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VORCAM - A COMPUTER PROGRAM FOR CALCULATING VORTEX LIFT EFFECT OF CAMBERED WINGS BY THE SUCTION ANALOGY

C. Edward Lan and Jen-Fu Chang

THE UNIVERSITY OF KANSAS CENTER FOR RESEARCH, INC.
Flight Research Laboratory
Lawrence, Kansas 66045

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National Aeronautics and
Space Administration

Langley Research Center
Hampton, Virginia 23665

INTRODUCTION

This report is a supplement to reference 1 and describes the usage of a computer program implementing an improved aerodynamic panel method described in reference 1. The method is applicable to cambered wings exhibiting edge-separated vortex flow at subsonic and supersonic speeds. The original method of the suction analogy (ref. 2) has been improved by determining the appropriate position and hence orientation of vortex force on cambered wings, as well as utilizing an effective angle of attack in supersonic flow.

In the following, the program capabilities, input format and output format are described. Then, input data of three sample test cases and the corresponding output, as well as the program listing are given.

PROGRAM CAPABILITIES

This program has the following main features:

(1) It is applicable to nonplanar wing configurations in subsonic and supersonic flow, such as wing-winglet, wing-vertical fin combinations, etc. For a wing with dihedral, it may be represented by up to five (5) contiguous spanwise panels with different dihedral angles.

(2) Arbitrary camber shapes may be defined at ten (10) or less spanwise stations. Option for exactly defining leading-edge flap geometry is also provided.

(3) The distribution of wing twist can be prescribed in a general way.

(4) The vortex-lift effect is calculated through the use of Polhamus' suction analogy.

INPUT DATA FORMAT

Group 1 Format (13A6), 1 card

TITLE (I) A descriptive phrase describing the case to be run.

Group 2 Format 8(6X, I4), 1 card

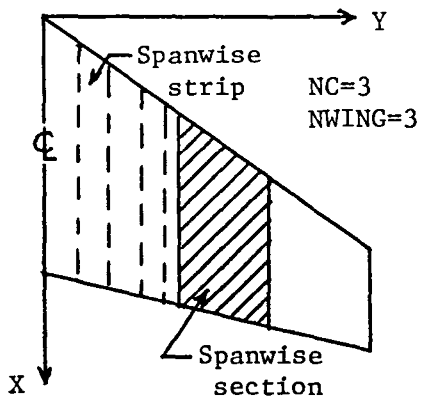
NC Number of spanwise sections on the right wing (bounded by points of discontinuities in geometry, such as change in sweep, edges of flap segments, panels with different dihedral angles, etc.) Limited to 5. (See Sketch 1).

M1(I), I=1, NC Number of spanwise strips in each spanwise section. There are NC numbers. Maximum total number of strips is 48. (See Sketch 1).

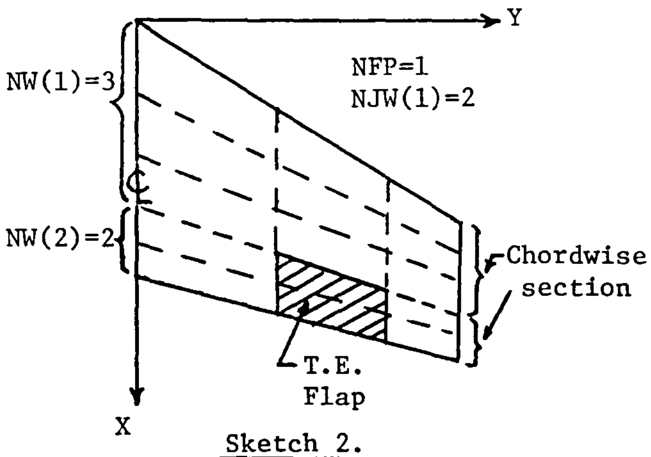
IWING = Last wing spanwise strip number, cumulative from center line, and used for a wing in combination with a tail, winglet or vertical fin. For a wing alone, set = 0.

NWING = The numerical value of last wing spanwise section, i. e., its most outboard section.

IWGLT = 1 if a winglet is present. = 2 if a vertical fin is present inboard of wing tip. = 0, otherwise.



Sketch 1.



Sketch 2.

Group 3 Format 8(6X, I4), 1 card

NFP Number of trailing-edge flap segments. Limited to 5.

NJW(I), I=1,NFP Numerical value of the spanwise section in which the trailing-edge flap segment is contained. For either clean or full-span flap configurations, set NFP = 1 and NJW(1) = 1.(See sketch 2).

NVRTX The spanwise strip number at which and outboard of which the leading-edge vortex lift effect is not included. Full vortex lift effect is assumed if this value is set to zero.

Group 4 Format 4(6X, I4), 1 card

NW(1), NW(2) } Numbers of chordwise aerodynamic panels in chordwise sections (See Sketch 2). The chordwise section may be bounded along trailing-edge flap hinge line or winglet leading edge. NW(2) = 0 for clean configurations. NW(1) + NW(2) is limited to 20.

ICAM = 0 for non-cambered airfoils.

= 1 if camber ordinates are to be read in.

= 2 if camber slopes are defined analytically in subroutine ZCDX.

= 3 if there are flat leading-edge flaps attached to a non-cambered wing.

IST Number of y stations at which camber ordinates are read in. Limited to 10. If ICAM = 3, IST is the number of leading-edge flap segments; for example, IST would be 1 for a simple flat leading-edge flap. If ICAM = 1, at least two y stations are needed, one being at the root and the other being at the tip.

Note: If a tail, winglet or vertical fin is present and has camber, only one camber shape is permitted. The last y station is used to describe that shape.

Omit Groups 5, 6, and 7 if ICAM ≠ 1. Repeat Groups 5, 6, 7 IST times.

Group 5 Format 4F10.6

YT(I) y-station at which camber ordinates are read in.

XNUM number of camber ordinates to be read in. Limited to 21.

CURV(I) = 0. if camber is to be formed by connecting straight segments, with first segment being regarded as flat leading-edge flap.

= 1. if cubic spline interpolation is used.

= 2. if cubic spline interpolation is used, with first segment being flat leading-edge flap.

CHND(I) Chord length at YT(I) station.

Group 6 Format 8F10.6

XT(I,J) x/c-values at which camber ordinates are read in for YT(I) station.

Group 7 Format 8F10.6

CA(J) z/c-values of camber ordinates at the corresponding XT(I,J)-locations.

Omit Groups 8, 9 and 10 if ICAM ≠ 3. Repeat IST times.

Group 8 Format 2F10.6

YLEF (I,1) Extreme inboard y-coordinate of Ith flat leading-edge flap segment.

YLEF (I,2) Extreme outboard y-coordinate of Ith flat leading-edge flap segment.

Group 9 Format 6F10.6

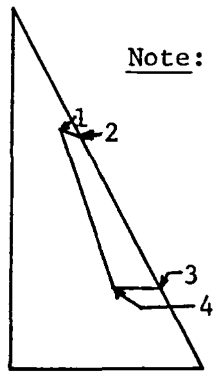
XLF(I,1), YLF(I,1), Z1 } First corner point coordinates of Ith flat leading-edge flap segment. See sketch 3.

XLF(I,2), YLF(I,2), Z2 } Second corner point coordinates of Ith flat leading-edge flap segment.

Group 10 Format 6F10.6

XLF(I,3), XLF(I,3), Z3 — Third corner point coordinates of Ith flat leading-edge flap segment.

XLF(I,4), YLF(I,4), Z4 — Fourth corner point coordinates of Ith flat leading-edge flap segment.



Note: The flat flap must be inside the boundary of planform described in Group 13.

Sketch 3.

Group 11 Format 8F10.6

AM Freestream Mach number

HALFSW Half of reference wing area, same units as (CREF) squared.

CREF Reference chord length

ALPCON = 1. if C_{L_α} and C_{m_α} are to be computed. For this case, set T.E. flap angles to zero. Otherwise, set ALPCON = 0.

DF(I), I=1, NFP Trailing-edge flap angles in degrees, inboard trailing-edge flap segment first.

Group 12 Format 4F10.6, 1 card

FALP number of angles of attack to be processed.

ALPI Initial angle of attack in degrees to be processed.

ALPIN incremental angle of attack in degrees to be processed.

PTION = 1. if detailed aerodynamic loading is to be printed.

= 0. if only overall aerodynamic characteristics are to be printed.

SUP =1. if effective angles of attack in supersonic flow are to be used. Use this option only if the leading edge is subsonic.

=0. otherwise.

Note: Set FALP, ALPI, and ALPIN to 0. if ALPCON = 1.0.

Group 13 Format 8F10.6

Corner-point coordinates of a spanwise section. See sketch 4a.

XXL(1) L. E. X-coordinate of the inboard chord.

XXT(1) T. E. X-coordinate of the inboard chord.

YL(1) Y-coordinate of the inboard chord.

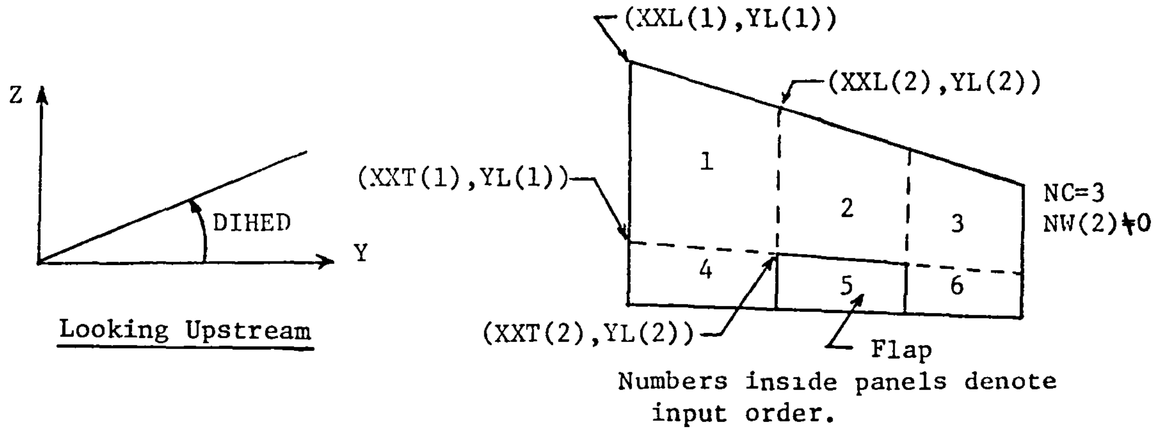
XXL(2) L. E. X-coordinate of the outboard chord.

XXT(2) T. E. X-coordinate of the outboard chord.

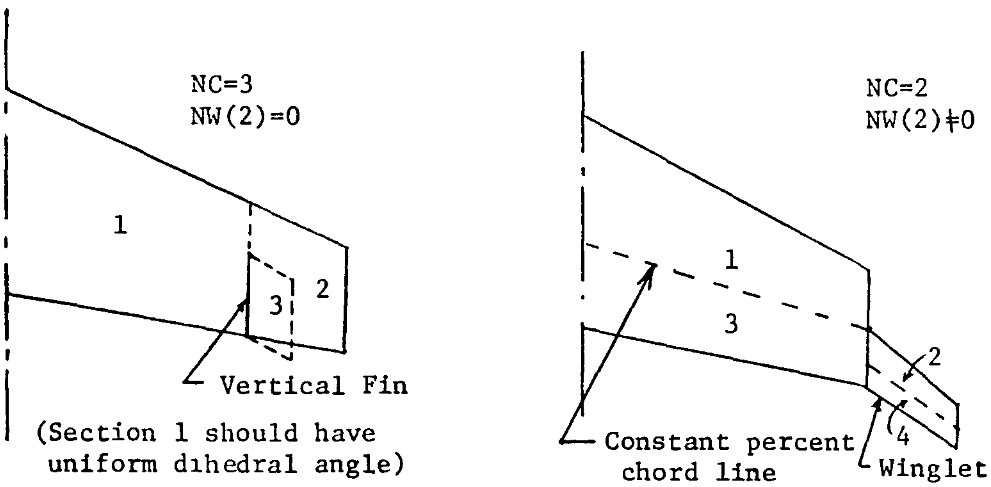
YL(2) Y-Coordinate of the outboard chord.

ZS elevation of the spanwise section.

DIHED dihedral angle in degrees for the section.



Sketch 4 a.



Sketch 4 b.

Group 14 Format 3F10.6

FCN = 1. if control point locations are to be calculated for this section based on 2-D theory.

= 0. if control point locations calculated for a preceding spanwise section are to be used. (For the aft most chordwise section, FCN should be the same as the corresponding leading chordwise section)

SWK Leading edge sweep angle of spanwise section projected on the X-Y plane, in degrees.

E = Hinge line location in fraction of local chord. (true also for non-flapped spanwise sections in a partial-span trailing-edge flap configuration)

= 1. for a configuration without trailing-edge flap segments.

TR Taper ratio for the section (i.e. tip chord/root chord of the tip section).

Note. Groups 13 and 14 are to be repeated NC times. With trailing-edge flaps or winglet, another NC cards are needed to describe the flap and the associated regions. The order of input is illustrated in Sketch 4. Panels with dihedral must be rotated to X-Y plane for geometric description.

Group 15 should be omitted if ALPCON = 1.0

Group 15 Format 2F10.6, 1 card

TWIST1 = 0. if there is no wing twist

= 1. if there is wing twist

RINC Root chord incidence in degrees

Groups 16, 17, and 18 should be omitted if TWIST1 = 0.

Group 16 Format 2F10.6, 1 card

YNUM Number of y- stations to be used to describe twist distribution.

TCURV = 0.if the twist distribution is assumed to have piecewise linear variation.

= 1.if cubic spline interpolation is used.

Group 17 Format 8F10.6

YTS(I) Nondimensional (based on semispan) y coordinates at which twist angles are defined. YNUM numbers. Limited to 21.

Group 18 Format 8F10.6

CA(I) Twist angles in degrees at the corresponding y-stations. Negative for washout (i.e., leading-edge down) .

Group 19 should be omitted if IWING = 0.

Group 19 Format 4F10.6, 1 card

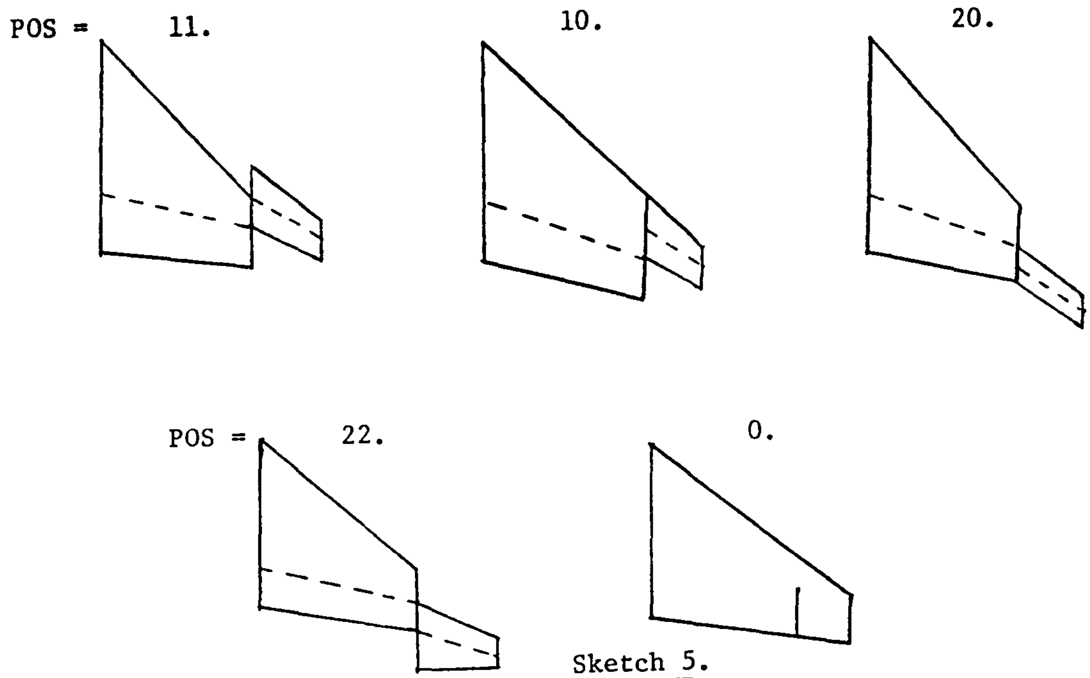
TINC Tail incidence angle in degrees

HALFSH Tail half area. If the tail is to represent the winglet at the tip, put HALFSH = HALFSW. If the tail is a vertical fin inboard of wing tip, set HALFSH = fin area.

POS Winglet position indicator. The number, or key value, used for the configuration is dependent on whether the winglet is attached to the wing first or second chordwise section, respectively. Key values are indicated in sketch 5. If there is no winglet, it should be 0.

CAMT = 0, if the tail is not cambered.

= 1, otherwise.



Sketch 5.

To run additional cases at the same time, repeat groups 1-19.

Remarks:

(1) With the existing dimensions for the arrays DQ(140, 140) and GAMMA (19600), a total of 140 panels can be used. The minimum memory for execution is 58K (decimal). If the dimension for these two arrays is increased, up to 200 panels can be accepted.

(2) Three working disk files are needed in execution. They are designated as (01), (02), and (03).

(3) If the number of panels is to be increased, the following statements (see program listing for statement identification) must be changed:

SSC 10 DQ(N,N), N being the number of panels.

SSC 11 GAMMA(M), M being at least (N+1)**2/4.

SSC 38 IQ = N.

OUTPUT FORMAT

(1) First, all input data will be printed.

HALFSW = half of reference wing area

CREF = reference chord

(2) Panel endpoint coordinates and edge slopes:

(X1, Y1) coordinates of the inboard endpoint of a panel edge

(X2, Y2) coordinates of the corresponding outboard endpoint of a panel edge

BP tangent of sweep angle of a panel edge. The first BP is for the upstream edge and the second BP is for the downstream edge of a panel.

(3) Control point coordinates

One set of (XCP, YCP, ZCP) defines a control point location.

(4) Pressure distribution in attached flow

XV nondimensional chordwise location (referred to local chord)

YV nondimensional spanwise location (referred to wing semispan)

CP = ΔC_p

(5) Sectional characteristics

Y/S nondimensional y-station, referred to wing semispan.

CL sectional lift coefficient

CM sectional pitching moment coefficient about the y axis.

CDI sectional induced drag coefficient.

CS*C sectional suction coefficient multiplied by local chord.

CAV sectional axial (along x-axis) force coefficient due to leading edge vortex

(6) The next group of output variables is the overall aerodynamic characteristics in attached potential flow. If ALPCON = 1.0, the lift and pitching moment coefficients will be C_{L_α} and C_{M_α}.

(7) If ALPCON = 1.0, the factors, K_p, $K_{v,\,le}$ and $K_{v,\,se}$, etc. to be used in the method of suction analogy for a noncambered wing will be printed next. They are used in the following formulas:

$$C_L = K_p \sin\alpha\cos^2\alpha + (K_{v,\ell e} + K_{v,se})\sin^2\alpha\cos\alpha$$

$$C_{D_i} = C_L \tan\alpha$$

$$C_m = K_p \sin\alpha\cos\alpha \frac{\bar{x}_p}{C_{ref}} + K_{v,\ell e}\sin^2\alpha \frac{\bar{x}_{\ell e}}{C_{ref}} + K_{v,se}\sin^2\alpha \frac{\bar{x}_{se}}{C_{ref}}$$

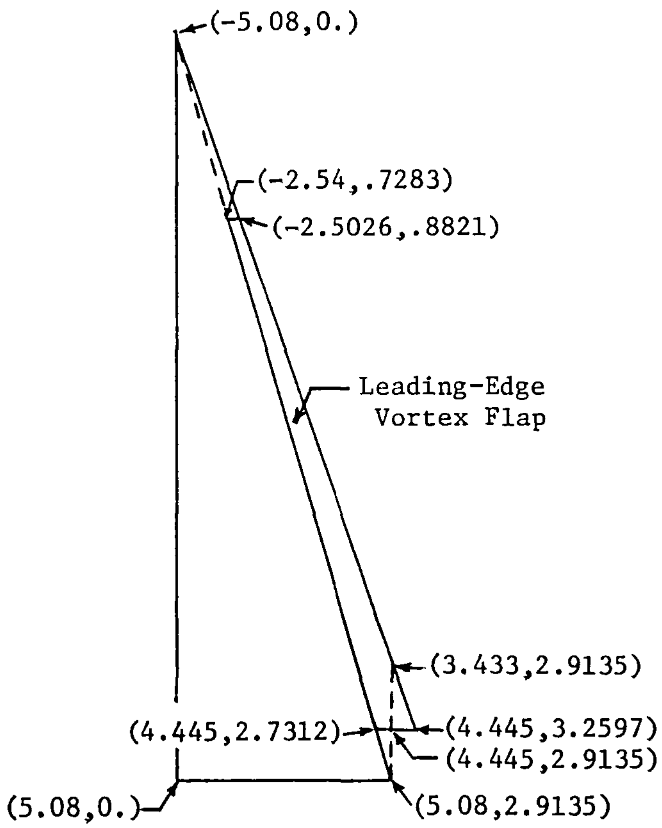
(8) The bending moment distribution and the bending moment coefficient at the root chord will be printed next (attached-flow results only).

(9) Finally, overall aerodynamic characteristics for attached flow and vortex-separated flow will be summarized. Most variables are self-explanatory. In the attached flow results, CB is the root chord bending moment coefficient. In the separated flow results, CAV is the total axial force coefficient due to leading-edge vortex.

