287 & -0.01986 & -0.01350 & -0.009662 \\
-0.04235 & -0.02171 & -0.01396 & -0.009911 & -0.007330 \\
-0.02853 & -0.01550 & -0.01043 & -0.007645 & -0.005792
\end{bmatrix}$$

(2) $v_m = 0.4$

$$[-m_a] = \begin{bmatrix}
-0.4080 & -0.1309 & -0.05838 & -0.03313 & -0.02120 \\
-0.1367 & -0.05603 & -0.03061 & -0.01952 & -0.01335 \\
-0.06878 & -0.03241 & -0.01959 & -0.01333 & -0.009543 \\
-0.04159 & -0.02140 & -0.01380 & -0.009804 & -0.007254 \\
-0.02799 & -0.01529 & -0.01031 & -0.007569 & -0.005740
\end{bmatrix}$$
<table>
<thead>
<tr>
<th>TABLE 32</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cropped delta wing, aspect ratio 3, taper ratio $1/7$</td>
</tr>
</tbody>
</table>

Values of $[\ell_2]$

(1) $y_m = 0.26$

$[\ell_2] = \begin{bmatrix}
1.490 & 0.6870 & 0.3399 & 0.2255 & 0.1608 \\
0.6244 & 0.3001 & 0.1888 & 0.1340 & 0.09964
\end{bmatrix}$

(2) $y_m = 0.4$

$[\ell_2] = \begin{bmatrix}
1.452 & 0.5929 & 0.3325 & 0.2208 & 0.1575 \\
0.6069 & 0.2937 & 0.1855 & 0.1318 & 0.09815
\end{bmatrix}$

(3) $y_m = 0.53$

$[\ell_2] = \begin{bmatrix}
1.443 & 0.5786 & 0.3251 & 0.2160 & 0.1542 \\
0.5884 & 0.2871 & 0.1821 & 0.1297 & 0.09665
\end{bmatrix}$
### TABLE 33

*Cropped delta wing, aspect ratio 3, taper ratio $1/7$*

Values of $[\theta_a]$

(i) $v_m = 0.26$

\[
[\theta_a] = \begin{bmatrix}
0.7211 & 0.2075 & 0.08468 & 0.04705 & 0.03079 \\
0.2050 & 0.08214 & 0.04749 & 0.03324 & 0.02497 \\
0.08603 & 0.04340 & 0.03038 & 0.02389 & 0.01929 \\
0.04357 & 0.02608 & 0.02100 & 0.01797 & 0.01529 \\
0.02478 & 0.01690 & 0.01532 & 0.01404 & 0.01246 \\
\end{bmatrix}
\]

(ii) $v_m = 0.4$

\[
[\theta_a] = \begin{bmatrix}
0.7693 & 0.2275 & 0.09588 & 0.05439 & 0.03595 \\
0.2264 & 0.09109 & 0.05251 & 0.03653 & 0.02726 \\
0.09898 & 0.04384 & 0.03344 & 0.02589 & 0.02069 \\
0.05248 & 0.02984 & 0.02312 & 0.01936 & 0.01626 \\
0.03139 & 0.01971 & 0.01690 & 0.01508 & 0.01317 \\
\end{bmatrix}
\]
\textbf{TABLE 34}

\textit{Cropped delta wing, aspect ratio 3, taper ratio 1/7}

Values of $[-m_2]$

\begin{align*}
(1) \quad v_m &= 0.26 \\
[-m_2] &= \begin{bmatrix}
-0.4048 & -0.1311 & -0.05908 & -0.03374 & -0.02167 \\
-0.1368 & -0.05630 & -0.03086 & -0.01974 & -0.01349 \\
-0.06913 & -0.03262 & -0.01974 & -0.01343 & -0.009616 \\
-0.04190 & -0.02156 & -0.01389 & -0.009868 & -0.007300 \\
-0.02824 & -0.01541 & -0.01038 & -0.007615 & -0.005771
\end{bmatrix}

(ii) \quad v_m &= 0.4 \\
[-m_2] &= \begin{bmatrix}
-0.3950 & -0.1274 & -0.05713 & -0.03251 & -0.02083 \\
-0.1332 & -0.05493 & -0.03014 & -0.01926 & -0.01318 \\
-0.06718 & -0.03188 & -0.01935 & -0.01318 & -0.009447 \\
-0.04069 & -0.02109 & -0.01365 & -0.009713 & -0.007192 \\
-0.02740 & -0.01509 & -0.01021 & -0.007507 & -0.005696
\end{bmatrix}
\end{align*}
TABLE 35

Cropped delta wing, aspect ratio 3, taper ratio 1/7

Values of $[-m_n]$

(i) $v_m = 0.26$

\[
[-m_n] = \begin{bmatrix}
0.2254 & 0.07564 & 0.03593 & 0.02164 & 0.01457 \\
0.06493 & 0.02556 & 0.01390 & 0.009044 & 0.006363 \\
0.02959 & 0.01267 & 0.007429 & 0.005096 & 0.003723 \\
0.01684 & 0.007476 & 0.004590 & 0.003281 & 0.002478 \\
0.01094 & 0.004885 & 0.003096 & 0.002290 & 0.001780 \\
\end{bmatrix}
\]