1. First Sample Case

<u>Input Data</u>

```
RAO CONFIGURATION
         2        12         2         0         2         0
         1         1         0
        10         0         3         1
     .7283    3.2597
     -2.54     .7283        0.   -2.5026     .8821    -.0677
     4.445    3.2597     -.254     4.445    2.7312        0.
        .2   15.1968     6.773        0.        0.
        1.       16.        0.        1.
     -5.08      5.08        0.     3.433      5.08    2.9135        0.        0.
        1.    71.107        1.        0.
     3.433     4.445    2.9135     4.445     4.445    3.2597        0.        0.
        1.    71.107        1.        0.
        0.        0.
```



Output

```
***************************************
   RAO CONFIGURATION

***************************************

INPUT DATA
       2        12         2         0         2         0
       1         1         0
      10         0         3         1
 .728300  3.259700
-2.540000  .728300  0.000000 -2.502600   .882100  -.067700
 4.445000  3.259700  -.254000  4.445000  2.731200  0.000000
  .200000 15.196800  6.773000  0.000000  0.000000
 1.000000 16.000000  0.000000  1.000000  0.000000
-5.080000  5.080000  0.000000  3.433000  5.080000  2.913500  0.000000  0.000000
 1.000000 71.107000  1.000000  0.000000
 3.433000  4.445000  2.913500  4.445000  4.445000  3.259700  0.000000  0.000000
 1.000000 71.107000  1.000000  0.000000
 0.000000  0.000000
        HALF SW=  .15197E+02         CREF=  .67730E+01

PANEL ENDPOINT COORDINATES AND EDGE SLOPES =

   X1         X2         Y1         Y2        BP        BP
 -5.08000   -4.80340   0.00000    .09467   2.92192   2.85041
 -4.83137   -4.56153   0.00000    .09467   2.85041   2.64290
 -4.10981   -3.85962   0.00000    .09467   2.64290   2.31969
 -2.98595   -2.76636   0.00000    .09467   2.31969   1.91242
 -1.56981   -1.38877   0.00000    .09467   1.91242   1.46096
  -.00000     .13830   0.00000    .09467   1.46096   1.00950
  1.56981    1.66537   0.00000    .09467   1.00950    .60223
  2.98595    3.04296   0.00000    .09467    .60223    .27902
  4.10981    4.13622   0.00000    .09467    .27902    .07150
  4.83137    4.83814   0.00000    .09467    .07150    .00000
 -4.80340   -4.32653    .09467    .25787   2.92192   2.85041
 -4.56153   -4.09634    .09467    .25787   2.85041   2.64290
 -3.85962   -3.42829    .09467    .25787   2.64290   2.31969
 -2.76636   -2.38778    .09467    .25787   2.31969   1.91242
 -1.38877   -1.07665    .09467    .25787   1.91242   1.46096
   .13830     .37673    .09467    .25787   1.46096   1.00950
  1.66537    1.83012    .09467    .25787   1.00950    .60223
  3.04296    3.14124    .09467    .25787    .60223    .27902
  4.13622    4.18176    .09467    .25787    .27902    .07150
  4.83814    4.84981    .09467    .25787    .07150    .00000
 -4.32653   -3.64608    .25787    .49075   2.92192   2.85041
 -4.09634   -3.43254    .25787    .49075   2.85041   2.64290
 -3.42829   -2.81281    .25787    .49075   2.64290   2.31969
 -2.38778   -1.84757    .25787    .49075   2.31969   1.91242
```

-1.07665	-.63129	.25787	.49075	1.91242	1.46096
.37673	.71696	.25787	.49075	1.46096	1.00950
1.83012	2.06521	.25787	.49075	1.00950	.60223
3.14124	3.28149	.25787	.49075	.60223	.27902
4.18176	4.24673	.25787	.49075	.27902	.07150
4.84981	4.86646	.25787	.49075	.07150	.00000
-3.64608	-2.80159	.49075	.77976	2.92192	2.85041
-3.43254	-2.60872	.49075	.77976	2.85041	2.64290
-2.81281	-2.04897	.49075	.77976	2.64290	2.31969
-1.84757	-1.17714	.49075	.77976	2.31969	1.91242
-.63129	-.07857	.49075	.77976	1.91242	1.46096
.71696	1.13920	.49075	.77976	1.46096	1.00950
2.06521	2.35698	.49075	.77976	1.00950	.60223
3.28149	3.45555	.49075	.77976	.60223	.27902
4.24673	4.32737	.49075	.77976	.27902	.07150
4.86646	4.88712	.49075	.77976	.07150	.00000
-2.80159	-1.84215	.77976	1.10813	2.92192	2.85041
-2.60872	-1.67275	.77976	1.10813	2.85041	2.64290
-2.04897	-1.18114	.77976	1.10813	2.64290	2.31969
-1.17714	-.41544	.77976	1.10813	2.31969	1.91242
-.07857	.54940	.77976	1.10813	1.91242	1.46096
1.13920	1.61893	.77976	1.10813	1.46096	1.00950
2.35698	2.68846	.77976	1.10813	1.00950	.60223
3.45555	3.65329	.77976	1.10813	.60223	.27902
4.32737	4.41899	.77976	1.10813	.27902	.07150
4.88712	4.91060	.77976	1.10813	.07150	.00000
-1.84215	-.82350	1.10813	1.45675	2.92192	2.85041
-1.67275	-.67903	1.10813	1.45675	2.85041	2.64290
-1.18114	-.25977	1.10813	1.45675	2.64290	2.31969
-.41544	.39325	1.10813	1.45675	2.31969	1.91242
.54940	1.21611	1.10813	1.45675	1.91242	1.46096
1.61893	2.12825	1.10813	1.45675	1.46096	1.00950
2.68846	3.04039	1.10813	1.45675	1.00950	.60223
3.65329	3.86325	1.10813	1.45675	.60223	.27902
4.41899	4.51627	1.10813	1.45675	.27902	.07150
4.91060	4.93553	1.10813	1.45675	.07150	.00000
-.82350	.19515	1.45675	1.80537	2.92192	2.85041
-.67903	.31469	1.45675	1.80537	2.85041	2.64290
-.25977	.66161	1.45675	1.80537	2.64290	2.31969
.39325	1.20195	1.45675	1.80537	2.31969	1.91242
1.21611	1.88282	1.45675	1.80537	1.91242	1.46096
2.12825	2.63757	1.45675	1.80537	1.46096	1.00950
3.04039	3.39232	1.45675	1.80537	1.00950	.60223
3.86325	4.07320	1.45675	1.80537	.60223	.27902
4.51627	4.61354	1.45675	1.80537	.27902	.07150
4.93553	4.96046	1.45675	1.80537	.07150	.00000
.19515	1.15459	1.80537	2.13374	2.92192	2.85041
.31469	1.25066	1.80537	2.13374	2.85041	2.64290
.66161	1.52944	1.80537	2.13374	2.64290	2.31969
1.20195	1.96365	1.80537	2.13374	2.31969	1.91242

1.88282	2.51079	1.80537	2.13374	1.91242	1.46096
2.63757	3.11730	1.80537	2.13374	1.46096	1.00950
3.39232	3.72381	1.80537	2.13374	1.00950	.60223
4.07320	4.27094	1.80537	2.13374	.60223	.27902
4.61354	4.70516	1.80537	2.13374	.27902	.07150
4.96046	4.98394	1.80537	2.13374	.07150	.00000
1.15459	1.99908	2.13374	2.42275	2.92192	2.85041
1.25066	2.07448	2.13374	2.42275	2.85041	2.64290
1.52944	2.29328	2.13374	2.42275	2.64290	2.31969
1.96365	2.63408	2.13374	2.42275	2.31969	1.91242
2.51079	3.06351	2.13374	2.42275	1.91242	1.46096
3.11730	3.53954	2.13374	2.42275	1.46096	1.00950
3.72381	4.01557	2.13374	2.42275	1.00950	.60223
4.27094	4.44500	2.13374	2.42275	.60223	.27902
4.70516	4.78580	2.13374	2.42275	.27902	.07150
4.98394	5.00460	2.13374	2.42275	.07150	.00000
1.99908	2.67953	2.42275	2.65563	2.92192	2.85041
2.07448	2.73827	2.42275	2.65563	2.85041	2.64290
2.29328	2.90876	2.42275	2.65563	2.64290	2.31969
2.63408	3.17429	2.42275	2.65563	2.31969	1.91242
3.06351	3.50887	2.42275	2.65563	1.91242	1.46096
3.53954	3.87977	2.42275	2.65563	1.46096	1.00950
4.01557	4.25066	2.42275	2.65563	1.00950	.60223
4.44500	4.58525	2.42275	2.65563	.60223	.27902
4.78580	4.85078	2.42275	2.65563	.27902	.07150
5.00460	5.02126	2.42275	2.65563	.07150	.00000
2.67953	3.15640	2.65563	2.81883	2.92192	2.85041
2.73827	3.20347	2.65563	2.81883	2.85041	2.64290
2.90876	3.34008	2.65563	2.81883	2.64290	2.31969
3.17429	3.55287	2.65563	2.81883	2.31969	1.91242
3.50887	3.82099	2.65563	2.81883	1.91242	1.46096
3.87977	4.11820	2.65563	2.81883	1.46096	1.00950
4.25066	4.41541	2.65563	2.81883	1.00950	.60223
4.58525	4.68353	2.65563	2.81883	.60223	.27902
4.85078	4.89631	2.65563	2.81883	.27902	.07150
5.02126	5.03293	2.65563	2.81883	.07150	.00000
3.15640	3.43300	2.81883	2.91350	2.92192	2.85041
3.20347	3.47330	2.81883	2.91350	2.85041	2.64290
3.34008	3.59027	2.81883	2.91350	2.64290	2.31969
3.55287	3.77246	2.81883	2.91350	2.31969	1.91242
3.82099	4.00202	2.81883	2.91350	1.91242	1.46096
4.11820	4.25650	2.81883	2.91350	1.46096	1.00950
4.41541	4.51098	2.81883	2.91350	1.00950	.60223
4.68353	4.74054	2.81883	2.91350	.60223	.27902
4.89631	4.92273	2.81883	2.91350	.27902	.07150
5.03293	5.03970	2.81883	2.91350	.07150	.00000
3.43300	3.93900	2.91350	3.08660	2.92317	2.85163
3.45777	3.95138	2.91350	3.08660	2.85163	2.64403
3.52964	3.98732	2.91350	3.08660	2.64403	2.32068
3.64158	4.04329	2.91350	3.08660	2.32068	1.91324

3.78264	4.11382	2.91350	3.08660	1.91324	1.46158
3.93900	4.19200	2.91350	3.08660	1.46158	1.00993
4.09536	4.27018	2.91350	3.08660	1.00993	.60249
4.23642	4.34071	2.91350	3.08660	.60249	.27914
4.34836	4.39668	2.91350	3.08660	.27914	.07153
4.42023	4.43262	2.91350	3.08660	.07153	.00000
3.93900	4.37721	3.08660	3.23651	2.92317	2.85163
3.95138	4.37887	3.08660	3.23651	2.85163	2.64403
3.98732	4.38368	3.08660	3.23651	2.64403	2.32068
4.04329	4.39118	3.08660	3.23651	2.32068	1.91324
4.11382	4.40063	3.08660	3.23651	1.91324	1.46158
4.19200	4.41110	3.08660	3.23651	1.46158	1.00993
4.27018	4.42158	3.08660	3.23651	1.00993	.60249
4.34071	4.43103	3.08660	3.23651	.60249	.27914
4.39668	4.43853	3.08660	3.23651	.27914	.07153
4.43262	4.44334	3.08660	3.23651	.07153	.00000

CONTROL POINT COORDINATES=

XCP	YCP	ZCP	XCP	YCP	ZCP
-4.74658	.04233	0.00000	-4.09761	.04233	0.00000
-3.04204	.04233	0.00000	-1.68385	.04233	0.00000
-.15508	.04233	0.00000	1.39576	.04233	0.00000
2.81805	.04233	0.00000	3.97368	.04233	0.00000
4.75050	.04233	0.00000	5.07315	.04233	0.00000
-4.39031	.16686	0.00000	-3.76488	.16686	0.00000
-2.74757	.16686	0.00000	-1.43863	.16686	0.00000
.03472	.16686	0.00000	1.52933	.16686	0.00000
2.90005	.16686	0.00000	4.01379	.16686	0.00000
4.76244	.16686	0.00000	5.07340	.16686	0.00000
-3.81959	.36636	0.00000	-3.23184	.36636	0.00000
-2.27584	.36636	0.00000	-1.04578	.36636	0.00000
.33877	.36636	0.00000	1.74331	.36636	0.00000
3.03143	.36636	0.00000	4.07804	.36636	0.00000
4.78158	.36636	0.00000	5.07380	.36636	0.00000
-3.06757	.62922	0.00000	-2.52949	.62922	0.00000
-1.65427	.62922	0.00000	-.52815	.62922	0.00000
.73941	.62922	0.00000	2.02526	.62922	0.00000
3.20453	.62922	0.00000	4.16271	.62922	0.00000
4.80680	.62922	0.00000	5.07432	.62922	0.00000
-2.17797	.94018	0.00000	-1.69864	.94018	0.00000
-.91898	.94018	0.00000	.08418	.94018	0.00000
1.21334	.94018	0.00000	2.35880	.94018	0.00000
3.40931	.94018	0.00000	4.26287	.94018	0.00000
4.83663	.94018	0.00000	5.07494	.94018	0.00000
-1.20247	1.28116	0.00000	-.78757	1.28116	0.00000
-.11270	1.28116	0.00000	.75563	1.28116	0.00000
1.73303	1.28116	0.00000	2.72454	1.28116	0.00000
3.63385	1.28116	0.00000	4.37269	1.28116	0.00000
4.86934	1.28116	0.00000	5.07562	1.28116	0.00000

-.19779	1.63234	0.00000	.15077	1.63234	0.00000
.71771	1.63234	0.00000	1.44718	1.63234	0.00000
2.26827	1.63234	0.00000	3.10122	1.63234	0.00000
3.86512	1.63234	0.00000	4.48580	1.63234	0.00000
4.90303	1.63234	0.00000	5.07632	1.63234	0.00000
.77770	1.97332	0.00000	1.06183	1.97332	0.00000
1.52399	1.97332	0.00000	2.11863	1.97332	0.00000
2.78796	1.97332	0.00000	3.46696	1.97332	0.00000
4.08967	1.97332	0.00000	4.59563	1.97332	0.00000
4.93574	1.97332	0.00000	5.07700	1.97332	0.00000
1.66731	2.28428	0.00000	1.89269	2.28428	0.00000
2.25928	2.28428	0.00000	2.73097	2.28428	0.00000
3.26190	2.28428	0.00000	3.80049	2.28428	0.00000
4.29444	2.28428	0.00000	4.69578	2.28428	0.00000
4.96557	2.28428	0.00000	5.07762	2.28428	0.00000
2.41932	2.54714	0.00000	2.59504	2.54714	0.00000
2.88085	2.54714	0.00000	3.24860	2.54714	0.00000
3.66253	2.54714	0.00000	4.08244	2.54714	0.00000
4.46755	2.54714	0.00000	4.78045	2.54714	0.00000
4.99078	2.54714	0.00000	5.07815	2.54714	0.00000
2.99005	2.74664	0.00000	3.12807	2.74664	0.00000
3.35258	2.74664	0.00000	3.64144	2.74664	0.00000
3.96659	2.74664	0.00000	4.29642	2.74664	0.00000
4.59892	2.74664	0.00000	4.84470	2.74664	0.00000
5.00992	2.74664	0.00000	5.07854	2.74664	0.00000
3.34632	2.87117	0.00000	3.46081	2.87117	0.00000
3.64705	2.87117	0.00000	3.88667	2.87117	0.00000
4.15639	2.87117	0.00000	4.43000	2.87117	0.00000
4.68093	2.87117	0.00000	4.88481	2.87117	0.00000
5.02187	2.87117	0.00000	5.07879	2.87117	0.00000
3.70190	3.00005	0.00000	3.75104	3.00005	0.00000
3.83090	3.00005	0.00000	3.93363	3.00005	0.00000
4.04923	3.00005	0.00000	4.16649	3.00005	0.00000
4.27401	3.00005	0.00000	4.36137	3.00005	0.00000
4.42009	3.00005	0.00000	4.44448	3.00005	0.00000
4.19730	3.17315	0.00000	4.21368	3.17315	0.00000
4.24030	3.17315	0.00000	4.27454	3.17315	0.00000
4.31308	3.17315	0.00000	4.35216	3.17315	0.00000
4.38800	3.17315	0.00000	4.41712	3.17315	0.00000
4.43670	3.17315	0.00000	4.44483	3.17315	0.00000

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ATTACHED POTENTIAL FLOW RESULTS

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XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX

PRESSURE DISTRIBUTION AT ALPHA = 16.000 DEG.

XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX

VORTEX	XV	YV	CP
1	.00616	.01299	.66045
2	.05450	.01299	.42629
3	.14645	.01299	.39207
4	.27300	.01299	.36306
5	.42178	.01299	.33331
6	.57822	.01299	.29316
7	.72700	.01299	.23522
8	.85355	.01299	.16427
9	.94550	.01299	.09189
10	.99384	.01299	.02882
11	.00616	.05119	.97927
12	.05450	.05119	.46497
13	.14645	.05119	.39738
14	.27300	.05119	.36276
15	.42178	.05119	.33154
16	.57822	.05119	.29009
17	.72700	.05119	.23164
18	.85355	.05119	.16123
19	.94550	.05119	.09009
20	.99384	.05119	.02832
21	.00616	.11239	1.33433
22	.05450	.11239	.55636
23	.14645	.11239	.42028
24	.27300	.11239	.36946
25	.42178	.11239	.33250
26	.57822	.11239	.28698
27	.72700	.11239	.22732
28	.85355	.11239	.15742
29	.94550	.11239	.08788
30	.99384	.11239	.02774
31	.00616	.19303	1.70423
32	.05450	.19303	.66988
33	.14645	.19303	.46467
34	.27300	.19303	.38705
35	.42178	.19303	.34013
36	.57822	.19303	.28609
37	.72700	.19303	.22464

38	.85355	.19303	.15445
39	.94550	.19303	.08607
40	.99384	.19303	.02724
41	.00616	.28843	2.64608
42	.05450	.28843	1.18747
43	.14645	.28843	.51945
44	.27300	.28843	.42675
45	.42178	.28843	.35277
46	.57822	.28843	.29050
47	.72700	.28843	.22559
48	.85355	.28843	.15359
49	.94550	.28843	.08522
50	.99384	.28843	.02698
51	.00616	.39303	3.04059
52	.05450	.39303	1.22440
53	.14645	.39303	.69636
54	.27300	.39303	.46840
55	.42178	.39303	.37245
56	.57822	.39303	.30355
57	.72700	.39303	.23157
58	.85355	.39303	.15568
59	.94550	.39303	.08556
60	.99384	.39303	.02705
61	.00616	.50076	3.65261
62	.05450	.50076	1.43878
63	.14645	.50076	1.06564
64	.27300	.50076	.50802
65	.42178	.50076	.41366
66	.57822	.50076	.32389
67	.72700	.50076	.24493
68	.85355	.50076	.16043
69	.94550	.50076	.08693
70	.99384	.50076	.02735
71	.00616	.60537	4.24953
72	.05450	.60537	1.63804
73	.14645	.60537	1.05286
74	.27300	.60537	.69044
75	.42178	.60537	.44861
76	.57822	.60537	.36687
77	.72700	.60537	.26215
78	.85355	.60537	.16755
79	.94550	.60537	.08794
80	.99384	.60537	.02756
81	.00616	.70076	4.89899
82	.05450	.70076	1.86541
83	.14645	.70076	1.13154
84	.27300	.70076	.89038
85	.42178	.70076	.64781
86	.57822	.70076	.39513
87	.72700	.70076	.29512

88	.85355	.70076	.16920
89	.94550	.70076	.08665
90	.99384	.70076	.02679
91	.00616	.78140	5.62578
92	.05450	.78140	2.12986
93	.14645	.78140	1.31383
94	.27300	.78140	.95862
95	.42178	.78140	.80524
96	.57822	.78140	.60432
97	.72700	.78140	.28871
98	.85355	.78140	.16970
99	.94550	.78140	.07528
100	.99384	.78140	.02376
101	.00616	.84260	6.36386
102	.05450	.84260	2.40666
103	.14645	.84260	1.40394
104	.27300	.84260	1.10221
105	.42178	.84260	.84618
106	.57822	.84260	.66364
107	.72700	.84260	.44785
108	.85355	.84260	.10503
109	.94550	.84260	.05611
110	.99384	.84260	.01788
111	.00616	.88081	7.05461
112	.05450	.88081	2.71053
113	.14645	.88081	1.85270
114	.27300	.88081	1.08840
115	.42178	.88081	.87316
116	.57822	.88081	.61042
117	.72700	.88081	.31411
118	.85355	.88081	.03870
119	.94550	.88081	.03558
120	.99384	.88081	.01120
121	.00616	.92035	11.35646
122	.05450	.92035	4.28909
123	.14645	.92035	2.50178
124	.27300	.92035	1.76764
125	.42178	.92035	1.40286
126	.57822	.92035	1.15412
127	.72700	.92035	.91859
128	.85355	.92035	.70187
129	.94550	.92035	.51242
130	.99384	.92035	.33517
131	.00616	.97345	21.57048
132	.05450	.97345	8.07183
133	.14645	.97345	4.58535
134	.27300	.97345	3.05466
135	.42178	.97345	2.16773
136	.57822	.97345	1.58400
137	.72700	.97345	1.16947
138	.85355	.97345	.86824
139	.94550	.97345	.64974
140	.99384	.97345	.47709

Y/S	CL(RIGHT)	CL(LEFT)	CM	CDI	CS*C	CAV
.01299	.28581	.28581	.04439	.07934	.07792	0.00000
.05119	.29605	.29605	.04238	.07777	.20439	0.00000
.11239	.31434	.31434	.03637	.07637	.37138	0.00000
.19303	.34056	.34056	.02267	.07481	.56432	0.00000
.28843	.39900	.39900	.00621	.07111	.53819	-.00488
.39303	.44264	.44264	-.03457	.06591	.77857	-.00815
.50076	.52030	.52030	-.08961	.05205	.93060	-.01160
.60537	.58536	.58536	-.16220	.05820	.87781	-.02474
.70076	.68349	.68349	-.25356	.03006	1.06459	-.03782
.78140	.78993	.78993	-.35558	.01717	.98398	-.04484
.84260	.87743	.87743	-.44320	-.02633	1.06810	-.06196
.88081	.92958	.92958	-.49436	-.05950	1.08670	-.07599
.92035	1.63984	1.63984	-.90084	-.26680	1.17173	0.00000
.97345	2.88017	2.88017	-1.63990	-1.39785	1.41122	0.00000

TOTAL LIFT COEFFICIENT = .52231

TOTAL INDUCED DRAG COEFFICIENT = .06396

THE INDUCED DRAG PARAMETER = .23445

TOTAL PITCHING MOMENT COEFFICIENT = -.07317

FAR-FIELD INDUCED DRAG= .06388

FAR-FIELD INDUCED DRAG PARAMETER= .23415

THE FOLLOWING BENDING MOMENT COEFFICIENT IS BASED ON Q*S*(B/2),
WHERE S = 30.39360 AND B/2 = 3.25970

Y/S	BM(RIGHT)	BM(LEFT)
.01299	.11302	.11302
.05119	.10316	.10316
.11239	.08836	.08836
.19303	.07066	.07066
.28843	.05241	.05241
.39303	.03576	.03576
.50076	.02221	.02221
.60537	.01243	.01243
.70076	.00621	.00621
.78140	.00279	.00279
.84260	.00121	.00121
.88081	.00061	.00061
.92035	.00024	.00024
.97345	.00001	.00001

THE BENDING MOMENT COEFFICIENT BASED ON WING HALF SPAN AND WING AREA
AT THE WING ROOT = .116470 (RIGHT), = .116470 (LEFT)

XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX

OVER-ALL AERODYNAMIC CHARACTERISTICS

XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX

ATTACHED FLOW

ALPHA	CL	CDI	CM	CB
16.0000	.52231	.06396	-.07317	.11647

SEPARATED FLOW

ALPHA	CLP	CLV,LE	CLV,SE	CL
16.0000	.51383	.15670	0.00000	.67053

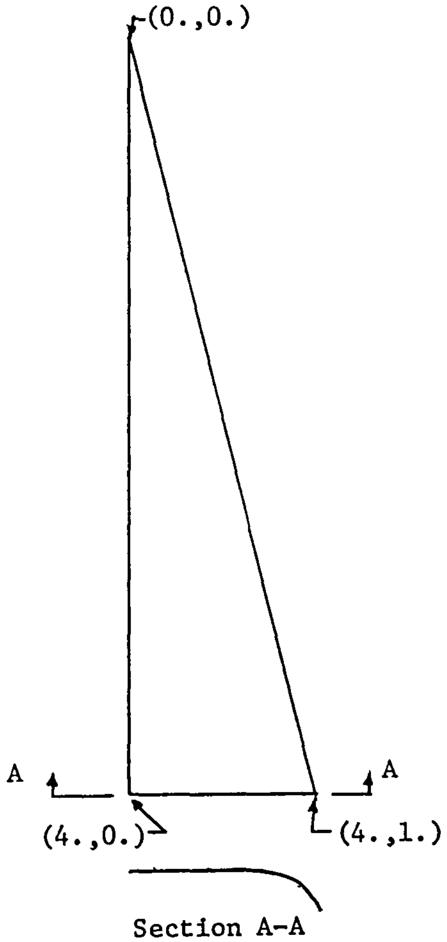
ALPHA	CDP	CDV,LE	CDV,SE	CDI	CAV
16.0000	.11745	.03210	0.00000	.14955	-.01233