(ii) $v_m = 0.4$

\[
[-m_n] = \begin{bmatrix}
0.2161 & 0.07162 & 0.03360 & 0.02008 & 0.01346 \\
0.06103 & 0.02392 & 0.01297 & 0.008430 & 0.005929 \\
0.02740 & 0.01177 & 0.006920 & 0.004762 & 0.003488 \\
0.01544 & 0.006900 & 0.004270 & 0.003071 & 0.002331 \\
0.009972 & 0.004488 & 0.002875 & 0.002146 & 0.001680 \\
\end{bmatrix}
\]
### TABLE 36

Cropped delta wing, aspect ratio 1.2, taper ratio $1/7$

Values of $[\xi]$

<table>
<thead>
<tr>
<th></th>
<th>$\nu = 0.3$</th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$-0.03550$</td>
<td>$-0.01159$</td>
<td>$-0.005372$</td>
<td>$-0.003191$</td>
<td>$-0.002137$</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>$-0.01112$</td>
<td>$-0.004720$</td>
<td>$-0.002794$</td>
<td>$-0.001950$</td>
<td>$-0.001450$</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$[\xi]$</td>
<td>$-0.005136$</td>
<td>$-0.002580$</td>
<td>$-0.001751$</td>
<td>$-0.001335$</td>
<td>$-0.001052$</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>$-0.002864$</td>
<td>$-0.001613$</td>
<td>$-0.001206$</td>
<td>$-0.0009794$</td>
<td>$-0.0008051$</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>$-0.001794$</td>
<td>$-0.001093$</td>
<td>$-0.0008825$</td>
<td>$-0.0007538$</td>
<td>$-0.0006403$</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>$\nu = 0.6$</th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$-0.1461$</td>
<td>$-0.06814$</td>
<td>$-0.02251$</td>
<td>$-0.01346$</td>
<td>$-0.009041$</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>$-0.04660$</td>
<td>$-0.01980$</td>
<td>$-0.01170$</td>
<td>$-0.008149$</td>
<td>$-0.006045$</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$[\xi]$</td>
<td>$-0.02195$</td>
<td>$-0.01093$</td>
<td>$-0.007352$</td>
<td>$-0.005566$</td>
<td>$-0.004368$</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>$-0.01267$</td>
<td>$-0.006893$</td>
<td>$-0.005078$</td>
<td>$-0.004083$</td>
<td>$-0.003335$</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>$-0.007947$</td>
<td>$-0.004712$</td>
<td>$-0.003726$</td>
<td>$-0.003143$</td>
<td>$-0.002650$</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Values of $\ell_a$</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>---------------------</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

(1) $\nu_m = 0.3$

\[
\begin{bmatrix}
0.8107 & 0.3383 & 0.1926 & 0.1290 & 0.09242 \\
0.3426 & 0.1629 & 0.1018 & 0.07198 & 0.05344 \\
0.2014 & 0.1029 & 0.06781 & 0.04962 & 0.03774 \\
0.1366 & 0.07300 & 0.04984 & 0.03737 & 0.02892 \\
0.1004 & 0.05536 & 0.03879 & 0.02962 & 0.02323 \\
\end{bmatrix}
\]

(11) $\nu_m = 0.6$

\[
\begin{bmatrix}
0.8075 & 0.3381 & 0.1927 & 0.1289 & 0.09228 \\
0.3356 & 0.1613 & 0.1013 & 0.07165 & 0.05316 \\
0.1959 & 0.1016 & 0.06735 & 0.04933 & 0.03749 \\
0.1323 & 0.07202 & 0.04948 & 0.03713 & 0.02872 \\
0.09698 & 0.05459 & 0.03850 & 0.02943 & 0.02306 \\
\end{bmatrix}
\]

-50-
TABLE 38
Cropped delta wing, aspect ratio 1.2, taper ratio $\frac{1}{7}$

Values of $[-m_{\infty}]$

(i) $\nu_{m} = 0.3$

\[-m_{\infty} \begin{bmatrix}
-0.004802 \\ -0.001554 \\ -0.0007947 \\ -0.0004987 \\ -0.0003503
\end{bmatrix} =
\begin{bmatrix}
-0.001950 \\ -0.0006338 \\ -0.0003170 \\ -0.0001923 \\ -0.0001302
\end{bmatrix} - \begin{bmatrix}
-0.001136 \\ -0.0003786 \\ -0.0001906 \\ -0.0001153 \\ -0.00007754
\end{bmatrix} - \begin{bmatrix}
-0.0007965 \\ -0.0002732 \\ -0.0001403 \\ -0.00008622 \\ -0.00005871
\end{bmatrix} - \begin{bmatrix}
-0.0005984 \\ -0.0002103 \\ -0.0001101 \\ -0.00006878 \\ -0.00004751
\end{bmatrix}\]