ALPHA	CMP	CMV,LE	CMV,SE	CM
16.0000	-.07317	-.01450	0.00000	-.08767

2. Second Sample Case

<u>Input Data</u>

```
ARC CP-924, SQUIRE WING 7
       1           14           0           1           0
       1            1           0
      10            0           2           0
     .09           2.   2.666667           0.          0.
      2.          10.        10.           1.          0.
      0.           4.         0.           4.          4.          1.          0.          0.
      1.  75.963757           1.           0.
      0.           0.
```



Output

```
****************************************
ARC CP-924, SQUIRE WING 7

****************************************

INPUT DATA
       1         14          0          1          0
       1          1          0
      10          0          2          0
 .090000  2.000000  2.666667  0.000000  0.000000
2.000000 10.000000 10.000000  1.000000  0.000000
0.000000  4.000000  0.000000  4.000000  4.000000  1.000000  0.000000  0.00000C
1.000000 75.963757  1.000000  0.000000
0.000000  0.000000
        HALF SW=  .20000E+01          CREF=  .26667E+01

PANEL ENDPOINT COORDINATES AND EDGE SLOPES =

   X1        X2        Y1        Y2        BP       BP
 0.00000    .09789   0.00000    .02447   4.00000  3.90211
  .09789    .19338   0.00000    .02447   3.90211  3.61803
  .38197    .47051   0.00000    .02447   3.61803  3.17557
  .82443    .90214   0.00000    .02447   3.17557  2.61803
 1.38197   1.44603   0.00000    .02447   2.61803  2.00000
 2.00000   2.04894   0.00000    .02447   2.00000  1.38197
 2.61803   2.65185   0.00000    .02447   1.38197   .82443
 3.17557   3.19575   0.00000    .02447    .82443   .38197
 3.61803   3.62738   0.00000    .02447    .38197   .09789
 3.90211   3.90451   0.00000    .02447    .09789   .00000
  .09789    .26795    .02447    .06699   4.00000  3.90211
  .19338    .35928    .02447    .06699   3.90211  3.61803
  .47051    .62433    .02447    .06699   3.61803  3.17557
  .90214   1.03715    .02447    .06699   3.17557  2.61803
 1.44603   1.55734    .02447    .06699   2.61803  2.00000
 2.04894   2.13397    .02447    .06699   2.00000  1.38197
 2.65185   2.71061    .02447    .06699   1.38197   .82443
 3.19575   3.23080    .02447    .06699    .82443   .38197
 3.62738   3.64362    .02447    .06699    .38197   .09789
 3.90451   3.90867    .02447    .06699    .09789   .00000
  .26795    .51371    .06699    .12843   4.00000  3.90211
  .35928    .59903    .06699    .12843   3.90211  3.61803
  .62433    .84662    .06699    .12843   3.61803  3.17557
 1.03715   1.23226    .06699    .12843   3.17557  2.61803
 1.55734   1.71819    .06699    .12843   2.61803  2.00000
 2.13397   2.25686    .06699    .12843   2.00000  1.38197
 2.71061   2.79552    .06699    .12843   1.38197   .82443
 3.23080   3.28145    .06699    .12843    .82443   .38197
```

3.64362	3.66709	.06699	.12843	.38197	.09789
3.90867	3.91468	.06699	.12843	.09789	.00000
.51371	.82443	.12843	.20611	4.00000	3.90211
.59903	.90214	.12843	.20611	3.90211	3.61803
.84662	1.12767	.12843	.20611	3.61803	3.17557
1.23226	1.47894	.12843	.20611	3.17557	2.61803
1.71819	1.92156	.12843	.20611	2.61803	2.00000
2.25686	2.41221	.12843	.20611	2.00000	1.38197
2.79552	2.90287	.12843	.20611	1.38197	.82443
3.28145	3.34549	.12843	.20611	.82443	.38197
3.66709	3.69676	.12843	.20611	.38197	.09789
3.91468	3.92229	.12843	.20611	.09789	.00000
.82443	1.18653	.20611	.29663	4.00000	3.90211
.90214	1.25538	.20611	.29663	3.90211	3.61803
1.12767	1.45519	.20611	.29663	3.61803	3.17557
1.47894	1.76640	.20611	.29663	3.17557	2.61803
1.92156	2.15856	.20611	.29663	2.61803	2.00000
2.41221	2.59326	.20611	.29663	2.00000	1.38197
2.90287	3.02797	.20611	.29663	1.38197	.82443
3.34549	3.42012	.20611	.29663	.82443	.38197
3.69676	3.73134	.20611	.29663	.38197	.09789
3.92229	3.93115	.20611	.29663	.09789	.00000
1.18653	1.58418	.29663	.39604	4.00000	3.90211
1.25538	1.64330	.29663	.39604	3.90211	3.61803
1.45519	1.81487	.29663	.39604	3.61803	3.17557
1.76640	2.08210	.29663	.39604	3.17557	2.61803
2.15856	2.41882	.29663	.39604	2.61803	2.00000
2.59326	2.79209	.29663	.39604	2.00000	1.38197
3.02797	3.16535	.29663	.39604	1.38197	.82443
3.42012	3.50208	.29663	.39604	.82443	.38197
3.73134	3.76931	.29663	.39604	.38197	.09789
3.93115	3.94088	.29663	.39604	.09789	.00000
1.58418	2.00000	.39604	.50000	4.00000	3.90211
1.64330	2.04894	.39604	.50000	3.90211	3.61803
1.81487	2.19098	.39604	.50000	3.61803	3.17557
2.08210	2.41221	.39604	.50000	3.17557	2.61803
2.41882	2.69098	.39604	.50000	2.61803	2.00000
2.79209	3.00000	.39604	.50000	2.00000	1.38197
3.16535	3.30902	.39604	.50000	1.38197	.82443
3.50208	3.58779	.39604	.50000	.82443	.38197
3.76931	3.80902	.39604	.50000	.38197	.09789
3.94088	3.95106	.39604	.50000	.09789	.00000
2.00000	2.41582	.50000	.60396	4.00000	3.90211
2.04894	2.45459	.50000	.60396	3.90211	3.61803
2.19098	2.56710	.50000	.60396	3.61803	3.17557
2.41221	2.74233	.50000	.60396	3.17557	2.61803
2.69098	2.96314	.50000	.60396	2.61803	2.00000
3.00000	3.20791	.50000	.60396	2.00000	1.38197
3.30902	3.45268	.50000	.60396	1.38197	.82443
3.58779	3.67349	.50000	.60396	.82443	.38197

3.80902	3.84872	.50000	.60396	.38197	.09789
3.95106	3.96123	.50000	.60396	.09789	.00000
2.41582	2.81347	.60396	.70337	4.00000	3.90211
2.45459	2.84251	.60396	.70337	3.90211	3.61803
2.56710	2.92678	.60396	.70337	3.61803	3.17557
2.74233	3.05803	.60396	.70337	3.17557	2.61803
2.96314	3.22341	.60396	.70337	2.61803	2.00000
3.20791	3.40674	.60396	.70337	2.00000	1.38197
3.45268	3.59007	.60396	.70337	1.38197	.82443
3.67349	3.75545	.60396	.70337	.82443	.38197
3.84872	3.88670	.60396	.70337	.38197	.09789
3.96123	3.97096	.60396	.70337	.09789	.00000
2.81347	3.17557	.70337	.79389	4.00000	3.90211
2.84251	3.19575	.70337	.79389	3.90211	3.61803
2.92678	3.25430	.70337	.79389	3.61803	3.17557
3.05803	3.34549	.70337	.79389	3.17557	2.61803
3.22341	3.46040	.70337	.79389	2.61803	2.00000
3.40674	3.58779	.70337	.79389	2.00000	1.38197
3.59007	3.71517	.70337	.79389	1.38197	.82443
3.75545	3.83008	.70337	.79389	.82443	.38197
3.88670	3.92127	.70337	.79389	.38197	.09789
3.97096	3.97982	.70337	.79389	.09789	.00000
3.17557	3.48629	.79389	.87157	4.00000	3.90211
3.19575	3.49886	.79389	.87157	3.90211	3.61803
3.25430	3.53534	.79389	.87157	3.61803	3.17557
3.34549	3.59217	.79389	.87157	3.17557	2.61803
3.46040	3.66377	.79389	.87157	2.61803	2.00000
3.58779	3.74314	.79389	.87157	2.00000	1.38197
3.71517	3.82252	.79389	.87157	1.38197	.82443
3.83008	3.89412	.79389	.87157	.82443	.38197
3.92127	3.95095	.79389	.87157	.38197	.09789
3.97982	3.98743	.79389	.87157	.09789	.00000
3.48629	3.73205	.87157	.93301	4.00000	3.90211
3.49886	3.73861	.87157	.93301	3.90211	3.61803
3.53534	3.75764	.87157	.93301	3.61803	3.17557
3.59217	3.78728	.87157	.93301	3.17557	2.61803
3.66377	3.82462	.87157	.93301	2.61803	2.00000
3.74314	3.86603	.87157	.93301	2.00000	1.38197
3.82252	3.90743	.87157	.93301	1.38197	.82443
3.89412	3.94477	.87157	.93301	.82443	.38197
3.95095	3.97441	.87157	.93301	.38197	.09789
3.98743	3.99344	.87157	.93301	.09789	.00000
3.73205	3.90211	.93301	.97553	4.00000	3.90211
3.73861	3.90451	.93301	.97553	3.90211	3.61803
3.75764	3.91146	.93301	.97553	3.61803	3.17557
3.78728	3.92229	.93301	.97553	3.17557	2.61803
3.82462	3.93593	.93301	.97553	2.61803	2.00000
3.86603	3.95106	.93301	.97553	2.00000	1.38197
3.90743	3.96618	.93301	.97553	1.38197	.82443
3.94477	3.97982	.93301	.97553	.82443	.38197

3.97441	3.99065	.93301	.97553	.38197	.09789
3.99344	3.99760	.93301	.97553	.09789	.00000
3.90211	3.98904	.97553	.99726	4.00000	3.90211
3.90451	3.98931	.97553	.99726	3.90211	3.61803
3.91146	3.99009	.97553	.99726	3.61803	3.17557
3.92229	3.99130	.97553	.99726	3.17557	2.61803
3.93593	3.99283	.97553	.99726	2.61803	2.00000
3.95106	3.99452	.97553	.99726	2.00000	1.38197
3.96618	3.99621	.97553	.99726	1.38197	.82443
3.97982	3.99774	.97553	.99726	.82443	.38197
3.99065	3.99895	.97553	.99726	.38197	.09789
3.99760	3.99973	.97553	.99726	.09789	.00000

CONTROL POINT COORDINATES=

XCP	YCP	ZCP	XCP	YCP	ZCP
.12803	.01093	0.00000	.38602	.01093	0.00000
.80352	.01093	0.00000	1.33933	.01093	0.00000
1.94154	.01093	0.00000	2.55184	.01093	0.00000
3.11115	.01093	0.00000	3.56538	.01093	0.00000
3.87059	.01093	0.00000	3.99730	.01093	0.00000
.25448	.04323	0.00000	.50405	.04323	0.00000
.90791	.04323	0.00000	1.42622	.04323	0.00000
2.00876	.04323	0.00000	2.59913	.04323	0.00000
3.14018	.04323	0.00000	3.57957	.04323	0.00000
3.87481	.04323	0.00000	3.99739	.04323	0.00000
.45908	.09549	0.00000	.69502	.09549	0.00000
1.07681	.09549	0.00000	1.56681	.09549	0.00000
2.11753	.09549	0.00000	2.67565	.09549	0.00000
3.18715	.09549	0.00000	3.60254	.09549	0.00000
3.88165	.09549	0.00000	3.99753	.09549	0.00000
.73289	.16543	0.00000	.95058	.16543	0.00000
1.30286	.16543	0.00000	1.75496	.16543	0.00000
2.26310	.16543	0.00000	2.77806	.16543	0.00000
3.25001	.16543	0.00000	3.63327	.16543	0.00000
3.89080	.16543	0.00000	3.99772	.16543	0.00000
1.06394	.25000	0.00000	1.25958	.25000	0.00000
1.57615	.25000	0.00000	1.98245	.25000	0.00000
2.43910	.25000	0.00000	2.90188	.25000	0.00000
3.32600	.25000	0.00000	3.67043	.25000	0.00000
3.90187	.25000	0.00000	3.99795	.25000	0.00000
1.43777	.34549	0.00000	1.60849	.34549	0.00000
1.88476	.34549	0.00000	2.23933	.34549	0.00000
2.63783	.34549	0.00000	3.04169	.34549	0.00000
3.41182	.34549	0.00000	3.71239	.34549	0.00000
3.91436	.34549	0.00000	3.99821	.34549	0.00000
1.83803	.44774	0.00000	1.98208	.44774	0.00000
2.21520	.44774	0.00000	2.51437	.44774	0.00000
2.85063	.44774	0.00000	3.19140	.44774	0.00000

3.50370	.44774	0.00000	3.75732	.44774	0.00000
3.92774	.44774	0.00000	3.99849	.44774	0.00000
2.24723	.55226	0.00000	2.36402	.55226	0.00000
2.55301	.55226	0.00000	2.79556	.55226	0.00000
3.06817	.55226	0.00000	3.34444	.55226	0.00000
3.59764	.55226	0.00000	3.80325	.55226	0.00000
3.94142	.55226	0.00000	3.99878	.55226	0.00000
2.64749	.65451	0.00000	2.73761	.65451	0.00000
2.88344	.65451	0.00000	3.07061	.65451	0.00000
3.28096	.65451	0.00000	3.49414	.65451	0.00000
3.68952	.65451	0.00000	3.84818	.65451	0.00000
3.95480	.65451	0.00000	3.99906	.65451	0.00000
3.02131	.75000	0.00000	3.08653	.75000	0.00000
3.19205	.75000	0.00000	3.32748	.75000	0.00000
3.47970	.75000	0.00000	3.63396	.75000	0.00000
3.77533	.75000	0.00000	3.89014	.75000	0.00000
3.96729	.75000	0.00000	3.99932	.75000	0.00000
3.35237	.83457	0.00000	3.39552	.83457	0.00000
3.46535	.83457	0.00000	3.55497	.83457	0.00000
3.65570	.83457	0.00000	3.75778	.83457	0.00000
3.85133	.83457	0.00000	3.92730	.83457	0.00000
3.97835	.83457	0.00000	3.99955	.83457	0.00000
3.62617	.90451	0.00000	3.65108	.90451	0.00000
3.69139	.90451	0.00000	3.74312	.90451	0.00000
3.80126	.90451	0.00000	3.86019	.90451	0.00000
3.91419	.90451	0.00000	3.95804	.90451	0.00000
3.98751	.90451	0.00000	3.99974	.90451	0.00000
3.83078	.95677	0.00000	3.84205	.95677	0.00000
3.86030	.95677	0.00000	3.88372	.95677	0.00000
3.91004	.95677	0.00000	3.93671	.95677	0.00000
3.96115	.95677	0.00000	3.98100	.95677	0.00000
3.99434	.95677	0.00000	3.99988	.95677	0.00000
3.95723	.98907	0.00000	3.96008	.98907	0.00000
3.96469	.98907	0.00000	3.97061	.98907	0.00000
3.97726	.98907	0.00000	3.98400	.98907	0.00000
3.99018	.98907	0.00000	3.99520	.98907	0.00000
3.99857	.98907	0.00000	3.99997	.98907	0.00000

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ATTACHED POTENTIAL FLOW RESULTS

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XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX

PRESSURE DISTRIBUTION AT ALPHA = 10.000 DEG.

XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX

VORTEX	XV	YV	CP
1	.00616	.01093	.28632
2	.05450	.01093	.17430
3	.14645	.01093	.16864
4	.27300	.01093	.16220
5	.42178	.01093	.15408
6	.57822	.01093	.14158
7	.72700	.01093	.12113
8	.85355	.01093	.09015
9	.94550	.01093	.05209
10	.99384	.01093	.01622
11	.00616	.04323	.53948
12	.05450	.04323	.19716
13	.14645	.04323	.17287
14	.27300	.04323	.16288
15	.42178	.04323	.15392
16	.57822	.04323	.14082
17	.72700	.04323	.11998
18	.85355	.04323	.08885
19	.94550	.04323	.05114
20	.99384	.04323	.01593
21	.00616	.09549	.64086
22	.05450	.09549	.28450
23	.14645	.09549	.18641
24	.27300	.09549	.16755
25	.42178	.09549	.15521
26	.57822	.09549	.14049
27	.72700	.09549	.11867
28	.85355	.09549	.08721
29	.94550	.09549	.05001
30	.99384	.09549	.01564
31	.00616	.16543	.68370
32	.05450	.16543	.41232
33	.14645	.16543	.22357
34	.27300	.16543	.17930
35	.42178	.16543	.15977
36	.57822	.16543	.14177
37	.72700	.16543	.11820
38	.85355	.16543	.08609
39	.94550	.16543	.04922
40	.99384	.16543	.01545

41	.00616	.25000	.73408
42	.05450	.25000	.51536
43	.14645	.25000	.29602
44	.27300	.25000	.20483
45	.42178	.25000	.17037
46	.57822	.25000	.14630
47	.72700	.25000	.11978
48	.85355	.25000	.08644
49	.94550	.25000	.04934
50	.99384	.25000	.01553
51	.00616	.34549	.79272
52	.05450	.34549	.57269
53	.14645	.34549	.39145
54	.27300	.34549	.25436
55	.42178	.34549	.19278
56	.57822	.34549	.15727
57	.72700	.34549	.12546
58	.85355	.34549	.08963
59	.94550	.34549	.05118
60	.99384	.34549	.01622
61	.00616	.44774	.86037
62	.05450	.44774	.59955
63	.14645	.44774	.47739
64	.27300	.44774	.33045
65	.42178	.44774	.23610
66	.57822	.44774	.18114
67	.72700	.44774	.13952
68	.85355	.44774	.09857
69	.94550	.44774	.05666
70	.99384	.44774	.01864
71	.00616	.55226	.93716
72	.05450	.55226	.61077
73	.14645	.55226	.53194
74	.27300	.55226	.41613
75	.42178	.55226	.30549
76	.57822	.55226	.22732
77	.72700	.55226	.17004
78	.85355	.55226	.11946
79	.94550	.55226	.07055
80	.99384	.55226	.02619
81	.00616	.65451	1.02390
82	.05450	.65451	.61570
83	.14645	.65451	.55339
84	.27300	.65451	.48299
85	.42178	.65451	.38823
86	.57822	.65451	.29979
87	.72700	.65451	.22646
88	.85355	.65451	.16231
89	.94550	.65451	.10204

90	.99384	.65451	.04686
91	.00616	.75000	1.12333
92	.05450	.75000	.62039
93	.14645	.75000	.54944
94	.27300	.75000	.51328
95	.42178	.75000	.45384
96	.57822	.75000	.38046
97	.72700	.75000	.30541
98	.85355	.75000	.23204
99	.94550	.75000	.15988
100	.99384	.75000	.09105
101	.00616	.83457	1.24223
102	.05450	.83457	.62993
103	.14645	.83457	.52933
104	.27300	.83457	.50475
105	.42178	.83457	.47639
106	.57822	.83457	.43127
107	.72700	.83457	.37341
108	.85355	.83457	.30552
109	.94550	.83457	.23029
110	.99384	.83457	.15244
111	.00616	.90451	1.39592
112	.05450	.90451	.65152
113	.14645	.90451	.50311
114	.27300	.90451	.46579
115	.42178	.90451	.44907
116	.57822	.90451	.42493
117	.72700	.90451	.38724
118	.85355	.90451	.33463
119	.94550	.90451	.26817
120	.99384	.90451	.19364
121	.00616	.95677	1.64413
122	.05450	.95677	.70924
123	.14645	.95677	.48886
124	.27300	.95677	.41496
125	.42178	.95677	.38369
126	.57822	.95677	.36310
127	.72700	.95677	.33470
128	.85355	.95677	.29385
129	.94550	.95677	.24251
130	.99384	.95677	.18495
131	.00616	.98907	2.49276
132	.05450	.98907	1.00211
133	.14645	.98907	.60414
134	.27300	.98907	.43810
135	.42178	.98907	.34729
136	.57822	.98907	.28943
137	.72700	.98907	.24663
138	.85355	.98907	.20974
139	.94550	.98907	.17597
140	.99384	.98907	.14357

Y/S	CL(RIGHT)	CL(LEFT)	CM	CDI	CS*C	CAV
.01093	.13557	.13557	-.08716	.02328	.00931	-.00023
.04323	.13977	.13977	-.09105	.02185	.01874	-.00070
.09549	.14693	.14693	-.09923	.02182	.01617	-.00077
.16543	.15946	.15946	-.11383	.02180	.01331	-.00073
.25000	.17479	.17479	-.13615	.02069	.01436	-.00088
.34549	.19405	.19405	-.16807	.01880	.01671	-.00118
.44774	.21739	.21739	-.21062	.01568	.01866	-.00157
.55226	.24381	.24381	-.26274	.01061	.01957	-.00204
.65451	.26933	.26933	-.31780	.00236	.01921	-.00260
.75000	.28421	.28421	-.35882	-.01049	.01759	-.00330
.83457	.27560	.27560	-.36303	-.02711	.01482	-.00422
.90451	.24274	.24274	-.32712	-.04209	.01117	-.00552
.95677	.20181	.20181	-.27571	-.05104	.00720	-.00788
.98907	.19240	.19240	-.26859	-.06926	.00427	-.01853

TOTAL LIFT COEFFICIENT = .19333

TOTAL INDUCED DRAG COEFFICIENT = .01438

THE INDUCED DRAG PARAMETER = .38461

TOTAL PITCHING MOMENT COEFFICIENT = -.17865

FAR-FIELD INDUCED DRAG= .01343

FAR-FIELD INDUCED DRAG PARAMETER= .35918

THE FOLLOWING BENDING MOMENT COEFFICIENT IS BASED ON Q*S*(B/2),
WHERE S = 4.00000 AND B/2 = 1.00000

Y/S	BM(RIGHT)	BM(LEFT)
.01093	.03618	.03618
.04323	.03317	.03317
.09549	.02860	.02860
.16543	.02306	.02306
.25000	.01724	.01724
.34549	.01180	.01180
.44774	.00725	.00725
.55226	.00390	.00390
.65451	.00176	.00176
.75000	.00063	.00063
.83457	.00017	.00017
.90451	.00003	.00003
.95677	.00000	.00000
.98907	-.00000	-.00000

THE BENDING MOMENT COEFFICIENT BASED ON WING HALF SPAN AND WING AREA
AT THE WING ROOT = .037233 (RIGHT), = .037233 (LEFT)

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ATTACHED POTENTIAL FLOW RESULTS

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XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX

PRESSURE DISTRIBUTION AT ALPHA = 20.000 DEG.

XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX

VORTEX	XV	YV	CP
1	.00616	.01093	.59386
2	.05450	.01093	.34685
3	.14645	.01093	.33325
4	.27300	.01093	.32151
5	.42178	.01093	.30662
6	.57822	.01093	.28287
7	.72700	.01093	.24338
8	.85355	.01093	.18233
9	.94550	.01093	.10610
10	.99384	.01093	.03325
11	.00616	.04323	1.44996
12	.05450	.04323	.38908
13	.14645	.04323	.34042
14	.27300	.04323	.32285
15	.42178	.04323	.30624
16	.57822	.04323	.28139
17	.72700	.04323	.24110
18	.85355	.04323	.17973
19	.94550	.04323	.10418
20	.99384	.04323	.03265
21	.00616	.09549	2.04141
22	.05450	.09549	.57556
23	.14645	.09549	.36644
24	.27300	.09549	.33124
25	.42178	.09549	.30844
26	.57822	.09549	.28057
27	.72700	.09549	.23840
28	.85355	.09549	.17636
29	.94550	.09549	.10182
30	.99384	.09549	.03203
31	.00616	.16543	2.51579
32	.05450	.16543	.93169
33	.14645	.16543	.44266
34	.27300	.16543	.35301
35	.42178	.16543	.31645
36	.57822	.16543	.28253
37	.72700	.16543	.23710
38	.85355	.16543	.17385
39	.94550	.16543	.10006
40	.99384	.16543	.03160
41	.00616	.25000	3.02074

42	.05450	.25000	1.30903
43	.14645	.25000	.61351
44	.27300	.25000	.40460
45	.42178	.25000	.33602
46	.57822	.25000	.29037
47	.72700	.25000	.23941
48	.85355	.25000	.17391
49	.94550	.25000	.09990
50	.99384	.25000	.03166
51	.00616	.34549	3.58378
52	.05450	.34549	1.63098
53	.14645	.34549	.87844
54	.27300	.34549	.51779
55	.42178	.34549	.38187
56	.57822	.34549	.31114
57	.72700	.34549	.24948
58	.85355	.34549	.17924
59	.94550	.34549	.10294
60	.99384	.34549	.03300
61	.00616	.44774	4.23073
62	.05450	.44774	1.92271
63	.14645	.44774	1.17179
64	.27300	.44774	.71630
65	.42178	.44774	.48166
66	.57822	.44774	.36166
67	.72700	.44774	.27749
68	.85355	.44774	.19630
69	.94550	.44774	.11346
70	.99384	.44774	.03855
71	.00616	.55226	4.99534
72	.05450	.55226	2.22406
73	.14645	.55226	1.44491
74	.27300	.55226	.98024
75	.42178	.55226	.66332
76	.57822	.55226	.47220
77	.72700	.55226	.34605
78	.85355	.55226	.24134
79	.94550	.55226	.14371
80	.99384	.55226	.05809
81	.00616	.65451	5.93640
82	.05450	.65451	2.57306
83	.14645	.65451	1.69781
84	.27300	.65451	1.25499
85	.42178	.65451	.91698
86	.57822	.65451	.66923
87	.72700	.65451	.48936
88	.85355	.65451	.34594
89	.94550	.65451	.22135
90	.99384	.65451	.11625
91	.00616	.75000	7.16895

92	.05450	.75000	3.02610
93	.14645	.75000	1.97039
94	.27300	.75000	1.51797
95	.42178	.75000	1.19797
96	.57822	.75000	.93827
97	.72700	.75000	.72445
98	.85355	.75000	.54167
99	.94550	.75000	.38284
100	.99384	.75000	.25051
101	.00616	.83457	8.93548
102	.05450	.83457	3.68002
103	.14645	.83457	2.32576
104	.27300	.83457	1.78798
105	.42178	.83457	1.47408
106	.57822	.83457	1.22224
107	.72700	.83457	1.00758
108	.85355	.83457	.80751
109	.94550	.83457	.62355
110	.99384	.83457	.46561
111	.00616	.90451	11.84204
112	.05450	.90451	4.77959
113	.14645	.90451	2.91916
114	.27300	.90451	2.17439
115	.42178	.90451	1.80316
116	.57822	.90451	1.53342
117	.72700	.90451	1.29786
118	.85355	.90451	1.08012
119	.94550	.90451	.87476
120	.99384	.90451	.69604
121	.00616	.95677	17.94619
122	.05450	.95677	7.11483
123	.14645	.95677	4.18510
124	.27300	.95677	2.96278
125	.42178	.95677	2.34378
126	.57822	.95677	2.00125
127	.72700	.95677	1.69745
128	.85355	.95677	1.40296
129	.94550	.95677	1.15303
130	.99384	.95677	.95019
131	.00616	.98907	39.89844
132	.05450	.98907	15.62324
133	.14645	.98907	8.91139
134	.27300	.98907	5.97402
135	.42178	.98907	4.31347
136	.57822	.98907	3.27890
137	.72700	.98907	2.60836
138	.85355	.98907	2.15858
139	.94550	.98907	1.86314
140	.99384	.98907	1.65125

Y/S	CL(RIGHT)	CL(LEFT)	CM	CDI	CS*C	CAV
.01093	.25868	.25868	-.17453	.09187	.03611	-.00006
.04323	.27294	.27294	-.18266	.08956	.08473	-.00060
.09549	.29152	.29152	-.19995	.08922	.11616	-.00207
.16543	.32578	.32578	-.23261	.09158	.14786	-.00410
.25000	.37076	.37076	-.28546	.09184	.19392	-.00677
.34549	.42999	.42999	-.36597	.09069	.24688	-.01051
.44774	.50722	.50722	-.48218	.08712	.29861	-.01578
.55226	.60592	.60592	-.64122	.07863	.34404	-.02337
.65451	.72486	.72486	-.84076	.05880	.38009	-.03479
.75000	.85445	.85445	-1.06001	.01462	.40568	-.05317
.83457	.97637	.97637	-1.26169	-.07440	.42167	-.08613
.90451	1.12089	1.12089	-1.48260	-.23862	.43089	0.00000
.95677	1.42314	1.42314	-1.92423	-.63096	.44930	0.00000
.98907	2.53512	2.53512	-3.62788	-3.03994	.56372	0.00000

TOTAL LIFT COEFFICIENT = .46291

TOTAL INDUCED DRAG COEFFICIENT = .07098

THE INDUCED DRAG PARAMETER = .33123

TOTAL PITCHING MOMENT COEFFICIENT = -.44135

FAR-FIELD INDUCED DRAG= .07155

FAR-FIELD INDUCED DRAG PARAMETER= .33390

THE FOLLOWING BENDING MOMENT COEFFICIENT IS BASED ON Q*S*(B/2),
WHERE S = 4.00000 AND B/2 = 1.00000

Y/S	BM(RIGHT)	BM(LEFT)
.01093	.09792	.09792
.04323	.09054	.09054
.09549	.07922	.07922
.16543	.06526	.06526
.25000	.05024	.05024
.34549	.03575	.03575
.44774	.02316	.02316
.55226	.01337	.01337
.65451	.00667	.00667
.75000	.00276	.00276
.83457	.00089	.00089
.90451	.00020	.00020
.95677	.00003	.00003
.98907	.00000	.00000

THE BENDING MOMENT COEFFICIENT BASED ON WING HALF SPAN AND WING AREA

AT THE WING ROOT = •100475 (RIGHT), = .100475 (LEFT)

XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX

OVER-ALL AERODYNAMIC CHARACTERISTICS

XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX

ATTACHED FLOW

ALPHA	CL	CDI	CM	CB
10.0000	.19333	.01438	-.17865	.03723
20.0000	.46291	.07098	-.44135	.10048

SEPARATED FLOW

ALPHA	CLP	CLV,LE	CLV,SF	CL
10.0000	.19376	.00383	0.00000	.19759
20.0000	.46535	.11690	0.00000	.58225

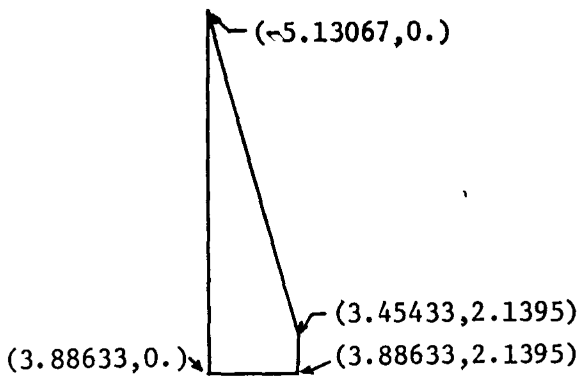
ALPHA	CDP	CDV,LE	CDV,SF	CDI	CAV
10.0000	.01607	-.00078	0.00000	.01529	-.00143
20.0000	.10396	.02752	0.00000	.13148	-.01412

ALPHA	CMP	CMV,LE	CMV,SF	CM
10.0000	-.17865	-.00244	0.00000	-.18109
20.0000	-.44135	-.11070	0.00000	-.55205

3. Third Sample Case

<u>Input Data</u>

```
NASA TN-D-8247--76-DEGREE-SWEEP, M=2.3
        1        14         0         1         0
        1         1         0
       10         0         1        10
       0.       16.        1.    9.0731
       0.      .025       .05        .1       .15        .2       .25        .3
      .35        .4        .5        .6        .7        .8        .9        1.
  .061787   .060189   .057952   .052683   .046335   .039755   .032776   .026287
  .021029   .016235   .007329   .000507  -.003615  -.005070  -.003527  -.000452
    .2154       16.        1.    8.2789
       0.      .025       .05        .1       .15        .2       .25        .3
      .35        .4        .5        .6        .7        .8        .9        1.
  .034920   .033990   .033012   .031079   .027975   .024726   .021476   .018070
  .014845   .011475   .004723  -.000797  -.004167  -.005979  -.003068   .000858
    .4305       16.        1.    7.3889
       0.      .025       .05        .1       .15        .2       .25        .3
      .35        .4        .5        .6        .7        .8        .9        1.
  .013304   .014129   .014955   .016024   .015956   .014955   .013642   .012072
  .010042   .007877   .003478  -.001137  -.005359  -.009352  -.012817  -.016701
    .6459       16.        1.    6.5303
       0.      .025       .05        .1       .15        .2       .25        .3
      .35        .4        .5        .6        .7        .8        .9        1.
  .005911   .007320   .008637   .010076   .010781   .011209   .011041   .010306
  .009448   .008162   .004824   .001317  -.002374  -.006493  -.010581  -.014701
    .8611       16.        1.    5.6563
       0.      .025       .05        .1       .15        .2       .25        .3
      .35        .4        .5        .6        .7        .8        .9        1.
  .004579   .006206   .007496   .009476   .009476   .011280   .013118   .013154
  .012712   .011810   .009653   .007143   .004933   .000760  -.003147  -.007054
   1.2918       16.        1.    3.9134
       0.      .025       .05        .1       .15        .2       .25        .3
      .35        .4        .5        .6        .7        .8        .9        1.
  .031865   .033551   .034522   .036541   .038611   .040297   .041550   .042648
  .043543   .044079   .044846   .045178   .043875   .041856   .038867   .033424
    1.507       16.        1.    3.0437
       0.      .025       .05        .1       .15        .2       .25        .3
      .35        .4        .5        .6        .7        .8        .9        1.
  .060157   .060326   .063508   .066170   .068864   .071098   .073266   .075106
  .076617   .077702   .079377   .079936   .080198   .079443   .077209   .072116
   1.7224       16.        1.    2.1671
       0.      .025       .05        .1       .15        .2       .25        .3
      .35        .4        .5        .6        .7        .8        .9        1.
  .112178   .114393   .116146   .119192   .122376   .125421   .125513   .131143
  .131974   .134188   .137373   .139495   .140880   .141110   .140280   .136311
   1.9378       16.        1.    1.2959
       0.      .025       .05        .1       .15        .2       .25        .3
      .35        .4        .5        .6        .7        .8        .9        1.
  .232640   .234586   .236978   .240528   .243846   .247319   .251100   .254572
  .257736   .260282   .265761   .270468   .273015   .274018   .274016   .270854
   2.1397       16.        1.     .4348
       0.      .025       .05        .1       .15        .2       .25        .3
      .35        .4        .5        .6        .7        .8        .9        1.
  .819687   .822447   .825437   .830727   .834867   .840156   .845216   .850046
  .853956   .858786   .869365   .878565   .886845   .894434   .900184   .899034
      2.3  10.10807     6.058        0.        0.
       2.       10.       10.        1.        1.
 -5.13067   3.88633        0.   3.45433   3.88633    2.1395        0.        0.
       1.       76.        1.      .048
       0.        0.
```



Output

```
******************************************
NASA TN-D-8247--76-DEGREE-SWEEP, M=2.3

******************************************

INPUT DATA
        1        14         0         1         0
        1         1         0
       10         0         1        10
 0.000000 16.000000  1.000000  9.073100
 0.000000   .025000   .050000   .100000   .150000   .200000   .250000   .300000
  .350000   .400000   .500000   .600000   .700000   .800000   .900000  1.000000
  .061787   .060189   .057952   .052683   .046335   .039755   .032778   .026287
  .021029   .016235   .007329   .000507  -.003615  -.005070  -.003527  -.000452
  .215400 16.000000  1.000000  8.278900
 0.000000   .025000   .050000   .100000   .150000   .200000   .250000   .300000
  .350000   .400000   .500000   .600000   .700000   .800000   .900000  1.000000
  .034920   .033990   .033012   .031079   .027975   .024726   .021476   .018070
  .014845   .011475   .004723  -.000797  -.004167  -.005979  -.003068   .000858
  .430500 16.000000  1.000000  7.388900
 0.000000   .025000   .050000   .100000   .150000   .200000   .250000   .300000
  .350000   .400000   .500000   .600000   .700000   .800000   .900000  1.000000
  .013304   .014129   .014955   .016024   .015956   .014955   .013642   .012072
  .010042   .007877   .003478  -.001137  -.005359  -.009352  -.012817  -.016701
  .645900 16.000000  1.000000  6.530300
 0.000000   .025000   .050000   .100000   .150000   .200000   .250000   .300000
  .350000   .400000   .500000   .600000   .700000   .800000   .900000  1.000000
  .005911   .007320   .008637   .010076   .010781   .011209   .011041   .010306
  .009448   .008162   .004824   .001317  -.002374  -.006493  -.010581  -.014701
  .861100 16.000000  1.000000  5.656300
 0.000000   .025000   .050000   .100000   .150000   .200000   .250000   .300000
  .350000   .400000   .500000   .600000   .700000   .800000   .900000  1.000000
  .004579   .006206   .007496   .009476   .009476   .011280   .013118   .013154
  .012712   .011810   .009653   .007143   .004933   .000760  -.003147  -.007054
 1.291800 16.000000  1.000000  3.913400
 0.000000   .025000   .050000   .100000   .150000   .200000   .250000   .300000
  .350000   .400000   .500000   .600000   .700000   .800000   .900000  1.000000
  .031865   .033551   .034522   .036541   .038611   .040297   .041550   .042648
  .043543   .044079   .044846   .045178   .043875   .041856   .038867   .033424
 1.507000 16.000000  1.000000  3.043700
 0.000000   .025000   .050000   .100000   .150000   .200000   .250000   .300000
  .350000   .400000   .500000   .600000   .700000   .800000   .900000  1.000000
  .060157   .060326   .063508   .066170   .068864   .071098   .073266   .075106
  .076617   .077702   .079377   .079936   .080198   .079443   .077209   .072116
 1.722400 16.000000  1.000000  2.167100
 0.000000   .025000   .050000   .100000   .150000   .200000   .250000   .300000
  .350000   .400000   .500000   .600000   .700000   .800000   .900000  1.000000
```

.112178	.114393	.116146	.119192	.122376	.125421	.125513	.1311
.131974	.134188	.137373	.139495	.140880	.141110	.140280	.1363
1.937800	16.000000	1.000000	1.295900				
0.000000	.025000	.050000	.100000	.150000	.200000	.250000	.3000
.350000	.400000	.500000	.600000	.700000	.800000	.900000	1.0000
.232040	.234586	.236978	.240528	.243846	.247319	.251100	.25457
.257736	.260282	.265761	.270468	.273015	.274018	.274018	.27085
2.139700	16.000000	1.000000	.434800				
0.000000	.025000	.050000	.100000	.150000	.200000	.250000	.30000
.350000	.400000	.500000	.600000	.700000	.800000	.900000	1.00000
.819687	.822447	.825437	.830727	.834867	.840156	.845216	.85004
.853956	.858786	.869365	.878565	.886845	.894434	.900184	.89903
2.300000	10.108070	6.058000	0.000000	0.000000			
2.000000	10.000000	10.000000	1.000000	1.000000			
-5.130670	3.886330	0.000000	3.454330	3.886330	2.139500	0.000000	0.00000
1.000000	76.000000	1.000000	.048000				
0.000000	0.000000						

HALF SW= .10108E+02 CPEF= .60580E+01

PANEL ENDPOINT COORDINATES AND EDGE SLOPFS =

X1	X2	Y1	Y2	BP	BP
-5.13067	-4.92058	0.00000	.05236	4.01262	3.91442
-4.91001	-4.70506	0.00000	.05236	3.91442	3.62945
-4.26962	-4.07960	0.00000	.05236	3.62945	3.18559
-3.27220	-3.10541	0.00000	.05236	3.18559	2.62629
-2.01537	-1.87787	0.00000	.05236	2.62629	2.00631
-.62217	-.51713	0.00000	.05236	2.00631	1.38633
.77103	.84362	0.00000	.05236	1.38633	.82703
2.02786	2.07116	0.00000	.05236	.82703	.38317
3.02528	3.04534	0.00000	.05236	.38317	.09820
3.66567	3.67081	0.00000	.05236	.09820	.00000
-4.92058	-4.55558	.05236	.14332	4.01262	3.91442
-4.70506	-4.34900	.05236	.14332	3.91442	3.62945
-4.07960	-3.74945	.05236	.14332	3.62945	3.18559
-3.10541	-2.81564	.05236	.14332	3.18559	2.62629
-1.87787	-1.63897	.05236	.14332	2.62629	2.00631
-.51713	-.33463	.05236	.14332	2.00631	1.38633
.84362	.96972	.05236	.14332	1.38633	.82703
2.07116	2.14639	.05236	.14332	.82703	.38317
3.04534	3.08020	.05236	.14332	.38317	.09820
3.67081	3.67974	.05236	.14332	.09820	.00000
-4.55558	-4.02812	.14332	.27477	4.01262	3.91442
-4.34900	-3.83444	.14332	.27477	3.91442	3.62945
-3.74945	-3.27236	.14332	.27477	3.62945	3.18559
-2.81564	-2.39689	.14332	.27477	3.18559	2.62629
-1.63897	-1.29374	.14332	.27477	2.62629	2.00631
-.33463	-.07089	.14332	.27477	2.00631	1.38633
.96972	1.15196	.14332	.27477	1.38633	.82703
2.14639	2.25510	.14332	.27477	.82703	.38317

3.08020	3.13057	.14332	.27477	.38317	.09820
3.67974	3.69265	.14332	.27477	.09820	.00000
-4.02812	-3.36124	.27477	.44097	4.01262	3.91442
-3.83444	-3.18388	.27477	.44097	3.91442	3.62945
-3.27236	-2.66916	.27477	.44097	3.62945	3.18559
-2.39689	-1.86746	.27477	.44097	3.18559	2.62629
-1.29374	-.85726	.27477	.44097	2.62629	2.00631
-.07089	.26255	.27477	.44097	2.00631	1.38633
1.15196	1.38236	.27477	.44097	1.38633	.82703
2.25510	2.39255	.27477	.44097	.82703	.38317
3.13057	3.19425	.27477	.44097	.38317	.09820
3.69265	3.70897	.27477	.44097	.09820	.00000
-3.36124	-2.58409	.44097	.63464	4.01262	3.91442
-3.18388	-2.42574	.44097	.63464	3.91442	3.62945
-2.66916	-1.96622	.44097	.63464	3.62945	3.18559
-1.86746	-1.25049	.44097	.63464	3.18559	2.62629
-.85726	-.34861	.44097	.63464	2.62629	2.00631
.26255	.65112	.44097	.63464	2.00631	1.38633
1.38236	1.65086	.44097	.63464	1.38633	.82703
2.39255	2.55273	.44097	.63464	.82703	.38317
3.19425	3.26846	.44097	.63464	.38317	.09820
3.70897	3.72799	.44097	.63464	.09820	.00000
-2.58409	-1.73063	.63464	.84734	4.01262	3.91442
-2.42574	-1.59317	.63464	.84734	3.91442	3.62945
-1.96622	-1.19426	.63464	.84734	3.62945	3.18559
-1.25049	-.57293	.63464	.84734	3.18559	2.62629
-.34861	.20998	.63464	.84734	2.62629	2.00631
.65112	1.07785	.63464	.84734	2.00631	1.38633
1.65086	1.94572	.63464	.84734	1.38633	.82703
2.55273	2.72863	.63464	.84734	.82703	.38317
3.26846	3.34996	.63464	.84734	.38317	.09820
3.72799	3.74887	.63464	.84734	.09820	.00000
-1.73063	-.83817	.84734	1.06975	4.01262	3.91442
-1.59317	-.72255	.84734	1.06975	3.91442	3.62945
-1.19426	-.38702	.84734	1.06975	3.62945	3.18559
-.57293	.13558	.84734	1.06975	3.18559	2.62629
.20998	.79410	.84734	1.06975	2.62629	2.00631
1.07785	1.52408	.84734	1.06975	2.00631	1.38633
1.94572	2.25406	.84734	1.06975	1.38633	.82703
2.72863	2.91258	.84734	1.06975	.82703	.38317
3.34996	3.43518	.84734	1.06975	.38317	.09820
3.74887	3.77071	.84734	1.06975	.09820	.00000
-.83817	.05429	1.06975	1.29216	4.01262	3.91442
-.72255	.14807	1.06975	1.29216	3.91442	3.62945
-.38702	.42022	1.06975	1.29216	3.62945	3.18559
.13558	.84410	1.06975	1.29216	3.18559	2.62629
.79410	1.37823	1.06975	1.29216	2.62629	2.00631
1.52408	1.97031	1.06975	1.29216	2.00631	1.38633
2.25406	2.56239	1.06975	1.29216	1.38633	.82703
2.91258	3.09652	1.06975	1.29216	.82703	.38317

3.43518	3.52040	1.06975	1.29216	.38317	.09820
3.77071	3.79255	1.06975	1.29216	.09820	.00000
.05429	.90775	1.29216	1.50486	4.01262	3.91442
.14807	.98064	1.29216	1.50486	3.91442	3.62945
.42022	1.19218	1.29216	1.50486	3.62945	3.18559
.84410	1.52165	1.29216	1.50486	3.18559	2.62629
1.37823	1.93682	1.29216	1.50486	2.62629	2.00631
1.97031	2.39704	1.29216	1.50486	2.00631	1.38633
2.56239	2.85725	1.29216	1.50486	1.38633	.82703
3.09652	3.27242	1.29216	1.50486	.82703	.38317
3.52040	3.60190	1.29216	1.50486	.38317	.09820
3.79255	3.81344	1.29216	1.50486	.09820	.00000
.90775	1.68490	1.50486	1.69853	4.01262	3.91442
.98064	1.73877	1.50486	1.69853	3.91442	3.62945
1.19218	1.89512	1.50486	1.69853	3.62945	3.18559
1.52165	2.13863	1.50486	1.69853	3.18559	2.62629
1.93682	2.44547	1.50486	1.69853	2.62629	2.00631
2.39704	2.78561	1.50486	1.69853	2.00631	1.38633
2.85725	3.12575	1.50486	1.69853	1.38633	.82703
3.27242	3.43260	1.50486	1.69853	.82703	.38317
3.60190	3.67611	1.50486	1.69853	.38317	.09820
3.81344	3.83246	1.50486	1.69853	.09820	.00000
1.68490	2.35178	1.69853	1.86473	4.01262	3.91442
1.73877	2.38933	1.69853	1.86473	3.91442	3.62945
1.89512	2.49832	1.69853	1.86473	3.62945	3.18559
2.13863	2.66806	1.69853	1.86473	3.18559	2.62629
2.44547	2.88195	1.69853	1.86473	2.62629	2.00631
2.78561	3.11905	1.69853	1.86473	2.00631	1.38633
3.12575	3.35616	1.69853	1.86473	1.38633	.82703
3.43260	3.57005	1.69853	1.86473	.82703	.38317
3.67611	3.73979	1.69853	1.86473	.38317	.09820
3.83246	3.84878	1.69853	1.86473	.09820	.00000
2.35178	2.87924	1.86473	1.99618	4.01262	3.91442
2.38933	2.90389	1.86473	1.99618	3.91442	3.62945
2.49832	2.97541	1.86473	1.99618	3.62945	3.18559
2.66806	3.08681	1.86473	1.99618	3.18559	2.62629
2.88195	3.22718	1.86473	1.99618	2.62629	2.00631
3.11905	3.38279	1.86473	1.99618	2.00631	1.38633
3.35616	3.53839	1.86473	1.99618	1.38633	.82703
3.57005	3.67876	1.86473	1.99618	.82703	.38317
3.73979	3.79016	1.86473	1.99618	.38317	.09820
3.84878	3.86168	1.86473	1.99618	.09820	.00000
2.87924	3.24424	1.99618	2.08714	4.01262	3.91442
2.90389	3.25995	1.99618	2.08714	3.91442	3.62945
2.97541	3.30555	1.99618	2.08714	3.62945	3.18559
3.08681	3.37658	1.99618	2.08714	3.18559	2.62629
3.22718	3.46608	1.99618	2.08714	2.62629	2.00631
3.38279	3.56529	1.99618	2.08714	2.00631	1.38633
3.53839	3.66449	1.99618	2.08714	1.38633	.82703
3.67876	3.75399	1.99618	2.08714	.82703	.38317