(ii) $\nu_{m} = 0.6$

\[-m_{\infty} \begin{bmatrix}
-0.01937 \\ -0.005964 \\ -0.002950 \\ -0.001815 \\ -0.001262
\end{bmatrix} =
\begin{bmatrix}
-0.007843 \\ -0.002435 \\ -0.001177 \\ -0.0006975 \\ -0.0004666
\end{bmatrix} - \begin{bmatrix}
-0.004554 \\ -0.001458 \\ -0.0007125 \\ -0.0004218 \\ -0.0002790
\end{bmatrix} - \begin{bmatrix}
-0.003185 \\ -0.001054 \\ -0.0005285 \\ -0.0003190 \\ -0.0002415
\end{bmatrix} - \begin{bmatrix}
-0.002388 \\ -0.0008131 \\ -0.0004171 \\ -0.0002568 \\ -0.0001757
\end{bmatrix}\]
| \[-\alpha\]  | -0.1924 | -0.05602 | -0.02141 | -0.01015 | -0.005341 |
| \[-\alpha\]  | -0.07046 | -0.02749 | -0.01428 | -0.008715 | -0.005730 |
| \[-\alpha\]  | -0.03787 | -0.01709 | -0.009998 | -0.006644 | -0.004673 |
| \[-\alpha\]  | -0.02408 | -0.01182 | -0.007393 | -0.005155 | -0.003765 |
| \[-\alpha\]  | -0.01685 | -0.008732 | -0.005705 | -0.004109 | -0.003077 |

\[V = 0.3\]

\[V = 0.6\]
**TABLE 40**

**Cropped delta wing, aspect ratio 1.2, taper ratio 1/7**

**Values of \([\ell_2]\)**

<table>
<thead>
<tr>
<th>(m = 0.3)</th>
<th>(\ell_1)</th>
<th>(\ell_2)</th>
<th>(\ell_3)</th>
<th>(\ell_4)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.8055</td>
<td>0.3362</td>
<td>0.1916</td>
<td>0.1283</td>
<td>0.09201</td>
</tr>
<tr>
<td>0.3413</td>
<td>0.1622</td>
<td>0.1014</td>
<td>0.07176</td>
<td>0.05330</td>
</tr>
<tr>
<td>([\ell_2]) =</td>
<td>0.2008</td>
<td>0.1026</td>
<td>0.06762</td>
<td>0.04951</td>
</tr>
<tr>
<td>0.1362</td>
<td>0.07279</td>
<td>0.04971</td>
<td>0.03730</td>
<td>0.02888</td>
</tr>
<tr>
<td>0.1002</td>
<td>0.05521</td>
<td>0.03870</td>
<td>0.02957</td>
<td>0.02321</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>(m = 0.6)</th>
<th>(\ell_1)</th>
<th>(\ell_2)</th>
<th>(\ell_3)</th>
<th>(\ell_4)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.7880</td>
<td>0.3305</td>
<td>0.1888</td>
<td>0.1266</td>
<td>0.09072</td>
</tr>
<tr>
<td>0.3310</td>
<td>0.1591</td>
<td>0.09997</td>
<td>0.07032</td>
<td>0.05263</td>
</tr>
<tr>
<td>([\ell_2]) =</td>
<td>0.1939</td>
<td>0.1003</td>
<td>0.06667</td>
<td>0.04891</td>
</tr>
<tr>
<td>0.1312</td>
<td>0.07134</td>
<td>0.04905</td>
<td>0.03688</td>
<td>0.02857</td>
</tr>
<tr>
<td>0.09628</td>
<td>0.05408</td>
<td>0.03819</td>
<td>0.02925</td>
<td>0.02297</td>
</tr>
</tbody>
</table>
### TABLE 44

**Cropped delta wing, aspect ratio 1.2, taper ratio 1/7**

Values of $[\ell_n]$

<table>
<thead>
<tr>
<th></th>
<th>$v_m = 0.3$</th>
</tr>
</thead>
<tbody>
<tr>
<td>$[\ell_n]$</td>
<td></td>
</tr>
<tr>
<td></td>
<td>0.6145</td>
</tr>
<tr>
<td></td>
<td>0.2133</td>
</tr>
<tr>
<td></td>
<td>0.1067</td>
</tr>
<tr>
<td></td>
<td>0.06631</td>
</tr>
<tr>
<td></td>
<td>0.04500</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>$v_m = 0.6$</th>
</tr>
</thead>
<tbody>
<tr>
<td>$[\ell_n]$</td>
<td></td>
</tr>
<tr>
<td></td>
<td>0.6163</td>
</tr>
<tr>
<td></td>
<td>0.2137</td>
</tr>
<tr>
<td></td>
<td>0.1089</td>
</tr>
<tr>
<td></td>
<td>0.06639</td>
</tr>
<tr>
<td></td>
<td>0.04502</td>
</tr>
</tbody>
</table>
TABLE 42

Cropped delta wing, aspect ratio 1.2, taper ratio $1/7$

Values of $[-m_k]$

(1) $v_m = 0.3$

$$[-m_k] = \begin{bmatrix}
-0.1872 & -0.05458 & -0.02085 & -0.009850 & -0.005153 \\
-0.06912 & -0.02708 & -0.01409 & -0.008606 & -0.005657 \\
-0.03730 & -0.01691 & -0.009910 & -0.005688 & -0.004633 \\
-0.02375 & -0.01172 & -0.007343 & -0.005122 & -0.003740 \\
-0.01664 & -0.008668 & -0.005673 & -0.004087 & -0.003060
\end{bmatrix}$$

(2) $v_m = 0.6$

$$[-m_k] = \begin{bmatrix}
-0.1867 & -0.05319 & -0.01998 & -0.009273 & -0.004761 \\
-0.06768 & -0.02644 & -0.01373 & -0.008370 & -0.005496 \\
-0.03636 & -0.01652 & -0.009697 & -0.006452 & -0.004540 \\
-0.02309 & -0.01146 & -0.007201 & -0.005032 & -0.003678 \\
-0.01614 & -0.008472 & -0.005569 & -0.004021 & -0.003015
\end{bmatrix}$$
TABLE 4.3
Cropped delta wing, aspect ratio 1.2, taper ratio 1/7

Values of $[-a_k]$:

(i) $v_M = 0.3$

\[
[-a_k] = \begin{bmatrix}
0.1423 & 0.04989 & 0.02521 & 0.01608 & 0.01136 \\
0.03606 & 0.01459 & 0.008439 & 0.005574 & 0.004382 \\
0.01453 & 0.006428 & 0.004086 & 0.003047 & 0.002387 \\
0.007428 & 0.003419 & 0.002335 & 0.001851 & 0.001515 \\
0.004416 & 0.002033 & 0.001472 & 0.001234 & 0.001051
\end{bmatrix}
\]

(ii) $v_M = 0.6$

\[
[-a_k] = \begin{bmatrix}
0.1433 & 0.05035 & 0.02546 & 0.01622 & 0.01143 \\
0.03600 & 0.01455 & 0.008400 & 0.005834 & 0.004350 \\
0.01437 & 0.006337 & 0.004024 & 0.003002 & 0.002352 \\
0.007276 & 0.003337 & 0.002280 & 0.001811 & 0.001485 \\
0.004296 & 0.001965 & 0.001427 & 0.001202 & 0.001027
\end{bmatrix}
\]
### TABLE 44

**Arrowhead wing, aspect ratio 1:32, taper ratio 7/8**

**Quarter chord sweep 63.4°**

Values of $[e_2]$

<table>
<thead>
<tr>
<th>$e_2$</th>
<th>0.303</th>
<th>0.606</th>
</tr>
</thead>
<tbody>
<tr>
<td>$v_m$</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>-0.002406</td>
<td>-0.001013</td>
</tr>
<tr>
<td></td>
<td>-0.000105</td>
<td>-0.0003500</td>
</tr>
<tr>
<td>$[e_2]$</td>
<td>-0.004003</td>
<td>-0.001765</td>
</tr>
<tr>
<td>$\eta$</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>-0.002371</td>
<td>-0.0001063</td>
</tr>
<tr>
<td></td>
<td>-0.001567</td>
<td>-0.0007126</td>
</tr>
</tbody>
</table>

Values for $e_2$ are given in the table above.
<table>
<thead>
<tr>
<th>( v_m )</th>
<th>0.303</th>
<th>0.606</th>
</tr>
</thead>
<tbody>
<tr>
<td>( \alpha _1 )</td>
<td>0.3407</td>
<td>0.3366</td>
</tr>
<tr>
<td>0.8271</td>
<td>0.3407</td>
<td>0.1920</td>
</tr>
<tr>
<td>0.3597</td>
<td>0.1708</td>
<td>0.1066</td>
</tr>
<tr>
<td>0.2149</td>
<td>0.1100</td>
<td>0.07257</td>
</tr>
<tr>
<td>0.1473</td>
<td>0.0797</td>
<td>0.05398</td>
</tr>
<tr>
<td>0.1091</td>
<td>0.06034</td>
<td>0.04232</td>
</tr>
</tbody>
</table>

Values of \( [\alpha] \)
### TABLE 46

**Arrowhead wing, aspect ratio 1.32, taper ratio 7/18, quarter chord sweep 61.4°**

Values of $[-\theta_g]$

(1) $v_m = 0.303$

$$\begin{bmatrix}
-0.003742 & -0.001446 & -0.0008073 & -0.0005518 & -0.0004083 \\
-0.001767 & -0.0005183 & -0.0002540 & -0.0001781 & -0.0001417 \\
-0.0009295 & -0.0003173 & -0.0001711 & -0.0001219 & -0.0000954 \\
-0.0005279 & -0.0001753 & -0.0000964 & -0.0000717 & -0.0000583 \\
-0.0004988 & -0.0001522 & -0.0000770 & -0.0000554 & -0.0000447
\end{bmatrix}$$