3.79016	3.82502	1.99618	2.08714	.38317	.09820
3.86168	3.87062	1.99618	2.08714	.09820	.00000
3.24424	3.43082	2.08714	2.13364	4.01262	3.91442
3.25995	3.44196	2.08714	2.13364	3.91442	3.62945
3.30555	3.47431	2.08714	2.13364	3.62945	3.18559
3.37658	3.52470	2.08714	2.13364	3.18559	2.62629
3.46608	3.58819	2.08714	2.13364	2.62629	2.00631
3.56529	3.65857	2.08714	2.13364	2.00631	1.38633
3.66449	3.72895	2.08714	2.13364	1.38633	.82703
3.75399	3.79245	2.08714	2.13364	.82703	.38317
3.82502	3.84283	2.08714	2.13364	.38317	.09820
3.87062	3.87518	2.08714	2.13364	.09820	.00000

CONTROL POINT COORDINATES=

XCP	YCP	ZCP	XCP	YCP	ZCP
-4.84011	.02338	0.00000	-4.24951	.02338	0.00000
-3.30234	.02338	0.00000	-2.09219	.02338	0.00000
-.73565	.02338	0.00000	.63669	.02338	0.00000
1.89283	.02338	0.00000	2.91201	.02338	0.00000
3.59636	.02338	0.00000	3.88024	.02338	0.00000
-4.56892	.09248	0.00000	-3.99668	.09248	0.00000
-3.07894	.09248	0.00000	-1.90639	.09248	0.00000
-.59201	.09248	0.00000	.73768	.09248	0.00000
1.95478	.09248	0.00000	2.94229	.09248	0.00000
3.60537	.09248	0.00000	3.88043	.09248	0.00000
-4.13012	.20430	0.00000	-3.58758	.20430	0.00000
-2.71747	.20430	0.00000	-1.60577	.20430	0.00000
-.35960	.20430	0.00000	.90108	.20430	0.00000
2.05502	.20430	0.00000	2.99128	.20430	0.00000
3.61995	.20430	0.00000	3.88074	.20430	0.00000
-3.54290	.35395	0.00000	-3.04010	.35395	0.00000
-2.23373	.35395	0.00000	-1.20347	.35395	0.00000
-.04858	.35395	0.00000	1.11976	.35395	0.00000
2.18917	.35395	0.00000	3.05685	.35395	0.00000
3.63946	.35395	0.00000	3.88115	.35395	0.00000
-2.83292	.53487	0.00000	-2.37817	.53487	0.00000
-1.64886	.53487	0.00000	-.71705	.53487	0.00000
.32746	.53487	0.00000	1.38415	.53487	0.00000
2.35136	.53487	0.00000	3.13612	.53487	0.00000
3.66305	.53487	0.00000	3.88164	.53487	0.00000
-2.03120	.73918	0.00000	-1.63071	.73918	0.00000
-.98842	.73918	0.00000	-.16779	.73918	0.00000
.75210	.73918	0.00000	1.68270	.73918	0.00000
2.53451	.73918	0.00000	3.22563	.73918	0.00000
3.68969	.73918	0.00000	3.88220	.73918	0.00000
-1.17279	.95793	0.00000	-.83039	.95793	0.00000
-.28127	.95793	0.00000	.42031	.95793	0.00000
1.20676	.95793	0.00000	2.00237	.95793	0.00000
2.73061	.95793	0.00000	3.32147	.95793	0.00000

3.71822	.95793	0.00000	3.88280	.95793	0.00000
-.29520	1.18157	0.00000	-.01220	1.18157	0.00000
.44167	1.18157	0.00000	1.02155	1.18157	0.00000
1.67157	1.18157	0.00000	2.32917	1.18157	0.00000
2.93109	1.18157	0.00000	3.41946	1.18157	0.00000
3.74738	1.18157	0.00000	3.88341	1.18157	0.00000
.56321	1.40032	0.00000	.78812	1.40032	0.00000
1.14881	1.40032	0.00000	1.60965	1.40032	0.00000
2.12623	1.40032	0.00000	2.64884	1.40032	0.00000
3.12719	1.40032	0.00000	3.51530	1.40032	0.00000
3.77591	1.40032	0.00000	3.88401	1.40032	0.00000
1.36493	1.60462	0.00000	1.53558	1.60462	0.00000
1.80925	1.60462	0.00000	2.15891	1.60462	0.00000
2.55087	1.60462	0.00000	2.94739	1.60462	0.00000
3.31033	1.60462	0.00000	3.60481	1.60462	0.00000
3.80255	1.60462	0.00000	3.88457	1.60462	0.00000
2.07492	1.78555	0.00000	2.19751	1.78555	0.00000
2.39412	1.78555	0.00000	2.64532	1.78555	0.00000
2.92691	1.78555	0.00000	3.21178	1.78555	0.00000
3.47252	1.78555	0.00000	3.68408	1.78555	0.00000
3.82614	1.78555	0.00000	3.88507	1.78555	0.00000
2.66214	1.93520	0.00000	2.74499	1.93520	0.00000
2.87786	1.93520	0.00000	3.04763	1.93520	0.00000
3.23793	1.93520	0.00000	3.43045	1.93520	0.00000
3.60667	1.93520	0.00000	3.74965	1.93520	0.00000
3.84565	1.93520	0.00000	3.88548	1.93520	0.00000
3.10093	2.04702	0.00000	3.15409	2.04702	0.00000
3.23933	2.04702	0.00000	3.34825	2.04702	0.00000
3.47034	2.04702	0.00000	3.59386	2.04702	0.00000
3.70691	2.04702	0.00000	3.79864	2.04702	0.00000
3.86023	2.04702	0.00000	3.88578	2.04702	0.00000
3.37212	2.11612	0.00000	3.40692	2.11612	0.00000
3.46274	2.11612	0.00000	3.53404	2.11612	0.00000
3.61398	2.11612	0.00000	3.69484	2.11612	0.00000
3.76886	2.11612	0.00000	3.82892	2.11612	0.00000
3.86924	2.11612	0.00000	3.88597	2.11612	0.00000

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ATTACHED POTENTIAL FLOW RESULTS

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XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX

PRESSURE DISTRIBUTION AT ALPHA = 10.000 DEG.

XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX

VORTEX	XV	YV	CP
1	.00616	.01093	.38162
2	.05450	.01093	.25086
3	.14645	.01093	.21598
4	.27300	.01093	.16603
5	.42178	.01093	.16383
6	.57822	.01093	.12948
7	.72700	.01093	.11334
8	.85355	.01093	.08014
9	.94550	.01093	.09354
10	.99384	.01093	.12971
11	.00616	.04323	.56351
12	.05450	.04323	.28598
13	.14645	.04323	.23212
14	.27300	.04323	.16462
15	.42178	.04323	.15310
16	.57822	.04323	.12184
17	.72700	.04323	.10640
18	.85355	.04323	.07438
19	.94550	.04323	.09625
20	.99384	.04323	.12980
21	.00616	.09549	.74839
22	.05450	.09549	.34130
23	.14645	.09549	.25239
24	.27300	.09549	.18345
25	.42178	.09549	.16458
26	.57822	.09549	.12588
27	.72700	.09549	.11382
28	.85355	.09549	.07286
29	.94550	.09549	.10992
30	.99384	.09549	.13389
31	.00616	.16543	.80597
32	.05450	.16543	.37474
33	.14645	.16543	.26340
34	.27300	.16543	.19221
35	.42178	.16543	.16563
36	.57822	.16543	.13345
37	.72700	.16543	.12408
38	.85355	.16543	.09501
39	.94550	.16543	.11721
40	.99384	.16543	.13200
41	.00616	.25000	.85006
42	.05450	.25000	.40902

43	.14645	.25000	.28561
44	.27300	.25000	.21051
45	.42178	.25000	.18266
46	.57822	.25000	.15043
47	.72700	.25000	.13796
48	.85355	.25000	.12438
49	.94550	.25000	.13219
50	.99384	.25000	.13960
51	.00616	.34549	.88152
52	.05450	.34549	.41529
53	.14645	.34549	.25612
54	.27300	.34549	.21694
55	.42178	.34549	.19263
56	.57822	.34549	.14996
57	.72700	.34549	.15120
58	.85355	.34549	.13842
59	.94550	.34549	.13520
60	.99384	.34549	.14352
61	.00616	.44774	.96889
62	.05450	.44774	.42761
63	.14645	.44774	.24673
64	.27300	.44774	.24905
65	.42178	.44774	.19974
66	.57822	.44774	.15390
67	.72700	.44774	.17437
68	.85355	.44774	.14816
69	.94550	.44774	.16083
70	.99384	.44774	.17064
71	.00616	.55226	1.11440
72	.05450	.55226	.45898
73	.14645	.55226	.29403
74	.27300	.55226	.26286
75	.42178	.55226	.20998
76	.57822	.55226	.18097
77	.72700	.55226	.18591
78	.85355	.55226	.17577
79	.94550	.55226	.19647
80	.99384	.55226	.21164
81	.00616	.65451	1.14674
82	.05450	.65451	.62044
83	.14645	.65451	.37049
84	.27300	.65451	.29863
85	.42178	.65451	.25095
86	.57822	.65451	.21453
87	.72700	.65451	.20634
88	.85355	.65451	.21623
89	.94550	.65451	.24148
90	.99384	.65451	.25732
91	.00616	.75000	1.20151
92	.05450	.75000	.69360

93	.14645	.75000	.41345
94	.27300	.75000	.35234
95	.42178	.75000	.25463
96	.57822	.75000	.20977
97	.72700	.75000	.21121
98	.85355	.75000	.22680
99	.94550	.75000	.26675
100	.99384	.75000	.28958
101	.00616	.83457	2.38686
102	.05450	.83457	1.02281
103	.14645	.83457	.64907
104	.27300	.83457	.53624
105	.42178	.83457	.35091
106	.57822	.83457	.30252
107	.72700	.83457	.30940
108	.85355	.83457	.31887
109	.94550	.83457	.35134
110	.99384	.83457	.36953
111	.00616	.90451	2.22840
112	.05450	.90451	.94662
113	.14645	.90451	.53834
114	.27300	.90451	.39350
115	.42178	.90451	.32105
116	.57822	.90451	.29690
117	.72700	.90451	.26202
118	.85355	.90451	.21426
119	.94550	.90451	.19799
120	.99384	.90451	.18826
121	.00616	.95677	1.48892
122	.05450	.95677	.67354
123	.14645	.95677	.39357
124	.27300	.95677	.29601
125	.42178	.95677	.18055
126	.57822	.95677	.05801
127	.72700	.95677	-.13793
128	.85355	.95677	-.20291
129	.94550	.95677	-.14939
130	.99384	.95677	-.10468
131	.00616	.98907	6.55450
132	.05450	.98907	2.93730
133	.14645	.98907	1.75209
134	.27300	.98907	.98096
135	.42178	.98907	.65517
136	.57822	.98907	.85096
137	.72700	.98907	.88151
138	.85355	.98907	.89186
139	.94550	.98907	.98837
140	.99384	.98907	1.04680

Y/S	CL(RIGHT)	CL(LEFT)	CM	CDI	CS*C	CAV
.01093	.12638	.12638	.03018	.03181	.01613	.00008
.04323	.14075	.14075	.03175	.03287	.04180	.00022
.09549	.15672	.15672	.03060	.03288	.07124	.00033
.16543	.17553	.17553	.02484	.03340	.08002	-.00008
.25000	.19902	.19902	.01186	.03487	.08513	-.00055
.34549	.20533	.20533	-.00439	.03314	.09492	-.00093
.44774	.21847	.21847	-.02532	.03232	.11289	-.00122
.55226	.24397	.24397	-.05154	.03229	.13903	-.00141
.65451	.29648	.29648	-.08912	.03612	.15466	-.00372
.75000	.31337	.31337	-.11839	.02723	.17621	-.00393
.83457	.48272	.48272	-.21818	.03178	.20543	-.00672
.90451	.38871	.38871	-.19610	.00165	.22734	-.01264
.95677	.10303	.10303	-.05010	-.06299	.23208	-.02334
.98907	.22602	.22602	-.12934	-.08417	.22854	-.04385

TOTAL LIFT COEFFICIENT = .21433

TOTAL INDUCED DRAG COEFFICIENT = .03139

THE INDUCED DRAG PARAMETER = .68331

TOTAL PITCHING MOMENT COEFFICIENT = -.01942

THE FOLLOWING BENDING MOMENT COEFFICIENT IS BASED ON Q*S*(B/2),
WHERE S = 20.21614 AND B/2 = 2.13950

Y/S	BM(RIGHT)	BM(LEFT)
.01093	.04439	.04439
.04323	.04097	.04097
.09549	.03574	.03574
.16543	.02933	.02933
.25000	.02254	.02254
.34549	.01610	.01610
.44774	.01058	.01058
.55226	.00623	.00623
.65451	.00317	.00317
.75000	.00132	.00132
.83457	.00036	.00036
.90451	.00006	.00006
.95677	.00001	.00001
.98907	.00000	.00000

THE BENDING MOMENT COEFFICIENT BASED ON WING HALF SPAN AND WING AREA
AT THE WING ROOT = .045570 (RIGHT), = .045570 (LEFT)

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ATTACHED POTENTIAL FLOW RESULTS

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XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX

PRESSURE DISTRIBUTION AT ALPHA = 20.000 DEG.

XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX

VORTEX	XV	YV	CP
1	.00616	.01093	.76710
2	.05450	.01093	.42524
3	.14645	.01093	.35045
4	.27300	.01093	.28513
5	.42178	.01093	.28905
6	.57822	.01093	.25060
7	.72700	.01093	.24565
8	.85355	.01093	.21769
9	.94550	.01093	.23049
10	.99384	.01093	.27887
11	.00616	.04323	1.15886
12	.05450	.04323	.51719
13	.14645	.04323	.38522
14	.27300	.04323	.27410
15	.42178	.04323	.25223
16	.57822	.04323	.22475
17	.72700	.04323	.21314
18	.85355	.04323	.18440
19	.94550	.04323	.19659
20	.99384	.04323	.23296
21	.00616	.09549	1.58442
22	.05450	.09549	.67001
23	.14645	.09549	.43984
24	.27300	.09549	.31524
25	.42178	.09549	.27566
26	.57822	.09549	.23531
27	.72700	.09549	.22764
28	.85355	.09549	.19422
29	.94550	.09549	.22714
30	.99384	.09549	.24765
31	.00616	.16543	1.75764
32	.05450	.16543	.75355
33	.14645	.16543	.45885
34	.27300	.16543	.32143
35	.42178	.16543	.26933
36	.57822	.16543	.23444
37	.72700	.16543	.23226
38	.85355	.16543	.21328
39	.94550	.16543	.23265
40	.99384	.16543	.24583
41	.00616	.25000	1.88760
42	.05450	.25000	.82947
43	.14645	.25000	.51584
44	.27300	.25000	.35451
45	.42178	.25000	.29264
46	.57822	.25000	.25377
47	.72700	.25000	.24115
48	.85355	.25000	.23384

49	.94550	.25000	.24383
50	.99384	.25000	.25009
51	.00616	.34549	1.84034
52	.05450	.34549	.78888
53	.14645	.34549	.44603
54	.27300	.34549	.32876
55	.42178	.34549	.28046
56	.57822	.34549	.23417
57	.72700	.34549	.23103
58	.85355	.34549	.22715
59	.94550	.34549	.22627
60	.99384	.34549	.23702
61	.00616	.44774	1.91598
62	.05450	.44774	.77177
63	.14645	.44774	.39991
64	.27300	.44774	.35662
65	.42178	.44774	.27624
66	.57822	.44774	.22332
67	.72700	.44774	.23912
68	.85355	.44774	.21889
69	.94550	.44774	.23677
70	.99384	.44774	.24924
71	.00616	.55226	2.15532
72	.05450	.55226	.77473
73	.14645	.55226	.45892
74	.27300	.55226	.37656
75	.42178	.55226	.28631
76	.57822	.55226	.24971
77	.72700	.55226	.24433
78	.85355	.55226	.23311
79	.94550	.55226	.25605
80	.99384	.55226	.27331
81	.00616	.65451	1.88506
82	.05450	.65451	1.16313
83	.14645	.65451	.63885
84	.27300	.65451	.46741
85	.42178	.65451	.36238
86	.57822	.65451	.30629
87	.72700	.65451	.28114
88	.85355	.65451	.28476
89	.94550	.65451	.30400
90	.99384	.65451	.31806
91	.00616	.75000	1.52908
92	.05450	.75000	1.18598
93	.14645	.75000	.64420
94	.27300	.75000	.54977
95	.42178	.75000	.34014
96	.57822	.75000	.26561
97	.72700	.75000	.25530
98	.85355	.75000	.25871

99	.94550	.75000	.28923
100	.99384	.75000	.30954
101	.00616	.83457	5.29916
102	.05450	.83457	2.10768
103	.14645	.83457	1.29269
104	.27300	.83457	1.07333
105	.42178	.83457	.66865
106	.57822	.83457	.53028
107	.72700	.83457	.49933
108	.85355	.83457	.48844
109	.94550	.83457	.49260
110	.99384	.83457	.49465
111	.00616	.90451	3.66705
112	.05450	.90451	1.39483
113	.14645	.90451	.72995
114	.27300	.90451	.52498
115	.42178	.90451	.41146
116	.57822	.90451	.34035
117	.72700	.90451	.24722
118	.85355	.90451	.12419
119	.94550	.90451	.02497
120	.99384	.90451	-.03396
121	.00616	.95677	-.53347
122	.05450	.95677	-.18246
123	.14645	.95677	-.11884
124	.27300	.95677	-.08309
125	.42178	.95677	-.20897
126	.57822	.95677	-.47873
127	.72700	.95677	-.87548
128	.85355	.95677	-1.10607
129	.94550	.95677	-1.13077
130	.99384	.95677	-1.10542
131	.00616	.98907	18.15734
132	.05450	.98907	8.18461
133	.14645	.98907	5.02490
134	.27300	.98907	3.01498
135	.42178	.98907	2.53814
136	.57822	.98907	3.01019
137	.72700	.98907	3.13394
138	.85355	.98907	3.04458
139	.94550	.98907	3.10342
140	.99384	.98907	3.15423

Y/S	CL(RIGHT)	CL(LEFT)	CM	CDI	CS*C	CAV
.01093	.22547	.22547	.04503	.09892	.03988	.00023
.04323	.24316	.24316	.05143	.10184	.10557	.00064
.09549	.28141	.28141	.05283	.11012	.18634	.00094
.16543	.30955	.30955	.04567	.11357	.23942	-.00024
.25000	.34640	.34640	.02709	.11954	.29075	-.00175
.34549	.33141	.33141	.00003	.10572	.35138	-.00253
.44774	.33038	.33038	-.03130	.09604	.42946	-.00311
.55226	.35592	.35592	-.06823	.09220	.52314	-.00363
.65451	.45220	.45220	-.12881	.10932	.59709	-.00672
.75000	.44279	.44279	-.15955	.07301	.69041	-.02078
.83457	.90141	.90141	-.40126	.16060	.80204	-.01773
.90451	.50820	.50820	-.23734	-.03195	.89535	-.00964
.95677	-.19923	-.19923	.17038	-.35970	.94248	0.00000
.98907	.77158	.77158	-.40821	-.23829	.94781	0.00000

TOTAL LIFT COEFFICIENT = .34672

TOTAL INDUCED DRAG COEFFICIENT = .09951

THE INDUCED DRAG PARAMETER = .82779

TOTAL PITCHING MOMENT COEFFICIENT = -.02220

THE FOLLOWING BENDING MOMENT COEFFICIENT IS BASED ON Q*S*(B/2), WHERE S = 20.21614 AND B/2 = 2.13950

Y/S	BM(RIGHT)	BM(LEFT)
.01093	.07189	.07189
.04323	.06613	.06613
.09549	.05735	.05735
.16543	.04672	.04672
.25000	.03563	.03563
.34549	.02535	.02535
.44774	.01665	.01665
.55226	.00982	.00982
.65451	.00499	.00499
.75000	.00202	.00202
.83457	.00046	.00046
.90451	.00005	.00005
.95677	.00003	.00003
.98907	.00000	.00000

THE BENDING MOMENT COEFFICIENT BASED ON WING HALF SPAN AND WING AREA AT THE WING ROOT = .073898 (RIGHT), = .073898 (LEFT)

XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX

OVER-ALL AERODYNAMIC CHARACTERISTICS

XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX

ATTACHED FLOW

ALPHA	CL	CDI	CM	CB
10.0000	.21433	.03139	-.01942	.04557
20.0000	.34672	.09951	-.02220	.07390

SEPARATED FLOW

ALPHA	CLP	CLV,LE	CLV,SE	CL
10.0000	.21349	.02781	.00691	.24822
20.0000	.33934	.09979	.02572	.46485

ALPHA	CDP	CDV,LE	CDV,SE	CDI	CAV
10.0000	.03809	.00331	.00069	.04209	-.00157
20.0000	.12372	.03278	.00720	.16370	-.00333

ALPHA	CMP	CMV,LE	CMV,SE	CM
10.0000	-.01942	-.00104	-.00422	-.02468
20.0000	-.02220	-.00702	-.01621	-.04543

FORTRAN PROGRAM LISTING

This program was written in Fortran IV language and is operational on CDC Cyber 175 computer system at Langley Research Center. For other computer systems, the library subroutine for matrix inversion may have to be changed. It is located in subroutines CONTRL and SOLUTN.