(2) $v_m = 0.606$

$$\begin{bmatrix}
-0.01377 & -0.005468 & -0.003109 & -0.002141 & -0.001587 \\
-0.006062 & -0.001869 & -0.0009498 & -0.0006809 & -0.0005470 \\
-0.003100 & -0.001119 & -0.0006362 & -0.0004650 & -0.0003679 \\
-0.001628 & -0.0005852 & -0.0003494 & -0.0002706 & -0.0002235 \\
-0.001611 & -0.0005186 & -0.0002810 & -0.0002100 & -0.0001723
\end{bmatrix}$$
### Table 47

Arrowhead wing, aspect ratio 1.32, taper ratio 7/18, quarter chord sweep 63.4°

Values of \([-\mu]\)

(i) \(\nu = 0.303\)

\[
[-\mu] = \begin{bmatrix}
-0.2029 & -0.06857 & -0.03245 & -0.01929 & -0.01279 \\
-0.08560 & -0.03723 & -0.02195 & -0.01499 & -0.01088 \\
-0.05210 & -0.02562 & -0.01624 & -0.01152 & -0.008540 \\
-0.03608 & -0.01911 & -0.01275 & -0.009334 & -0.007082 \\
-0.02627 & -0.01447 & -0.009981 & -0.007439 & -0.005801
\end{bmatrix}
\]

(ii) \(\nu = 0.606\)

\[
[-\mu] = \begin{bmatrix}
-0.2061 & -0.06923 & -0.03253 & -0.01922 & -0.01268 \\
-0.08634 & -0.03742 & -0.02193 & -0.01494 & -0.01083 \\
-0.05205 & -0.02568 & -0.01627 & -0.01152 & -0.008529 \\
-0.03578 & -0.01909 & -0.01276 & -0.009335 & -0.007074 \\
-0.02617 & -0.01447 & -0.009992 & -0.007501 & -0.005796
\end{bmatrix}
\]
**TABLE 4.8**

Arrowhead wing, aspect ratio 1.32, taper ratio 7/18, quarter chord sweep 63.4°

Values of $[\ell_3]$ 

<table>
<thead>
<tr>
<th>$v_m$ = 0.303</th>
<th>0.8239</th>
<th>0.3395</th>
<th>0.1913</th>
<th>0.1272</th>
<th>0.09070</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0.3585</td>
<td>0.1704</td>
<td>0.1064</td>
<td>0.07517</td>
<td>0.05576</td>
</tr>
<tr>
<td>$[\ell_3]$</td>
<td>0.2142</td>
<td>0.1098</td>
<td>0.07246</td>
<td>0.05305</td>
<td>0.04034</td>
</tr>
<tr>
<td></td>
<td>0.1468</td>
<td>0.07882</td>
<td>0.05391</td>
<td>0.04045</td>
<td>0.03131</td>
</tr>
<tr>
<td></td>
<td>0.1087</td>
<td>0.06023</td>
<td>0.04228</td>
<td>0.03231</td>
<td>0.02535</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>$v_m$ = 0.606</th>
<th>0.8024</th>
<th>0.3324</th>
<th>0.1880</th>
<th>0.1253</th>
<th>0.08949</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0.3468</td>
<td>0.1665</td>
<td>0.1046</td>
<td>0.07420</td>
<td>0.05517</td>
</tr>
<tr>
<td>$[\ell_3]$</td>
<td>0.2064</td>
<td>0.1072</td>
<td>0.07129</td>
<td>0.05242</td>
<td>0.03998</td>
</tr>
<tr>
<td></td>
<td>0.1410</td>
<td>0.07686</td>
<td>0.05305</td>
<td>0.04000</td>
<td>0.03106</td>
</tr>
<tr>
<td></td>
<td>0.1042</td>
<td>0.05869</td>
<td>0.04160</td>
<td>0.03196</td>
<td>0.02516</td>
</tr>
</tbody>
</table>
Table 4.9

Arrowhead wing, aspect ratio 1.32, taper ratio 7/18, quarter chord sweep 63.40

Values of $[\eta_\alpha]$

<table>
<thead>
<tr>
<th>$\eta_\alpha$</th>
<th>0.303</th>
<th>0.5283</th>
<th>0.1883</th>
<th>0.09477</th>
<th>0.05929</th>
<th>0.04092</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.2803</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0.1094</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0.07043</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0.04992</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>$\eta_\alpha$</th>
<th>0.606</th>
<th>0.5345</th>
<th>0.1924</th>
<th>0.09752</th>
<th>0.06109</th>
<th>0.04210</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.2026</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0.1105</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0.07097</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0.05016</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### TABLE 50

Arrowhead wing, aspect ratio 1.32, taper ratio 7/18, quarter chord sweep 63.4°

Values of \([-\varepsilon_2]\)

<table>
<thead>
<tr>
<th>(v_m)</th>
<th>(-0.2001)</th>
<th>(-0.06774)</th>
<th>(-0.03210)</th>
<th>(-0.01909)</th>
<th>(-0.01265)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(-0.08455)</td>
<td>(-0.03699)</td>
<td>(-0.02181)</td>
<td>(-0.01490)</td>
<td>(-0.01081)</td>
</tr>
<tr>
<td>([-\varepsilon_2])</td>
<td>(-0.05158)</td>
<td>(-0.02545)</td>
<td>(-0.01615)</td>
<td>(-0.01145)</td>
<td>(-0.008490)</td>
</tr>
<tr>
<td></td>
<td>(-0.03578)</td>
<td>(-0.01901)</td>
<td>(-0.01269)</td>
<td>(-0.009289)</td>
<td>(-0.007045)</td>
</tr>
<tr>
<td></td>
<td>(-0.02602)</td>
<td>(-0.01438)</td>
<td>(-0.009337)</td>
<td>(-0.007465)</td>
<td>(-0.005773)</td>
</tr>
</tbody>
</table>

\((i)\) \(v_m = 0.303\)

<table>
<thead>
<tr>
<th>(v_m)</th>
<th>(-0.1953)</th>
<th>(-0.06597)</th>
<th>(-0.03113)</th>
<th>(-0.01844)</th>
<th>(-0.01214)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(-0.08244)</td>
<td>(-0.03623)</td>
<td>(-0.02137)</td>
<td>(-0.01457)</td>
<td>(-0.01055)</td>
</tr>
<tr>
<td>([-\varepsilon_2])</td>
<td>(-0.05020)</td>
<td>(-0.02500)</td>
<td>(-0.01590)</td>
<td>(-0.01125)</td>
<td>(-0.008326)</td>
</tr>
<tr>
<td></td>
<td>(-0.03176)</td>
<td>(-0.01869)</td>
<td>(-0.01251)</td>
<td>(-0.009149)</td>
<td>(-0.006924)</td>
</tr>
<tr>
<td></td>
<td>(-0.02531)</td>
<td>(-0.01416)</td>
<td>(-0.009810)</td>
<td>(-0.007350)</td>
<td>(-0.005681)</td>
</tr>
</tbody>
</table>

\((i1)\) \(v_m = 0.606\)
<table>
<thead>
<tr>
<th>Table 51</th>
</tr>
</thead>
<tbody>
<tr>
<td>Arrowhead wing, aspect ratio 1:32, taper ratio 7/18, quarter chord sweep 63.4°</td>
</tr>
</tbody>
</table>

Values of $[-m_a]$

(i) $y_m = 0.303$

<table>
<thead>
<tr>
<th>$[-m_a]$</th>
<th>0.09368</th>
<th>0.03729</th>
<th>0.02092</th>
<th>0.01412</th>
<th>0.01027</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0.03344</td>
<td>0.01244</td>
<td>0.007462</td>
<td>0.005699</td>
<td>0.004641</td>
</tr>
<tr>
<td></td>
<td>0.01438</td>
<td>0.007054</td>
<td>0.004997</td>
<td>0.004015</td>
<td>0.003303</td>
</tr>
<tr>
<td></td>
<td>0.006099</td>
<td>0.003643</td>
<td>0.003020</td>
<td>0.002650</td>
<td>0.002294</td>
</tr>
<tr>
<td></td>
<td>0.006387</td>
<td>0.002993</td>
<td>0.002315</td>
<td>0.002043</td>
<td>0.001797</td>
</tr>
</tbody>
</table>

(ii) $y_m = 0.606$

<table>
<thead>
<tr>
<th>$[-m_a]$</th>
<th>0.09154</th>
<th>0.03708</th>
<th>0.02096</th>
<th>0.01415</th>
<th>0.01027</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0.03144</td>
<td>0.01224</td>
<td>0.007524</td>
<td>0.005753</td>
<td>0.004663</td>
</tr>
<tr>
<td></td>
<td>0.01286</td>
<td>0.006882</td>
<td>0.005028</td>
<td>0.004049</td>
<td>0.003317</td>
</tr>
<tr>
<td></td>
<td>0.00683</td>
<td>0.003507</td>
<td>0.003048</td>
<td>0.002679</td>
<td>0.002308</td>
</tr>
<tr>
<td></td>
<td>0.005374</td>
<td>0.002867</td>
<td>0.002344</td>
<td>0.002072</td>
<td>0.001812</td>
</tr>
</tbody>
</table>
### TABLE 52