The following table is an index to the program listing.

```
      PROGRAM SSCAMSU(INPUT,OUTPUT,TAPE5=INPUT,TAPE6=OUTPUT,TAPE1,TAPE2,
     1TAPE3)
C *** THIS LIFTING-SURFACE PROGRAM IS BASED ON IMPROVED WOODWARD'S
C     PANEL METHOD FOR SUBSONIC AND SUPERSONIC FLOWS.
C
C *** GAMMA MUST BE DIMENSIONED TO HAVE AT LEAST (N+1)**2/4 ELEMENTS,
C     WHERE N IS THE SIZE OF THE MATRIX
C
      DIMENSION DQ(140,140)
      DIMENSION GAMMA(19600), ZBV(200), ZBDXV(200), ZBDYV(200)
      DIMENSION TP(20,2), WST(200,4), VST(200,4), CTDS(20,2)
      DIMENSION CP(200), AW(205), CA(205), SVP(20,10), DZDYT(20,2)
      DIMENSION XXL(2), YL(2), XXT(2), CPCWL(21), CPSWL(31), YBREAK(10)
      DIMENSION ALPH(50), SNALP(50), CLS(50), DCOS(5), DSIN(5), CLY(50)
      DIMENSION BREAK(10), SWP(20,10), CHORDT(4), TFLP(5), CTP(2)
      DIMENSION BMR(50), BML(50), DF(5), TITLE(13), CSU(50), YCN(6)
      DIMENSION PERCT(20), F(5,20), ZBDX(200), ZB(200), DUM(200), CAVS(5
     10)
      EQUIVALENCE  (DQ(1,1),GAMMA(1))
      EQUIVALENCE  (VST(1,1),GAMMA(1000)), (WST(1,1),GAMMA(1))
C
      COMMON /SCHEME/ C(2),X(21,41),Y(21,41),SLOPE(21),XL(2,21),XTT(41),
     1XLL(41)
      COMMON /GEOM/ HALFSW,XCP(200),YCP(200),ZCP(200),XLE(100),YLE(100),
     1XTE(100),PSI(30),CH(100),XV(200),YV(200),SN(20,2),XN(200,4),YN(200
     2,4),BPPIM(200,4),WIDTH(7),YCON(51),SWEEP(100),HALFB,SJ(31,7)
     3,ZN(200,4)
      COMMON /AERO/ AM,B,CL(50),CT(50),CD(50),CM(50)
      COMMON /CONST/ NCS,NCW,M1(7),MJW1(2,5),MJW2(2,5),NJW(5),NFP,NW(2)
      COMMON /CAMB/ ICAM,IM(10),XT(10,21),AAM(10,20),BBM(10,20),
     1CCM(10,20),DDM(10,20),YT(10),CURV(10),CHND(10)
      COMMON /TWST1/ NYM,YTS(21),AY(1,20),BY(1,20),CCY(1,20),DY(1,20)
      COMMON /LEFLP/ YLEF(10,2),XNF(10),YNF(10),ZNF(10),XLF(10,4),YLF(10
     1,4),SLP1(10)
C
C
      IQ = 140
      PI=3.14159265
      NCON=1
 1    CONTINUE
      REWIND 01
      WRITE (6,200)
```

```
 200  FORMAT (1H1)
C *** CASE TITLE ***
      READ(5,150)(TITLE(I),I=1,13)
      IF(EOF(5))139,999
  999 CONTINUE
      WRITE (6, 144)
      WRITE (6, 150)  (TITLE(I),I=1,13)
      WRITE (6, 144)
      NCS=0
      IPANEL=1
      DO  2 I=1,5
      DF(I) = 0.
 2    TFLP(I) = 0.
      WRITE (6, 145)
C
C *** NC = TOTAL NUMBER OF SPANWISE SECTIONS
C *** M1(I) = NUMBER OF SPANWISE STRIPS IN EACH SECTION
C *** IWING = LAST WING VORTEX STRIP NUMBER IF A TAIL IS PRESENT
C           = 0 OTHERWISE
C *** NWING = THE NUMERICAL ORDER OF LAST WING SPANWISE SECTION
C *** IWGLT = 1 IF A WINGLET TO BE REPRESENTED BY A TAIL IS PRESENT
C           = 2 IF THE WINGLET IS AT A LOCATION AWAY FROM THE WING TIP
C
      READ (5, 141) NC,(M1(I),I=1,NC),IWING,NWING,IWGLT
      WRITE (6, 141) NC,(M1(I),I=1,NC),IWING,NWING,IWGLT
      DO  3 I  = 1,NC
 3    M1(I) = M1(I) + 1
C
C *** NFP = NUMBER OF FLAP SPANS, LIMITED TO FIVE.
C *** NJW(I) = THE NUMERICAL ORDERS OF FLAP SPANS
C *** FOR A CLEAN OR FULL-SPAN FLAP CONFIGURATION, PUT NFP = NJW(1) = 1
C     NVRTX = VORTEX STRIP NUMBER ATEND OUTBOARD OF WHICH THE L.E. VORTE
C     X LIFT EFFECT IS NOT INCLUDED. IF IT IS ZERO, TOTAL VORTEX LIFT
C     EFFECT IS ASSUMED.
C
      READ (5, 141) NFP,(NJW(I),I=1,NFP),NVRTX
      WRITE (6, 141) NFP,(NJW(I),I=1,NFP),NVRTX
C
C *** NW(I) = NUMBER OF CHORDWISE VORTEX ELEMENTS IN CHORDWISE SECTIONS.
C     NW(2) = 0 FOR CLEAN CONFIGURATIONS.
C     ICAM = CAMBER CODE
C          = 0 FOR ZERO CAMBER
```

```
C           = 1 FOR CAMBER ORDINATES TO BE READ IN
C           = 2 IF CAMBER FUNCTION IS DEFINED ANALYTICALLY IN SUBROUTINE
C              ZCDX
C           = 3 IF THERE ARE PLANE L.E. FLAPS ATTACHED TO A PLANE WING.
C              IN THIS CASE, IST IS THE NUMBER OF L.E. FLAPS.
C     IST = NUMBER OF SPANWISE STATIONS AT WHICH CAMBER ORDINATES ARE
C           READ IN. LIMITED TO 10.
C *** NOTE : IF THE TAIL HAS CAMBER, USE THE LAST STATION ( =IST ) TO
C     DESCRIBE IT. ONLY CUBIC SPLINE IS USED TO CALCULATE THE CAMBER
C     SLOPE. ***
C
      READ (5, 141) (NW(I),I=1,2),ICAM,IST
      WRITE (6, 141) (NW(I),I=1,2),ICAM,IST
C
C *** IF ICAM = 1, READ IN THE X-COORDINATES AND THE CAMBER ORDINATES
C     YT = Y STATION AT WHICH CAMBER ORDINATES ARE TO BE READ IN.
C     XNUM = NUMBER OF CAMBER ORDINATES TO BE READ IN, LIMITED TO 21.
C     CURV = 0. IF CAMBER IS FORMED BY CONNECTING STRAIGHT SEGMENTS,
C              WITH FIRST SEGMENT BEING LEADING EDGE FLAP.
C          = 1. IF CUBIC SPLINE INTERPOLATION IS USED
C          = 2. IF CUBIC SPLINE INTERPOLATION IS USED, WITH FIRST
C              SEGMENT BEING LEADING EDGE FLAP
C     CHND = CHORD LENGTH AT YT STATION
C     XT = NONDIMENSIONAL X COORDINATES
C     CA = NONDIMENSIONAL CAMBER ORDINATES
C     IF CHND = 0., USE ACTUAL DIMENSIONAL CAMBER ORDINATE
C
      IF  (ICAM .NE. 1) GO TO  9
      DO  8 I=1,IST
      JJ = I
      READ (5, 140) YT(I),XNUM,CURV(I),CHND(I)
      WRITE (6, 140) YT(I),XNUM,CURV(I),CHND(I)
      IM(I) = XNUM
      IP = IM(I)
      ICV = CURV(I)
      READ (5, 140) (XT(I,J).J=1,IP)
      READ (5, 140) (CA(J),J = 1,IP)
      WRITE (6, 140) (XT(I,J),J = 1,IP)
      WRITE (6, 140) (CA(J), J = 1,IP)
      DO  4 K = 1,IP
 4    AW(K) = XT(I,K)
      IF  (ICV .EQ. 0) GO TO  5
```

```
      CALL SPLINE (IP,AW,CA,AAM,BBM,CCM,DDM,JJ,10)                      SSC 126
      GO TO  8                                                          SSC 127
    5 DO  7 J = 2,IP                                                    SSC 128
      AAM(I,J-1) = 0.                                                   SSC 129
      BBM(I,J-1) = 0.                                                   SSC 130
      IF  (ABS(AW(J)-AW(J-1)) .LE. 1.E-20) GO TO  6                     SSC 131
      CCM(I,J-1) = (CA(J) - CA(J-1)) / (AW(J) - AW(J-1))                SSC 132
    6 DDM(I,J-1) = CA(J-1)                                              SSC 133
    7 CONTINUE                                                          SSC 134
    8 CONTINUE                                                          SSC 135
    9 CONTINUE                                                          SSC 136
      IF  (ICAM .NE. 3) GO TO  11                                       SSC 137
C                                                                       SSC 138
C     YLEF(I,1) = EXTREME INBOARD Y-COORDINATE OF A L.E. FLAP.          SSC 139
C     YLEF(I,2) = EXTREME OUTBOARD Y-COORDINATE OF A L.E. FLAP.         SSC 140
C     X1,Y1,Z1, ETC. ARE CORNER POINT COORDINATES OF A L.E. FLAP, INPUT SSC 141
C     IN CLOCKWISE ORDER, FIRST FROM THE MOST INBOARD POINT.            SSC 142
C                                                                       SSC 143
      DO  10 I=1,IST                                                    SSC 144
      READ (5, 140) (YLEF(I,K),K=1,2)                                   SSC 145
      WRITE (6, 140) (YLEF(I,K),K=1,2)                                  SSC 146
      READ (5, 140) XLF(I,1),YLF(I,1),Z1,XLF(I,2),YLF(I,2),Z2           SSC 147
      READ (5, 140) XLF(I,3),YLF(I,3),Z3,XLF(I,4),YLF(I,4),Z4           SSC 148
      WRITE (6, 140) XLF(I,1),YLF(I,1),Z1,XLF(I,2),YLF(I,2),Z2          SSC 149
      WRITE (6, 140) XLF(I,3),YLF(I,3),Z3,XLF(I,4),YLF(I,4),Z4          SSC 150
      IF (ABS(XLF(I,4)-XLF(I,1)).GT.1.E-18) SLP1(I)=(YLF(I,4)-YLF(I,1))/ SSC 151
     1 (XLF(I,4)-XLF(I,1))                                              SSC 152
      IF (ABS(XLF(I,4)-XLF(I,1)).LE.1.E-18) SLP1(I)=1.E18               SSC 153
      XNF(I)=(YLF(I,4)-YLF(I,1))*(Z3-Z2)-(YLF(I,3)-YLF(I,2))*(Z4-Z1)    SSC 154
      YNF(I)=(XLF(I,3)-XLF(I,2))*(Z4-Z1)-(XLF(I,4)-XLF(I,1))*(Z3-Z2)    SSC 155
      ZNF(I)=(XLF(I,4)-XLF(I,1))*(YLF(I,3)-YLF(I,2))-(XLF(I,3)-XLF(I,2)) ASH   3
     1*(YLF(I,4)-YLF(I,1))                                              SSC 157
      IF (ABS(ZNF(I)) .GT. 1.E-3) GO TO 10                              ASH   4
      XNF(I)=(YLF(I,4)-YLF(I,1))*(Z2-Z1)-(YLF(I,2)-YLF(I,1))*(Z4-Z1)    ASH   5
      YNF(I)=(XLF(I,2)-XLF(I,1))*(Z4-Z1)-(XLF(I,4)-XLF(I,1))*(Z2-Z1)    ASH   6
      ZNF(I)=(XLF(I,4)-XLF(I,1))*(YLF(I,2)-YLF(I,1))-(XLF(I,2)-XLF(I,1)) ASH   7
     1*(YLF(I,4)-YLF(I,1))                                              ASH   8
   10 CONTINUE                                                          ASH   9
   11 CONTINUE                                                          SSC 158
      IF  (ICAM .EQ. 0) IST=1                                           SSC 159
      LAT = 0                                                           SSC 160
C                                                                       SSC 161
```

```
C *** AM = MACH NUMBER
C *** HALFSW = REFERENCE HALF WING AREA
C *** CREF = REFERENCE CHORD
C *** ALPCON = CONTROL INPUT FOR LARGE ALPHA COMPUTATION
C              = 1. IF ALPHA = 1. RADIAN (IN THIS CASE, PUT DF(I) = 0.)
C              = 0. OTHERWISE
C *** DF(I) = FLAP ANGLES IN DEGREES
C
      READ (5, 140) AM,HALFSW,CREF,ALPCON,(DF(I),I=1,NFP)
      WRITE (6, 140) AM,HALFSW,CREF,ALPCON,(DF(I),I=1,NFP)
      DO  12 I=1,NFP
      DF(I) = DF(I)*PI/180.
 12   TFLP(I) = -DF(I)
C
C *** FALP = NUMBER OF ALPHA TO BE EVALUATED
C *** ALPI = SMALLEST ALPHA IN DEGREES
C *** ALPIN = INCREMENTAL ALPHA IN DEGREES
C *** PTION = 1. IF PRESSURE DISTRIBUTION, SPAN LOADING AND BENDING
C                   MOMENT DISTRIBUTION ARE TO BE PRINTED OUT
C             = 0. OTHERWISE
C     SUP = 1. IF AN EFFECTIVE ANGLE OF ATTACK IN SUPERSONIC FLOW IS TO
C                BE USED.
C         = 0. OTHERWISE
C
      READ(5,140) FALP,ALPI,ALPIN,PTION,SUP
      WRITE(6,140)FALP,ALPI,ALPIN,PTION,SUP
      NALP = FALP
      IF  (NALP.EQ.0) NALP=1
      ALPI = ALPI * PI / 180.
      ALPIN = ALPIN * PI / 180.
      IPT = PTION
      ISUP = SUP
      ALP = ALPI
      NCW=NW(1)
      L=1
      CHORDT(2)=0.
      CHORDT(3)=0.
      CHORDT(4)=0.
      IV=0
      IDIH=0
 13   CONTINUE
      NCPCWL = NCW + 1
```

```
      N1 = NCW - 1                                                      SSC 200
      CPCWL(1) = 0.                                                     SSC 201
      LL=1                                                              SSC 202
      FN=NCW                                                            SSC 203
      DO  14 I=1,NCW                                                    SSC 204
      FI=I                                                              SSC 205
      CPCWL(I+1) = .5 * (1. - COS(FI * PI / FN)) * 100.                 SSC 206
      SN(I,L)  = SIN((2. * FI - 1.) * PI / (2. * FN))                   SSC 207
      XP = .5 * (1. - COS((2. * FI - 1.) * PI / (2. * FN)))  * 100.     SSC 208
 14   PERCT(I) = (XP-CPCWL(I))/(CPCWL(I+1)-CPCWL(I))                    SSC 209
      CPCWL(NCW+1) = 100.                                               SSC 210
      KZ=0                                                              SSC 211
      DO  27 KK = 1,NC                                                  SSC 212
C                                                                       SSC 213
C *** COORDINATES OF BREAK CHORDS BOUNDING SPANWISE SECTIONS,           SSC 214
C     FROM ROOT TO TIP ON THE RIGHT WING                                SSC 215
C *** DIHED = THE DIHEDRAL ANGLE IN DEGREES FOR THE SECTION             SSC 216
C                                                                       SSC 217
      READ (5, 140) ((XXL(I),XXT(I),YL(I),I=1,2),ZS,DIHED)              SSC 218
      WRITE (6, 140) ((XXL(I),XXT(I),YL(I),I=1,2),ZS,DIHED)             SSC 219
C                                                                       SSC 220
C *** FCN = 1 IF CONTROL POINTS ARE TO BE CALCULATED FOR THIS SECTION   SSC 221
C         = 0 IF PREVIOUSLY CALCULATED CONTROL POINTS ARE TO BE USED    SSC 222
C     NOTE. FOR THE SECOND CHORDWISE SECTION, FCN SHOULD BE THE SAME AS SSC 223
C     THE CORRESPONDING FIRST CHORDWISE SECTION.                        SSC 224
C *** SWK=L.E. SWEEP ANGLE OF THE SECTION IN DEGREES.                   SSC 225
C *** E = HINGE LINE LOCATION IN FRACTION OF LOCAL CHORD                SSC 226
C       = 1. FOR CLEAN CONFIGURATION                                    SSC 227
C     TR= TAPER RATIO FOR THE SECTION                                   ASH  16
C                                                                       SSC 228
      READ(5,140)FCN,SWK,E,TR                                           ASH  17
      WRITE(6,140)FCN,SWK,E,TR                                          ASH  18
      YBREAK(KK)=YL(2)                                                  SSC 231
      FM=M1(KK)                                                         SSC 232
      NSW=M1(KK)                                                        SSC 233
      SWEP = SWK                                                        SSC 234
      DO  15 J=1,NSW                                                    SSC 235
      FJ=J                                                              SSC 236
      CPSWL(J)=0.5*(1.-COS((2.*FJ-1.)*PI/(2.*FM)))*100.                 SSC 237
      YCON(J)=0.5*(1.-COS(FJ*PI/FM))                                    SSC 238
      SJ(J,KK)=SIN(FJ*PI/FM)                                            SSC 239
 15   CONTINUE                                                          SSC 240
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      IF  (DIHED .GT. 5.) IDIH = 1                                      SSC 241
      DCOS(KK) = COS(DIHED * PI / 180.)                                 SSC 242
      DSIN(KK)=SIN(DIHED    *PI/180.)                                   SSC 243
      IF  (IWING .NE. 0 .AND. DCOS(KK) .LE. 0.001) IV=1                 SSC 244
      IF  (KK .EQ. NC) GO TO  16                                        SSC 245
      IF  (IWING .NE. 0 .AND. KK .EQ. NWING) GO TO  16                  SSC 246
      CPSWL(1)=0.                                                       SSC 247
      CPSWL(NSW)=100.                                                   SSC 248
      GO TO  17                                                         SSC 249
 16   CPSWL(1)=0.                                                       SSC 250
      IF  (IWGLT .EQ. 1 .AND. KK .EQ. NWING) CPSWL(NSW)=100.            SSC 251
 17   IF  (KK .EQ. NJW(LL)) MJW1(L,LL)=IPANEL                           SSC 252
      LR=(L-1)*NC+KK                                                    SSC 253
      MC = FCN                                                          SSC 254
      NCP = 0                                                           SSC 255
      DETA = 0.                                                         SSC 256
      IF  (MC .NE. 0) KZ = KZ + 1                                       SSC 257
      CORR = 0.                                                         SSC 258
      CORK = 0.                                                         ASH  19
      CORL = 0.                                                         ASH  20
      IF  (L .EQ. 2) GO TO  22                                          SSC 259
      IF (MC.EQ.0) GO TO  19                                            SSC 260
      IF (NW(2).EQ.0) GO TO  18                                         SSC 261
      IF (KK.NE.NJW(LL)) GO TO  18                                      SSC 262
      NCP = 1                                                           SSC 263
      DETA = DF(LL)                                                     SSC 264
 18   CONTINUE                                                          SSC 265
C     DETERMINE CONTROL POINT LOCATIONS BY 2-D THEORY                   SSC 266
      CALL CONTRL (F,NW(1),NW(2),E,DETA,ALP,CPCWL,NCP,KZ)               SSC 267
 19   CORR = 0.                                                         SSC 268
      IF  (AM .LT. 1. ) GO TO  20                                       SSC 269
      CORR = 0.03                                                       SSC 270
 20   IF (SWEP .GT. 60.) CORK = .0035*(SWEP-60.)                        ASH  21
      IF (KK .NE. NC) GO TO 185                                         ASH  22
      AR=YL(2)*YL(2)*2./HALFSW                                          ASH  23
      IF (TR .GT. 1.) TR = 1.                                           ASH  24
      CORL = .14*(1.-TR)**3/(2.+AR)                                     ASH  25
  185 CONTINUE                                                          ASH  26
      IF (CORL .GT. CORK) CORK = CORL                                   ASH  27
       CORR= CORR + CORK                                                ASH  28
      F(KZ,1)=F(KZ,1)+CORR                                              SSC 272
      N1 = NCW - 1                                                      SSC 273
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```
      DO  21 KQ = 2,N1                                                  SSC 274
   21 F(KZ,KQ)=F(KZ,KQ)+CORR*(NCW-KQ)/FLOAT(NCW)                        SSC 275
   22 CONTINUE                                                          SSC 276
      CALL PANEL (XXL,YL,XXT,CPCWL,CPSWL,NSW,IPANEL,LPANEL,F,PERCT,SWP, SSC 277
     1 LR,ZS,SVP,KZ,L)                                                  SSC 278
      F(KZ,1)=F(KZ,1)-CORR                                              SSC 279
      DO  23 KQ = 2,N1                                                  SSC 280
   23 F(KZ,KQ)=F(KZ,KQ)-CORR*(NCW-KQ)/FLOAT(NCW)                        SSC 281
      IPANEL=LPANEL+1                                                   SSC 282
      NCS=NCS+NSW-1                                                     SSC 283
      WIDTH(KK)=YL(2)-YL(1)                                             SSC 284
      BREAK(KK)=YL(1)                                                   SSC 285
      BREAK(KK+1) = YL(2)                                               SSC 286
      IF  (KK .EQ. NJW(LL)) MJW2(L,LL)=LPANEL                           SSC 287
      IF  (IWING .NE. 0 .AND. KK .EQ. NWING) GO TO  24                  SSC 288
      IF  (KK .NE. NC) GO TO  26                                        SSC 289
   24 IF  (KK .EQ. NC .AND. IWING .NE. 0) GO TO  25                     SSC 290
      CHORDT(L)=XXT(2)-XXL(2)                                           SSC 291
      HALFB=YL(2)                                                       SSC 292
      YCN(L) = XXL(2)                                                   SSC 293
      GO TO  26                                                         SSC 294
   25 CHORDT(L+2) = XXT(2) - XXL(2)                                     SSC 295
      HALFBH = YL(2)                                                    SSC 296
      YCN(L+2) = XXL(2)                                                 SSC 297
   26 IF  (KK .EQ.  NJW(LL)) LL = LL + 1                                SSC 298
   27 CONTINUE                                                          SSC 299
      IF  (L .EQ. 2) GO TO  30                                          SSC 300
      LPAN1 = LPANEL                                                    SSC 301
      IF  (NW(2) .EQ. 0) GO TO  28                                      SSC 302
      L = 2                                                             SSC 303
      NCW = NW(2)                                                       SSC 304
      GO TO  13                                                         SSC 305
   28 DO  29 I = 1,NFP                                                  SSC 306
      MJW1(2,I) = 0                                                     SSC 307
   29 MJW2(2,I)=0                                                       SSC 308
      NCS=NCS*2                                                         SSC 309
   30 CONTINUE                                                          SSC 310
      NCS=NCS/2                                                         SSC 311
      NCW=NW(1)+NW(2)                                                   SSC 312
      IF  (NVRTX .EQ. 0) NVRTX = NCS + 1                                SSC 313
      DF(2)=0.                                                          SSC 314
      DF(3)=0.                                                          SSC 315
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      IF  (IWGLT .NE. 0) IV=0                                           SSC 316
      CAMLE1=0.                                                         SSC 317
      CAMLE2=0.                                                         SSC 318
      CAMLE3=0.                                                         SSC 319
      YTW=HALFB                                                         SSC 320
      TINC=0.                                                           SSC 321
      IALP=ALPCON                                                       SSC 322
      POS=0.                                                            SSC 323
      TWIST1 = 0.                                                       SSC 324
      ITWST = 0                                                         SSC 325
      ICAMB = 0                                                         SSC 326
      HALFSH = 0.                                                       SSC 327
C                                                                       SSC 328
C *** THE FOLLOWING DATA ARE NOT NEECED IF ALPCON = 1.                  SSC 329
C *** TWIST1 = 0. IF NO TWIST IS PRESENT                                SSC 330
C            = 1. IF THERE IS TWIST                                     SSC 331
C *** RINC = ROOT CHORD INCIDENCE                                       SSC 332
C                                                                       SSC 335
      IF  (IALP .EQ. 1) GO TO  31                                       SSC 336
      READ(5,140) TWIST1,RINC                                           ASH  29
      WRITE(6,140)TWIST1,RINC                                           ASH  30
 31   CONTINUE                                                          SSC 339
      IF  (TWIST1 .GT. 0.) ITWST = 1                                    SSC 340
      IF  (ICAM .EQ. 2) ICAMB = 1                                       SSC 341
      IF  (ITWST .EQ. 0) GO TO  34                                      SSC 342
C                                                                       SSC 343
C *** YNUM = NUMBER OF Y-COORDINATES TO BE INPUT TO DESCRIBE TWIST      SSC 344
C            DISTRIBUTION                                               SSC 345
C *** TCURV = 0. IF THE TWIST DISTRIBUTION IS GIVEN PIECEWISE LINEAR    SSC 346
C             VARIATION                                                 SSC 347
C           = 1. OTHERWISE                                              SSC 348
C                                                                       SSC 349
      READ (5, 140) YNUM,TCURV                                          SSC 350
      WRITE (6, 140) YNUM,TCURV                                         SSC 351
      NYM = YNUM                                                        SSC 352
      NTCV = TCURV                                                      SSC 353
C                                                                       SSC 354
C *** READ IN THE NONDIMENSIONAL Y-COORDINATES AT WHICH TWIST ANGLES    SSC 355
C     ARE DEFINED. LIMITED TO 21.                                       SSC 356
C *** READ IN THE CORRESPONDING TWIST ANGLES IN DEGREES. I.E. THE       SSC 357
C     DIFFERENCE IN ANGLES OF ATTACK AT Y AND ROOT CHORD.               SSC 358
C     NEGATIVE FOR WASHOUT.                                             SSC 359
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C                                                                       SSC 360
      READ (5, 140) (YTS(I), I = 1,NYM)                                 SSC 361
      READ (5, 140) (CA(I), I = 1,NYM)                                  SSC 362
      WRITE (6, 140) (YTS(I), I = 1,NYM)                                SSC 363