Values of \[
\frac{[e_k]}{[\{e_k\}]_{m=0}}
\] for cropped delta wings

<table>
<thead>
<tr>
<th>(A = 3), (v_m = 0.26)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.8970</td>
</tr>
<tr>
<td>1.8731</td>
</tr>
<tr>
<td>1.8592</td>
</tr>
<tr>
<td>1.8503</td>
</tr>
<tr>
<td>1.8441</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>(A = 1.2), (v_m = 0.3)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.0255</td>
</tr>
<tr>
<td>1.0238</td>
</tr>
<tr>
<td>1.0225</td>
</tr>
<tr>
<td>1.0214</td>
</tr>
<tr>
<td>1.0204</td>
</tr>
</tbody>
</table>
TABLE 53

Values of \( \frac{\frac{1}{2} \cdot [\ell_x]_{z,z}}{A} \) for cropped delta wings

\( (\frac{1}{A} [\ell_x]_{z,z})_{A=0} \)

(i) \( A = 3, \) \( \nu_m = 0.26 \)

\[
\begin{array}{cccccc}
0.7026 & 0.5882 & 0.4710 & 0.4289 & 0.4142 \\
0.5384 & 0.5411 & 0.5623 & 0.6093 & 0.6490 \\
0.4200 & 0.4909 & 0.5850 & 0.6848 & 0.7616 \\
0.3344 & 0.4418 & 0.5839 & 0.7229 & 0.8291 \\
0.2714 & 0.3958 & 0.5732 & 0.7449 & 0.8756
\end{array}
\]

(ii) \( A = 1.2, \) \( \nu_m = 0.3 \)

\[
\begin{array}{cccccc}
0.5987 & 0.5652 & 0.5037 & 0.4907 & 0.4809 \\
0.5604 & 0.5563 & 0.5567 & 0.5776 & 0.5925 \\
0.5308 & 0.5447 & 0.5782 & 0.6147 & 0.6444 \\
0.5090 & 0.5317 & 0.5778 & 0.6347 & 0.6753 \\
0.4929 & 0.5186 & 0.5779 & 0.6471 & 0.6956
\end{array}
\]
TABLE 5a

Values of \( \frac{[-m^2]}{[e_{rs}]} \) for cropped delta wings

\[
\left( \frac{1}{A} \frac{[-m^2]}{[e_{rs}]} \right)_{\text{A}=0}
\]

(1) \( A = 3, \ \nu_m = 0.26 \)

\[
\begin{array}{cccccc}
2.6661 & 3.6390 & 5.2816 & 11.0550 & -154.8 \\
2.1399 & 2.4198 & 2.6632 & 2.3586 & 3.2329 \\
1.9104 & 2.0975 & 2.2348 & 2.3599 & 2.4283 \\
1.7731 & 1.9378 & 2.0494 & 2.1345 & 2.1649 \\
1.6794 & 1.8357 & 1.9409 & 2.0135 & 2.0306
\end{array}
\]

(ii) \( A = 1.2, \ \nu_m = 0.3 \)

\[
\begin{array}{cccccc}
1.2327 & 1.5148 & 1.8640 & 3.2274 & -36.81 \\
1.0812 & 1.1639 & 1.2163 & 1.2918 & 1.3553 \\
1.0307 & 1.0870 & 1.1219 & 1.1572 & 1.1699 \\
1.0056 & 1.0535 & 1.0832 & 1.1079 & 1.1091 \\
0.9898 & 1.0328 & 1.0605 & 1.0806 & 1.0767
\end{array}
\]
## Table 55

Values of $[-m_r]_u$ for cropped delta wings

\[
\left( \frac{1}{A} [-m_r]_{u} \right)_{A=0}
\]

1. **Case 1: $A = 3$, $v_m = 0.26$**

<table>
<thead>
<tr>
<th>$A$</th>
<th>$v_m$</th>
<th>$[-m_r]_u$</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.8097</td>
<td>0.8093</td>
<td>0.7259</td>
</tr>
<tr>
<td>1.0343</td>
<td>0.927</td>
<td>0.8785</td>
</tr>
<tr>
<td>1.2080</td>
<td>1.0443</td>
<td>0.9906</td>
</tr>
<tr>
<td>1.4256</td>
<td>1.1486</td>
<td>1.0784</td>
</tr>
<tr>
<td>1.6946</td>
<td>1.2495</td>
<td>1.1494</td>
</tr>
</tbody>
</table>

2. **Case 2: $A = 1.2$, $v_m = 0.3$**

<table>
<thead>
<tr>
<th>$A$</th>
<th>$v_m$</th>
<th>$[-m_r]_u$</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.5616</td>
<td>0.538</td>
<td>0.5094</td>
</tr>
<tr>
<td>0.5744</td>
<td>0.5526</td>
<td>0.5335</td>
</tr>
<tr>
<td>0.5934</td>
<td>0.5297</td>
<td>0.5448</td>
</tr>
<tr>
<td>0.6288</td>
<td>0.5253</td>
<td>0.5464</td>
</tr>
<tr>
<td>0.6841</td>
<td>0.5199</td>
<td>0.5466</td>
</tr>
</tbody>
</table>