      WRITE (6, 140) (CA(I), I = 1,NYM)                                 SSC 364
      IF  (NTCV .EQ. 0) GO TO  32                                       SSC 365
      CALL SPLINE (NYM,YTS,CA,AY,BY,CCY,DY,1,1)                         SSC 366
      GO TO  34                                                         SSC 367
 32   DO  33 J = 2,NYM                                                  SSC 368
      AY(1,J-1) = 0.                                                    SSC 369
      BY(1,J-1) = 0.                                                    SSC 370
      CCY(1,J-1) = (CA(J) - CA(J-1))/(YTS(J) - YTS(J-1))                SSC 371
 33   DY(1,J-1) = CA(J-1)                                               SSC 372
 34   CONTINUE                                                          SSC 373
C                                                                       SSC 374
C *** IF A TAIL IS PRESENT, READ IN                                     SSC 375
C *** TINC = INCIDENCE ANGLE IN DEGREES                                 SSC 376
C *** HALFSH = HALF TAIL AREA                                           SSC 377
C *** IF THE TAIL IS TO REPRESENT THE WINGLET, PUT HALFSH = HALFSW      SSC 378
C *** IF THE WINGLET IS INBOARD OF THE WING TIP, PUT HALFSH = WINGLET   SSC 379
C     AREA                                                              SSC 380
C *** POS = THE WINGLET POSITION INDICATOR WITH RESPECT TO WING TIP     SSC 381
C     FOR DETAIL SEE INSTRUCTIONS                                       SSC 382
C *** CAMT = 0. IF THERE IS NO CAMBER                                   SSC 383
C            = 1. OTHERWISE.                                            SSC 384
C                                                                       SSC 385
      IF  (IWING .EQ. 0) GO TO  35                                      SSC 386
      READ (5, 140) TINC,HALFSH,POS,CAMT                                SSC 387
      WRITE (6, 140) TINC,HALFSH,POS,CAMT                               SSC 388
 35   CONTINUE                                                          SSC 389
      IPOS = POS                                                        SSC 390
      ICAMT = CAMT                                                      SSC 391
      IF  (IALP .EQ. 1) GO TO  39                                       SSC 392
      RINC = RINC * PI / 180.                                           SSC 393
      TINC = TINC * PI / 180.                                           SSC 394
      TINP = TINC + ALP                                                 SSC 395
      AVTW = 0.                                                         ASH  31
      DO  38 I = 1,NCS                                                  SSC 397
      IF  (IWING .NE. 0. AND. I.GT.IWING) GO TO  36                     SSC 398
      IF  (ITWST .EQ. 1) GO TO  37                                      SSC 399
      ATW = 0.                                                          SSC 400
      SNALP(I) = 0.                                                     SSC 401
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      ALPH(I) = 1.                                                       ASH  32
      GO TO  38                                                          SSC 403
36    ALPH(I) = 1.                                                       ASH  33
      SNALP(I) = 0.                                                      SSC 405
      GO TO  38                                                          SSC 406
37    YC = YLE(I)/HALFB                                                  SSC 407
      CALL TWST(YC,ATW)                                                  ASH  34
      SNALP(I) = SIN(ATW)                                                ASH  35
      ALPH(I) = COS(ATW)                                                 ASH  36
      AVTW = AVTW + ATW                                                  ASH  37
38    CONTINUE                                                           SSC 412
39    CONTINUE                                                           SSC 413
      AVTW = AVTW/NCS                                                    ASH  38
      WRITE (6, 142) HALFSW,CREF                                         SSC 414
      JWING=IWING                                                        SSC 415
      CM(50)=IV                                                          SSC 416
      WRITE (6, 146)                                                     SSC 417
      WRITE (6, 149)                                                     SSC 418
      WRITE (6, 143) (XN(I,1),XN(I,2),YN(I,1),YN(I,2),BPRIM(I,1),BPRIM(I SSC 419
     1,3),I=1,LPANEL)                                                    SSC 420
      WRITE (6, 147)                                                     SSC 421
      WRITE (6, 148)                                                     SSC 422
      WRITE (6, 143) (XCP(I),YCP(I),ZCP(I),I=1,LPANEL)                   SSC 423
      J1=LPANEL+1                                                        SSC 424
      B1 = ABS(1.-AM*AM)                                                 SSC 425
      MM = NW(1)                                                         SSC 426
      NN = NW(1)                                                         SSC 427
      IZ = 1                                                             SSC 428
      B = B1                                                             SSC 429
      IPN = 1                                                            SSC 430
      IF  (NW(2) .EQ. 0) GO TO  40                                       SSC 431
      II = 1+ NCS                                                        SSC 432
      CHORD = CH(1) + CH(II)                                             SSC 433
      GO TO  41                                                          SSC 434
40    CHORD = CH(1)                                                      SSC 435
41    CONTINUE                                                           SSC 436
      CSD = DCOS(1)                                                      SSC 437
      SSD = DSIN(1)                                                      SSC 438
      ZBDX(1) = 0.                                                       SSC 439
      ZP = 0.                                                            SSC 440
      IF (IALP.EQ.1) GO TO  43                                           SSC 441
      XC = (XCP(1)-XLE(IZ))/CHORD                                        SSC 442
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      IF  (ICAM .EQ. 3) XC = XCP(1)                                     SSC 443
      IF (ICAMB.EQ.1) GO TO  42                                         SSC 444
      YK1 = (YCP(1)-YN(1,1))/(YN(1,2)-YN(1,1))                          SSC 445
      XK1 = XN(1,1)+(XN(1,2)-XN(1,1))*YK1                               SSC 446
      XK2 = XN(1,3)+(XN(1,4)-XN(1,3))*YK1                               SSC 447
      X1 = (XK1-XLE(IZ))/CHORD                                          SSC 448
      X2 = (XK2-XLE(IZ))/CHORD                                          SSC 449
      CALL ZCR (XC,YCP(1),ZCA,ZR,ICAM,X1,X2,CHORD,ZY,0,IST)             ASH  39
      ZBDX(1) = ZR                                                      SSC 451
      GO TO  43                                                         SSC 452
42    YC = YLE(IZ)                                                      SSC 453
      XC = XCP(1)                                                       SSC 454
      CALL ZCDX (XC,YC,ZCA,ZR,ZY)                                       SSC 455
      ZBDX(1) = ZR                                                      SSC 456
43    CONTINUE                                                          SSC 457
      AVZC = ZBDX(1)                                                    ASH  40
      IJ = 2                                                            SSC 458
      NJ=LPANEL-1                                                       SSC 459
      LL=1                                                              SSC 460
44    CONTINUE                                                          SSC 461
      ZBDX(IJ) = 0.                                                     SSC 462
      IF (IALP.EQ.1) GO TO  52                                          SSC 463
      IF  (NW(2) .EQ. 0) GO TO  45                                      SSC 464
      II=IZ+NCS                                                         SSC 465
      CHORD = CH(IZ) + CH(II)                                           SSC 466
      GO TO  46                                                         SSC 467
45    CHORD=CH(IZ)                                                      SSC 468
46    CONTINUE                                                          SSC 469
      XC = (XCP(IJ) - XLE(IZ))/CHORD                                    SSC 470
      IF  (IZ .GT. JWING .AND. JWING .NE. 0 ) GO TO  51                 SSC 471
      IF  (ICAM .EQ. 3) XC = XCP(IJ)                                    SSC 472
      LCAM = 0                                                          SSC 473
      IF (ICAMB.EQ.1) GO TO  47                                         SSC 474
      YK1 = (YCP(IJ)-YN(IJ,1))/(YN(IJ,2)-YN(IJ,1))                      SSC 475
      XK1 = XN(IJ,1)+(XN(IJ,2)-XN(IJ,1))*YK1                            SSC 476
      XK2 = XN(IJ,3)+(XN(IJ,4)-XN(IJ,3))*YK1                            SSC 477
      X1 = (XK1-XLE(IZ))/CHORD                                          SSC 478
      X2 = (XK2-XLE(IZ))/CHORD                                          SSC 479
      ZR = 0.                                                           SSC 480
      CALL ZCR (XC,YCP(IJ),ZCA,ZR,ICAM,X1,X2,CHORD,ZY,0,IST)            ASH  41
      ZBDX(IJ) = ZR                                                     SSC 482
      GO TO  48                                                         SSC 483
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47    YC = YLE(IZ)                                                    SSC 484
      XC = XCP(IJ)                                                    SSC 485
      CALL ZCDX (XC,YC,ZCA,ZR,ZY)                                     SSC 486
      ZBDX(IJ) = ZR                                                   SSC 487
48    CONTINUE                                                        SSC 488
      IF  (IJ .GE. MJW1(1,LL) .AND. IJ .LE. MJW2(1,LL)) GO TO  50     SSC 489
      IF  (IJ .GE. MJW1(2,LL) .AND. IJ .LE. MJW2(2,LL)) GO TO  49     SSC 490
      GO TO  52                                                       SSC 491
49    IF (LL.EQ.NAL) GO TO  52                                        SSC 492
      ZBDX(IJ) = ZBDX(IJ)+TFLP(LL)                                    SSC 493
      GO TO  52                                                       SSC 494
50    IF  (IJ .EQ. MM) ZBDX(IJ) = ZBDX(IJ) + .5*TFLP(LL)              SSC 495
      GO TO  52                                                       SSC 496
51    IF  (ICAMT .EQ. 0) GO TO  52                                    SSC 497
      CALL ZCR (XC,YCP(IJ),ZCA,ZR,ICAM,X1,X2,CHORD,ZY,IST,IST)        ASH  42
      ZBDX(IJ) = ZR                                                   SSC 499
52    CONTINUE                                                        SSC 500
      AVZC = AVZC + ZBDX(IJ)                                          ASH  43
      IF  (IJ .GE. LPAN1 .AND. IJ .LT. LPANEL) GO TO  53              SSC 501
      IF  (IJ .EQ. MJW2(1,LL)) LL = LL + 1                            SSC 502
      GO TO  54                                                       SSC 503
53    NN = NW(2)                                                      SSC 504
      IF  (IJ .EQ. MJW2(2,LL)) LL = LL + 1                            SSC 505
54    CONTINUE                                                        SSC 506
      IF  (IJ .LT. MM) GO TO  56                                      SSC 507
      IF (IJ.LE.LPAN1) XLL(IZ) = SSD                                  SSC 508
      IF (IJ.LE.LPAN1) XTT(IZ) = CSD                                  SSC 509
      IZ=IZ+1                                                         SSC 510
      MM=MM+NN                                                        SSC 511
      IF  (IWING .NE. 0 .AND. IZ .EQ. (IWING+1)) GO TO  55            SSC 512
      IF(IZ .GT. NCS) GO TO 55                                        ASH  44
      IF  (YLE(IZ) .LT. YBREAK(IPN)) GO TO  56                        SSC 513
55    CONTINUE                                                        SSC 514
      IPN=IPN+1                                                       SSC 515
      IF  (IJ .EQ. LPAN1 .OR. IJ .EQ. LPANEL) IPN=1                   SSC 516
      CSD=DCOS(IPN)                                                   SSC 517
      SSD=DSIN(IPN)                                                   SSC 518
56    IF  (IJ .EQ. LPAN1) IZ=1                                        SSC 519
      IF  (IJ .EQ. LPAN1) LL=1                                        SSC 520
      IJ=IJ+1                                                         SSC 521
      NJ=NJ-1                                                         SSC 522
      IF  (IJ .LE. LPANEL) GO TO  44                                  SSC 523
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      ZBDY=0.                                                           SSC 524
      REWIND 02                                                         SSC 525
C     CALCULATE THE DOWNWASH AND SIDEWASH INFLUENCE MATRICES BASED ON   SSC 526
C     LOCAL PANEL COORDINATES AND STORE ON FILE (02)                    SSC 527
      CALL ADICMX (AM,XN,YN,ZN,XCP,YCP,ZCP,LPANEL,BPRIM,AW,CA,IWING,XTT, SSC 528
     1 XLL,YBREAK,IWGLT,NC,WST,VST,NW,NCS,YLE,LPAN1,IV,M1,ZBDY)         SSC 529
      KNT = 0                                                           SSC 530
      IF  (NALP.GT.1) KNT=1                                             SSC 531
      ALP = ALPI                                                        SSC 532
      AVZC = AVZC/LPANEL                                                ASH  46
      DO  138 JP = 1,NALP                                               SSC 533
      ALPHAQ = ALP                                                      SSC 534
      ALPM = 0.                                                         ASH  47
      ALAV = ALP+RINC+AVTW-ATAN(AVZC)                                   ASH  48
      SK = 1.                                                           ASH  49
      IF (ALAV .LT. 0.) SK = -1.                                        ASH  50
      IF (ISUP .EQ. 1 .AND. AM .GT. 1.) ALPM = SK*(-ABS(ALAV)-SQRT(AM*AM ASH  51
     1-1.)*.5*PMWAVE(ALAV,AM))                                          ASH  52
      ALPM = ALPM*.5                                                    ASH  53
      IF(AM.GT.1.4) ALPM=ALPM*0.9797959/SQRT(AM*AM-1.)                  ASH  54
      COSA = COS(ALP+RINC+ALPM)                                         ASH  55
      SINA = SIN(ALP+RINC+ALPM)                                         ASH  56
      COSAT = COS(ALP+TINC+ALPM)                                        ASH  57
      SINAT = SIN(ALP+TINC+ALPM)                                        ASH  58
      IF  (IALP .EQ. 0) GO TO  57                                       SSC 539
      SINA = 1.                                                         SSC 540
      COSA = 1.                                                         SSC 541
      SINAT = 1.                                                        SSC 542
      COSAT =1.                                                         SSC 543
 57   CONTINUE                                                          SSC 544
      IJP = JP                                                          SSC 545
      CALL SOLUTN (GAMMA,AW,CA,LPANEL,LPAN1,XLL,XTT,SNALP,ALPH,ZBDX,ZBDY SSC 546
     1,IALP,COSA,SINA,COSAT,SINAT,IWING,XCP,YCP,NW,IJP,KNT,DUM,DQ,IQ)   ASH  59
      CM(1)=ITWST                                                       SSC 549
      DO  58 I=1,LPANEL                                                 SSC 550
 58   CP(I)=GAMMA(I)                                                    SSC 551
C     CALCULATE EDGE SUCTION                                            SSC 552
      CTX = 0.                                                          SSC 553
      CALL GAMAX (AW,CA,LPAN1,LPANEL,CP,NC,BREAK,SWP,CHORDT,IWING,NWING, SSC 554
     1 HALFBH,YCN,CTP,CTX,IWGLT,IPOS,0,SVP,0,DZDYT,TP,CTDS)             SSC 555
      DO  59 I=1,LPANEL                                                 SSC 556
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59    GAMMA(I)=0.                                                    SSC 557
      COSA = COS(ALP+RINC)                                           ASH  60
      SINA = SIN(ALP+RINC)                                           ASH  61
      COSAT = COS(ALP+TINC)                                          ASH  62
      SINAT = SIN(ALP+TINC)                                          ASH  63
      CLPP = 0.                                                      SSC 558
      CDPP = 0.                                                      SSC 559
      CDVL = 0.                                                      SSC 560
      IPN = 1                                                        SSC 561
      ZBB = 0.                                                       SSC 562
      YB = 0.                                                        SSC 563
      YBB = 0.                                                       SSC 564
      CLT=0.                                                         SSC 565
      CMT=0.                                                         SSC 566
      CDT=0.                                                         SSC 567
      CLL=0.                                                         SSC 568
      CLW=0.                                                         SSC 569
      CMW=0.                                                         SSC 570
      CDW=0.                                                         SSC 571
      CSL = 0.                                                       SSC 572
      CSXL = 0.                                                      SSC 573
      CAV = 0.                                                       SSC 574
      KC=1                                                           SSC 575
      NCOL=M1(1)                                                     SSC 576
      KLL=0                                                          SSC 577
      MM=0                                                           SSC 578
      NCW1 = NCW+1                                                   SSC 579
      NL = 1                                                         SSC 580
      IF  (JP .NE. 1) GO TO  80                                      SSC 581
      DO  73 I = 1,NCS                                               SSC 582
      IF  (NW(2) .EQ. 0) GO TO  60                                   SSC 583
      I1 = I + NCS                                                   SSC 584
      CHORD = CH(I) + CH(I1)                                         SSC 585
      GO TO  61                                                      SSC 586
60    CHORD=CH(I)                                                    SSC 587
61    CONTINUE                                                       SSC 588
      DO  69 J = 1,NCW                                               SSC 589
      NN=J+MM                                                        SSC 590
      IF  (NW(2) .EQ. 0) GO TO  62                                   SSC 591
      IF  (J .LE. NW(1)) GO TO  62                                   SSC 592
      LL = LPAN1 - NW(1) * I + NN + NW(2) * (I - 1)                  SSC 593
      GO TO  63                                                      SSC 594
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62    LL = NN                                                         SSC 595
63    CONTINUE                                                        SSC 596
      XC = (XV(LL) - XLE(I))/CHORD                                    SSC 597
      IF  (JWING.NE. 0 .AND. I .GT. JWING) GO TO  67                  SSC 598
      IF  (IALP.EQ.1) GO TO  67                                       SSC 599
      IF  (ICAM .EQ. 3) XC = XV(LL)                                   SSC 600
      IF (ICAMB.EQ.1) GO TO  64                                       SSC 601
      YK1 = (YV(LL)-YN(LL,1))/(YN(LL,2)-YN(LL,1))                     SSC 602
      XK1 = XN(LL,1)+(XN(LL,2)-XN(LL,1))*YK1                          SSC 603
      XK2 = XN(LL,3)+(XN(LL,4)-XN(LL,3))*YK1                          SSC 604
      X1 = (XK1-XLE(I))/CHORD                                         SSC 605
      X2 = (XK2-XLE(I))/CHORD                                         SSC 606
      CALL ZCR (XC,YV(LL),ZCA,ZR,ICAM,X1,X2,CHORD,ZY,0,IST)           ASH  64
      ZBV(LL) = ZCA * CHORD                                           SSC 608
      IF  (ICAM .EQ. 3) ZBV(LL) = ZCA                                 SSC 609
      ZBDXV(LL) = ZR                                                  SSC 610
      IF  (ICAM .EQ. 3) ZBDYV(LL) = ZY                                SSC 611
      GO TO  65                                                       SSC 612
64    YC = YLE(I)                                                     SSC 613
      XC = XV(LL)                                                     SSC 614
      CALL ZCDX (XC,YC,ZCA,ZR,ZY)                                     SSC 615
      ZBV(LL) = ZCA                                                   SSC 616
      ZBDYV(LL) = ZY                                                  SSC 617
      ZBDXV(LL) = ZR                                                  SSC 618
65    IF  (LL.GE.MJW1(2,NL).AND.LL.LE.MJW2(2,NL)) GO TO  66           SSC 619
      GO TO  68                                                       SSC 620
66    IF  (NL.EQ.NAL) GO TO  68                                       SSC 621
      ZBV(LL) = ZBV(LL) + (XCP(LL) -XLE(I1)) * TFLP(NL)               SSC 622
      ZBDXV(LL) = ZBDXV(LL) + TFLP(NL)                                SSC 623
      GO TO  68                                                       SSC 624
67    ZBV(LL) = 0.                                                    SSC 625
      ZBDXV(LL) = 0.                                                  SSC 626
      IF  (ICAMT .EQ. 0) GO TO  68                                    SSC 627
      CALL ZCR (XC,YV(LL),ZCA,ZR,ICAM,X1,X2,CHORD,ZY,IST,IST)         ASH  65
      ZBDXV(LL) = ZR                                                  SSC 629
      ZBV(LL) = ZCA*CHORD                                             SSC 630
68    CONTINUE                                                        SSC 631
69    CONTINUE                                                        SSC 632
      MM = (NCW-NW(2))*I                                              SSC 633
      IF  (LL.EQ.MJW2(2,NL)) NL = NL+1                                SSC 634
      IF  (IALP .EQ. 1) GO TO  71                                     SSC 635
      XC = 0.                                                         SSC 636
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      IF  (ICAM .EQ. 3) XC = XLE(I)                                     SSC 637
      IF  (JWING.NE.0.AND.I.GT.JWING) GO TO  71                         SSC 638
      IF  (ICAMB.EQ.1) GO TO  70                                        SSC 639
      CALL ZCR (XC,YLE(I),ZCA,ZR,ICAM,0.,0.,CHORD,ZY,0,IST)             ASH  66
      X(1,I) = ZR                                                       SSC 641
      X(2,I) = ZCA * CHORD                                              SSC 642
      IF  (ICAM .EQ. 3) X(3,I) = ZY                                     SSC 643