- 68 -
<table>
<thead>
<tr>
<th>Table 56</th>
</tr>
</thead>
<tbody>
<tr>
<td>Values of $\frac{[-m]}{[a]}_{m=0}$ for cropped delta wings</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>(1) $A = 3, \quad \frac{v_m}{m} = 0.26$</th>
</tr>
</thead>
<tbody>
<tr>
<td>$2.6277 \quad 3.5705 \quad 5.1243 \quad 10.3695 \quad -3034.9$</td>
</tr>
<tr>
<td>$2.1284 \quad 2.4056 \quad 2.6459 \quad 2.9387 \quad 2.419$</td>
</tr>
<tr>
<td>$1.9076 \quad 2.0922 \quad 2.2281 \quad 2.3520 \quad 2.4219$</td>
</tr>
<tr>
<td>$1.7746 \quad 1.9360 \quad 2.0460 \quad 2.1310 \quad 2.1620$</td>
</tr>
<tr>
<td>$1.6833 \quad 1.8356 \quad 1.9391 \quad 2.0116 \quad 2.0289$</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>(1i) $A = 3, \quad \frac{v_m}{m} = 0.4$</th>
</tr>
</thead>
<tbody>
<tr>
<td>$2.5180 \quad 3.3888 \quad 4.7773 \quad 9.2781 \quad 135.53$</td>
</tr>
<tr>
<td>$2.0556 \quad 2.3280 \quad 2.5616 \quad 2.8461 \quad 3.1078$</td>
</tr>
<tr>
<td>$1.8478 \quad 2.0363 \quad 2.1744 \quad 2.2993 \quad 2.3703$</td>
</tr>
<tr>
<td>$1.7223 \quad 1.8896 \quad 2.0047 \quad 2.0923 \quad 2.1252$</td>
</tr>
<tr>
<td>$1.6352 \quad 1.7954 \quad 1.9042 \quad 1.9797 \quad 1.9997$</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>(1ii) $A = 1.2, \quad \frac{v_m}{m} = 0.3$</th>
</tr>
</thead>
<tbody>
<tr>
<td>$1.2105 \quad 1.4811 \quad 1.7982 \quad 2.9730 \quad 79.126$</td>
</tr>
<tr>
<td>$1.0720 \quad 1.1541 \quad 1.2060 \quad 1.2819 \quad 1.3458$</td>
</tr>
<tr>
<td>$1.0262 \quad 1.0814 \quad 1.1152 \quad 1.1525 \quad 1.1665$</td>
</tr>
<tr>
<td>$1.0037 \quad 1.0498 \quad 1.0792 \quad 1.1047 \quad 1.1071$</td>
</tr>
<tr>
<td>$0.9898 \quad 1.0301 \quad 1.0574 \quad 1.0738 \quad 1.0752$</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>(1iv) $A = 1.2, \quad \frac{v_m}{m} = 0.6$</th>
</tr>
</thead>
<tbody>
<tr>
<td>$1.1415 \quad 1.3650 \quad 1.5794 \quad 2.3270 \quad 7.9858$</td>
</tr>
<tr>
<td>$1.0256 \quad 1.1011 \quad 1.1477 \quad 1.2203 \quad 1.2831$</td>
</tr>
<tr>
<td>$0.9872 \quad 1.0408 \quad 1.0763 \quad 1.1151 \quad 1.1327$</td>
</tr>
<tr>
<td>$0.9691 \quad 1.0148 \quad 1.0463 \quad 1.0756 \quad 1.0826$</td>
</tr>
<tr>
<td>$0.9582 \quad 0.9983 \quad 1.0282 \quad 1.0531 \quad 1.0540$</td>
</tr>
</tbody>
</table>
These abstract cards are inserted in reports and technical notes for the convenience of librarians and others who need to maintain an information index. Detached cards are subject to the same security regulations as the parent document, and a record of their location should be made on the inside of the back cover of the parent document.
Intermediate results which D. E. Lehrian had earlier obtained by the vortex lattice method. The results are compared, for some cases, with the corresponding values given by very low aspect ratio theory.
Title: Aerodynamic derivatives for two cropped delta wings and one arrowhead wing oscillating in distortion modes

Availability: Open Document, Open Description, Normal Closure before FOI Act: 30 years

Former reference (Department): REPORTS STRUCT 201

Held by The National Archives, Kew

This document is now available at the National Archives, Kew, Surrey, United Kingdom.

DTIC has checked the National Archives Catalogue website (http://www.nationalarchives.gov.uk) and found the document is available and releasable to the public.


The document has been released under the 30 year rule. (The vast majority of records selected for permanent preservation are made available to the public when they are 30 years old. This is commonly referred to as the 30 year rule and was established by the Public Records Act of 1967).

This document may be treated as UNLIMITED.