      IF  (ICAM .EQ. 3) X(2,I) = ZCA                                    SSC 644
      GO TO  72                                                         SSC 645
 70   YC = YLE(I)                                                       SSC 646
      XC = XLE(I)                                                       SSC 647
      CALL ZCDX (XC,YC,ZCA,ZR,ZY)                                       SSC 648
      X(1,I) = ZR                                                       SSC 649
      X(2,I) = ZCA                                                      SSC 650
      X(3,I) = ZY                                                       SSC 651
      GO TO  72                                                         SSC 652
 71   X(1,I) = 0.                                                       SSC 653
      X(2,I) = 0.                                                       SSC 654
      IF  (ICAMT .EQ. 0) GO TO  72                                      SSC 655
      CALL ZCR (XC,YLE(I),ZCA,ZP,ICAM,0.,0.,CHORD,ZY,IST,IST)           ASH  67
      X(1,I) = ZR                                                       SSC 657
 72   CONTINUE                                                          SSC 658
 73   CONTINUE                                                          SSC 659
      IF  (ICAMB .EQ. 1 .OR. ICAM .EQ. 3) GO TO  78                     SSC 660
      DO  74 I = 1,NCS                                                  SSC 661
 74   X(3,I) = 0.                                                       SSC 662
      IF  (IALP.EQ.1) GO TO  78                                         SSC 663
      DO  75 I = 1,LPANEL                                               SSC 664
 75   AW(I) = -ZBDXV(I) * 2.                                            SSC 665
C     CALCULATE DZCDY AT PRESSURE POINTS.                               SSC 666
      CALL GAMAX (ZBV,ZBDYV,LPAN1,LPANEL,AW,NC,BREAK,SWP,CHORDT,IWING,  SSC 667
     1 NWING,HALFBH,YCN,CTP,CTX,IWGLT,IPOS,1,SVP,0,DZDYT,TP,CTDS)       SSC 668
      DO  76 I = 1,NCS                                                  SSC 669
      J = (I-1)*NW(1)+1                                                 SSC 670
      ZBV(J) = X(2,I)                                                   SSC 671
 76   AW(J) = -X(1,I) * 2.                                              SSC 672
C     CALCULATE DZCDY ALONG THE LEADING EDGE                            SSC 673
      CALL GAMAX (ZBV,DUM,LPAN1,LPANEL,AW,NC,BREAK,SWP,CHORDT,IWING,    SSC 674
     1 NWING,HALFBH,YCN,CTP,CTX,IWGLT,IPOS,2,SVP,0,DZDYT,TP,CTDS)       SSC 675
      DO  77 I = 1,NCS                                                  SSC 676
      J = (I-1)*NW(1)+1                                                 SSC 677
 77   X(3,I) = DUM(J)                                                   SSC 678
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   78   CONTINUE                                                        SSC 679
        DO  79 I=1,LPANEL                                               SSC 680
        ZB(I) = SQRT(1. + ZBDYV(I)**2)                                  SSC 681
   79   CONTINUE                                                        SSC 682
   80   CONTINUE                                                        SSC 683
        MM = 0                                                          SSC 684
        DO  83 I = 1,NCS                                                SSC 686
C       TO FIND L.E. SUCTION FROM L.E. THRUST, DZDY IS ASSUMED ZERO.    SSC 687
        ZDY = 0.                                                        SSC 688
        FA = SIN(SWEEP(I))/COS(SWEEP(I))                                SSC 689
        IF  (IALP .EQ. 1) GO TO  81                                     SSC 690
        CK = XTT(I)                                                     ASH  68
        IF (ABS(CK) .LE. 1.E-18) CK = 1.E-18                            ASH  69
        DZCDX=(-SNALP(I)+X(1,I)*ALPH(I))/(CK*(ALPH(I)+X(1,I)*SNALP(I))) ASH  70
        DZCDY = (XLL(I)*ALPH(I) + ZDY*CK)/(CK*ALPH(I) -ZDY*XLL(I))      ASH  71
        ZLDY = DZCDX*FA + DZCDY                                         ASH  72
        DRDY = SQRT(1. + FA*FA + ZLDY * ZLDY)                           SSC 695
        FB = DZCDX                                                      ASH  73
        F1 = SQRT(1. + FB * FB + DZCDY *DZCDY)                          SSC 700
        F2=  SQRT((DZCDY * ZLDY + 1.)**2 + (-FB + DZCDY * FA) **2)      SSC 701
        FT = F1 * DRDY / F2                                             SSC 702
        GO TO  82                                                       SSC 703
   81   FT = SQRT(1. + FA * FA)                                         SSC 704
   82   CSU(I) = CT(I) * FT                                             SSC 705
   83   CT(I) = ABS(CT(I))                                              SSC 706
        DO  102 I = 1,NCS                                               SSC 707
        IF (NW(2).EQ.0) GO TO  84                                       SSC 708
        II = I+NCS                                                      SSC 709
        CHORD = CH(I) + CH(II)                                          SSC 710
        GO TO  85                                                       SSC 711
   84   CHORD = CH(I)                                                   SSC 712
   85   CML = 0.                                                        SSC 713
        CLS(I) = 0.                                                     SSC 714
        CL(I)=0.                                                        SSC 715
        CD(I)=0.                                                        SSC 716
        CLY(I) = 0.                                                     SSC 717
        CDPPS = 0.                                                      SSC 718
        CLPPS = 0.                                                      SSC 719
        CAVS(I) = 0.                                                    SSC 720
        DO  92 J = 1, NCW                                               SSC 721
        NN = J+MM                                                       SSC 722
        IF  (NW(2).EQ.0) GO TO  86                                      SSC 723
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      IF  (J.LE.NW(1)) GO TO  86                                        SSC 724
      LL =LPAN1-NW(1)*I+NN+NW(2)*(I-1)                                  SSC 725
      IL = II                                                           SSC 726
      JLL = J-NW(1)                                                     SSC 727
      L = 2                                                             SSC 728
      FN = NW(2)                                                        SSC 729
      GO TO  87                                                         SSC 730
86    LL = NN                                                           SSC 731
      IL = I                                                            SSC 732
      JLL = J                                                           SSC 733
      L = 1                                                             SSC 734
      FN = NW(1)                                                        SSC 735
87    CONTINUE                                                          SSC 736
      IF (IALP.EQ.1) GO TO  89                                          SSC 737
      CK = XTT(I)                                                       ASH  74
      IF (ABS(CK) .LE. 1.E-18) CK = 1.E-18                              ASH  75
      DZCDX = (-SNALP(I) + ZBDXV(LL)*ALPH(I))/(CK*(ALPH(I) + ZBDXV(LL)* ASH  76
     1SNALP(I)))                                                        ASH  77
      CZY = (XLL(I)*ALPH(I)+ZBDYV(LL)*CK)/(CK*ALPH(I)-ZBDYV(LL)*XLL(I)) ASH  78
      CZYY = ZBDYV(LL)                                                  ASH  79
      CS = COSA                                                         SSC 743
      SS = SINA                                                         SSC 744
      IF  (JWING.NE.0.AND.I.GT.JWING) GO TO  88                         SSC 745
      GO TO  90                                                         SSC 746
88    CS = COSAT                                                        SSC 747
      SS = SINAT                                                        SSC 748
      GO TO  90                                                         SSC 749
89    CS = 1.                                                           SSC 750
      SS = 1.                                                           SSC 751
      IF  (ABS(XTT(I)).LE.1.E-18) CZY=1.E18                             SSC 752
      IF  (ABS(XTT(I)).GT.1.E-18) CZY=XLL(I)/XTT(I)                     SSC 753
90    IF (IALP.EQ.1) ZX=0.                                              SSC 754
      IF (IALP .NE. 1) ZX = DZCDX                                       ASH  80
      SSQ=SS*ALPH(I)+CS*SNALP(I)                                        ASH  81
      CSQ=CS*ALPH(I)-SS*SNALP(I)                                        ASH  82
      CK=(ZX*SSQ+CSQ)/SQRT(1.+ZX*ZX)                                    ASH  83

      CP(LL)=CP(LL)*CK-CA(LL)*SS*(XLL(I)+ZBDYV(LL)*XTT(I))/ZB(LL)*2.    SSC 757
      CSD=XTT(I)                                                        SSC 758
      GBS=.5*CP(LL)*SN(JLL,L)*CH(IL)/FN                                 SSC 759
      WBS = 0.                                                          SSC 760
      IF  (IALP .EQ. 1) FAC = 1./SQRT(1.+CZY*CZY)                       SSC 761
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      IF  (IALP. EQ. 1) GO TO  91                                       SSC 762
      FAC = 1./SQRT(1. + ZX*ZX + CZY*CZY)                               SSC 763
   91 CONTINUE                                                          SSC 764
      CFM=1.                                                            SSC 765
      PL=CFM*(ZX*SS+CS)*FAC                                             SSC 766
      PD=CFM*(-ZX*CS+SS)*FAC                                            SSC 767
      PM=CFM*(XV(LL)+ZBV(LL)*ZX)*FAC                                    SSC 768
      CL(I) = CL(I)+GBS*PL                                              SSC 769
      CML = CML -GBS*PM                                                 SSC 770
      CD(I)=CD(I) + GBS*PD                                              SSC 771
      CDPPS = CDPPS + GBS*CFM*(-ZX*CS + SS) * FAC                       SSC 772
      CLPPS = CLPPS + GBS*CFM*( ZX*SS + CS) * FAC                       SSC 773
      CLS(I) = CLS(I)+WBS                                               SSC 774
      CLY(I)=CLY(I)+GBS*CFM/SQRT(1.+ZX*ZX+CZYY*CZYY)                    SSC 775
   92 CONTINUE                                                          SSC 776
      IF  (IALP.EQ.1) GO TO  94                                         SSC 777
      ZX = (-SNALP(I)+X(1,I)*ALPH(I))/(ALPH(I)+X(1,I)*SNALP(I))         ASH  85
      FAA = 1./SQRT(1.+ZX*ZX)                                           SSC 780
      RR=ABS(CSU(I))*CHORD                                              SSC 781
      XC=XLE(I)+RR                                                      SSC 782
      ZXX=100.                                                          SSC 783
      XCC = XTE(I)                                                      ASH  86
      IF  (NW(2) .NE. 0) XCC = XTE(I) + XTE(I+NCS)                      SSC 785
      IF  (XC .LT. XCC) GO TO  93                                       SSC 786
      ZXX=0.                                                            ASH  87
      CZY = 0.                                                          ASH  88
      GO TO 190                                                         ASH  89
   93 CONTINUE                                                          SSC 788
      XY=(XC-XLE(I))/CHORD                                              SSC 789
      IF (ICAM .LE. 1) CALL ZCR (XY,YLE(I),ZC,ZXX,ICAM,0.,0.,CHORD,CZY,0 SSC 790
     1,IST)                                                             ASH  90
      IF (ICAM.EQ.3) CALL ZCR (XC,YLE(I),ZC,ZXX,ICAM,XLE(I),RR,CHORD,CZY SSC 792
     1,0,IST)                                                           ASH  91
      IF  (ICAM .EQ. 2) CALL ZCDX (XC,YLE(I),ZA,ZXX,CZY)                SSC 794
  190 CONTINUE                                                          ASH  92
      CK = XTT(I)                                                       ASH  93
      IF (ABS(CK) .LE. 1.E-18) CK = 1.E-18                              ASH  94
      CZY = (XLL(I)*ALPH(I)+CZY*CK)/(CK*ALPH(I)-CZY*XLL(I))             ASH  95
      CYY = CZY                                                         SSC 798
      FAC = 1./SQRT(1. + ZXX*ZXX + CYY*CYY)                             SSC 799
      GO TO  95                                                         SSC 800
   94 ZX = 0.                                                           SSC 801
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```
      ZXX = 0.
      SS = 0.
      CS = 1.
      FAA = 1.
      FAC = 1.
95    CONTINUE
      CL(I) = CL(I)*PI/CHORD+CT(I)*(SS-CS*ZX)*FAA
      CM(I)=CML*PI/(CREF*CHORD)
      CLPPS = CLPPS*PI/CHORD
      CDPPS = CDPPS*PI/CHORD
      CD(I) = CD(I)*PI/CHORD-CT(I)*(CS+SS*ZX)*FAA
      CLS(I)=CLS(I)*PI/CHORD
      CLY(I) = CLY(I)*PI/CHORD+CT(I)*(SS-CS*ZX)*FAA
      IF  (I .LT. NCOL) GO TO  96
      KLL=NCOL-1
      KC=KC+1
      NCOL=NCOL+M1(KC)-1
96    KL=I-KLL
      FM=M1(KC)
      AA=CHORD*SJ(KL,KC)*WIDTH(KC)/FM
      CT(I)=CSU(I)*CHORD
      CLT=CLT+CL(I)*AA
      CMT=CMT+CM(I)*AA
      CDT=CDT+CD(I)*AA
      CLPP = CLPP + CLPPS * AA
      CDPP = CDPP + CDPPS * AA
      IF  (I .GE. NVRTX) GO TO  97
      CDVL = CDVL + CSU(I)*(-ZXX*CS + SS)*FAC*AA
      CSL = CSL + CSU(I) * (ZXX*SS + CS) * FAC * AA
      CAVS(I) = CSU(I)*(-ZXX)*FAC
      CAV = CAV + CAVS(I)*AA
      XP = X(2,I)
      PM = XLE(I) + XP*ZXX
      CSXL = CSXL - CSU(I)*PM*FAC*AA
97    CONTINUE
      MM=(NCW-NW(2))*I
      IF  (IWING .NE. 0 .AND. I .EQ. IWING) GO TO  98
      IF  (I .EQ. NCS) GO TO  101
      IF  (YLE(I+1) .LT. YBREAK(IPN)) GO TO  101
98    ZBB = ZBB + (YBREAK(IPN) - YB) * XLL(I)
      YBB = YBB + (YBREAK(IPN) - YB) * XTT(I)
      YB = YBREAK(IPN)
```

```
      IF  (IWING .NE. 0.AND. I .EQ. IWING) GO TO  99
      GO TO  100
99    IF  (IWGLT .EQ. 1) GO TO  100
      ZBB = 0.
      YB = 0.
      YBB = 0.
      IF  (IWGLT .NE. 2) GO TO  100
      ZBB = YBREAK(NC-2) * XLL(1)
      YBB = YBREAK(NC-2) * XTT(1)
      YB = YBREAK (NC-2)
100   CONTINUE
      IPN = IPN + 1
101   CONTINUE
      IF  (LL .EQ. MJW2(2,NL)) NL = NL + 1
      IF  (IWING .EQ. 0) GO TO  102
      IF  (I .NE. JWING) GO TO  102
      CLW=CLT
      CMW=CMT
      CDW=CDT
102   CONTINUE
      IF  (IALP.EQ.1) XLEBAR=CSXL/CSL
      CLT=CLT*PI/(2.*HALFSW)
      CMT=CMT*PI/(2.*HALFSW)
      CDT=CDT*PI/(2.*HALFSW)
      CLW=CLW*PI/(2.*HALFSW)
      CMW=CMW*PI/(2.*HALFSW)
      CDW=CDW*PI/(2.*HALFSW)
      CLPP = CLPP * PI / (2.* HALFSW)
      CDPP = CDPP * PI / (2. * HALFSW)
      CDVL = CDVL * PI / (2. * HALFSW)
      CAV = CAV*PI/(2.*HALFSW)
      IPS1 = IPOS/10
      IW = 1
      IF  (IWING.NE.0) IW=2
      CDVS = 0.
      CLVS = 0.
      CMVS = 0.
      DO  113 K = 1,IW
      IPZ = 1
      CDVSS = 0.
      CLVSS = 0.
      CMVSS = 0.
```

```
      IF  (K.EQ.2) IPZ = 3                                              SSC 886
      IF  (CHORDT(IPZ).LE..001) GO TO  113                              SSC 887
      ISN = 1                                                           SSC 888
      FN = NW(1)                                                        SSC 889
      CHD = CHORDT(IPZ)                                                 SSC 890
      CHORD = CHD + CHORDT(IPZ+1)                                       SSC 891
      YQ = HALFB                                                        SSC 892
      DO  112 I = 1,NCW                                                 SSC 893
      J = I                                                             SSC 894
      X1 = YCN(IPZ)                                                     SSC 895
      IF  (K.EQ.2) GO TO  103                                           SSC 896
      IF  (IPS1.EQ.2.AND.I.GT.NW(1)) GO TO  112                         SSC 897
      IF  (IPS1.EQ.1) GO TO  112                                        SSC 898
103   CONTINUE                                                          SSC 899
      IF  (I.LE.NW(1)) GO TO  104                                       SSC 900
      ISN = 2                                                           SSC 901
      FN = NW(2)                                                        SSC 902
      J = I-NW(1)                                                       SSC 903
      X1 = YCN(IPZ+1)                                                   SSC 904
      CHD = CHORDT(IPZ+1)                                               SSC 905
104   FJ = J                                                            SSC 906
      XM = X1+.5*CHD*(1.-COS((2.*FJ-1.)*PI/(2.*FN)))                    SSC 907
      IK = NCS                                                          SSC 908
      IF  (K.EQ.1.AND.IWING.NE.0) IK = IWING                            SSC 909
      IF  (IALP.EQ.1) GO TO  109                                        SSC 910
      XC = (XM-X1)/CHORD                                                SSC 911
      IF  (K.EQ.2) GO TO  108                                           SSC 912
      IF  (ICAM .EQ. 3) XC = XM                                         SSC 913
      IF  (ICAMB.EQ.1) GO TO  105                                       SSC 914
      YC = .999*HALFB                                                   SSC 915
      CALL ZCR (XC,YC,ZCA,ZR,ICAM,0.,0.,CHD,ZY,0,IST)                   ASH  96
      DZX = ZR                                                          SSC 917
      GO TO  106                                                        SSC 918
105   YC = HALFB                                                        SSC 919
      XC = XM                                                           SSC 920
      CALL ZCDX (XC,YC,ZCA,ZR,ZY)                                       SSC 921
      DZX = ZR                                                          SSC 922
      DZY = ZY                                                          SSC 923
      GO TO  107                                                        SSC 924
106   DZY = -DZX*TP(I,K)+DZDYT(I,K)                                     SSC 925
107   CONTINUE                                                          SSC 926
      CK = XTT(IK)                                                      ASH  97
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```
      IF (ABS(CK) .LE. 1.E-18) CK = 1.E-18                              ASH   98
      ZX = (-SNALP(IK) + DZX*ALPH(IK))/(CK*(ALPH(IK)+DZX*SNALP(IK)))    ASH   99
      CZY = XLL(IK)*ALPH(IK)                                            ASH  100
      CS = COSA                                                         SSC  932
      SS = SINA                                                         SSC  933
      GO TO  111                                                        SSC  934
  108 ZX = -SNALP(IK)                                                   SSC  935
      CS = COSAT                                                        SSC  936
      SS = SINAT                                                        SSC  937
      IF  (ICAMT .EQ. 0) GO TO  110                                     SSC  938
      YC = .999*HALFBH                                                  SSC  939
      CALL ZCP (XC,YC,ZCA,DZX,ICAM,0.,0.,CHD,ZY,IST,IST)                ASH  101
      ZX = (-SNALP(IK)+DZX*ALPH(IK))/(CK*(ALPH(IK)+DZX*SNALP(IK)))      ASH  102
      GO TO  110                                                        SSC  942
  109 ZX = 0.                                                           SSC  943
      CS = 1.                                                           SSC  944
      SS = 1.                                                           SSC  945
  110 CONTINUE                                                          SSC  946
      IF  (ABS(XTT(IK)).LE.1.E-18) CZY=XLL(IK)*1.E18                    SSC  947
      IF  (ABS(XTT(IK)).GT.1.E-18) CZY=XLL(IK)/XTT(IK)                  SSC  948
  111 FAC = 1./SQRT(1.+ZX*ZX+CZY*CZY)                                   SSC  949
      CLVSS = CLVSS+CTDS(I,K)*(ZX*SS+CS)*FAC*SN(J,ISN)*CHD*CHORD/FN     SSC  950
      CDVSS = CDVSS+CTDS(I,K)*(-ZX*CS+SS)*FAC*SN(J,ISN)*CHD*CHORD/FN    SSC  951
      CMVSS = CMVSS-XM*CTDS(I,K)*FAC*SN(J,ISN)*CHD*CHORD/FN             SSC  952
  112 CONTINUE                                                          SSC  953
      CLVS = CLVS+CLVSS                                                 SSC  954
      CDVS = CDVS+CDVSS                                                 SSC  955
      CMVS = CMVS+CMVSS                                                 SSC  956
  113 CONTINUE                                                          SSC  957
      CLVS = CLVS*PI/(2.*HALFSW)                                        SSC  958
      CDVS = CDVS*PI/(2.*HALFSW)                                        SSC  959
      CMVS = CMVS*PI/(2.*HALFSW*CREF)                                   SSC  960
      CTIP = CLVS                                                       SSC  961
      IF  (IALP.EQ.1.AND.CLVS.GT..001) CTX=CMVS/CLVS*CREF               SSC  962
      CDCL2=0.                                                          SSC  963
      CSXL = CSXL*PI/(2.*HALFSW*CREF)                                   SSC  964
      CSL = CSL*PI/(2.*HALFSW)                                          SSC  965
      IF  (IALP.EQ.1) XBP = CMT/CLT*CREF                                SSC  966
      IF  (ABS(CLT) .LE. 0.001) GO TO  114                              SSC  967
      CDCL2=CDT/(CLT*CLT)                                               SSC  968
  114 CONTINUE                                                          SSC  969
      IF  (LAT .NE. 0) GO TO  116                                       SSC  970
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C     CALCULATE BENDING MOMENT DISTRIBUTION
      CALL BENDIN (NC,CLY,BMR,IWING,BREAK,CBMR,CBTR,NWING,HALFSH,HALFBH,
     1DCOS,DSIN,IWGLT)
      CBML=CBMR
      CBTL = CBTR
      DO  115 I=1,NCS
  115 BML(I)=BMR(I)
      GO TO  119
  116 DO  117 I=1,NCS
  117 YCON(I)=CLY(I)+CLS(I)
      CALL BENDIN (NC,YCON,BMR,IWING,BREAK,CBMR,CBTR,NWING,HALFSH,HALFBH
     1,DCOS,DSIN,IWGLT)
      DO  118 I=1,NCS
  118 YCON(I)=CLY(I)-CLS(I)
      CALL BENDIN (NC,YCON,BML,IWING,BREAK,CBML,CBTL,NWING,HALFSH,HALFBH
     1,DCOS,DSIN,IWGLT)
  119 CONTINUE
      IF  (IPT .EQ. 0) GO TO  130
      WRITE (6, 144)
      WRITE (6, 151)
      WRITE (6, 144)
      ALP=ALP*180./PI
      WRITE (6, 152)
      IF  (IALP .NE. 1) WRITE (6, 153) ALP
      IF  (IALP .EQ. 1) WRITE (6, 154)
      WRITE (6, 152)
      IF  (LAT .EQ. 0) WRITE (6, 155)
      IF  (LAT .NE. 0) WRITE (6, 156)
      K1=0
      JJ1=0
      HAB=HALFB
      IF  (IWGLT .EQ. 1) IWING = NCS
      DO  126 I=1,NCS
      IF  (I .GT. IWING .AND. IWING .NE. 0) HAB=HALFBH
      IF  (I .GT. IWING .AND. IWGLT .EQ. 2) HAB=HALFB
      IF  (NW(2) .EQ. 0) GO TO  120
      I1=I+NCS
      CHORD=CH(I)+CH(I1)
      GO TO  121
  120 CHORD=CH(I)
  121 CONTINUE
      DO  125 J=1,NCW
```

```
      JJ=JJ1+J
      KK=K1+J
      IF  (NW(2) .EQ. 0) GO TO  122
      IF  (J .LE. NW(1)) GO TO  122
      LL=LPAN1-NW(1)*I+JJ+NW(2)*(I-1)
      GO TO  123
  122 LL=JJ
  123 CONTINUE
      XI=(XV(LL)-XLE(I))/CHORD
      ETA=YV(LL)/HAB
      IF  (LAT .EQ. 0) GO TO  124
      CPR=CP(LL)+GAMMA(LL)
      CPL=CP(LL)-GAMMA(LL)
      WRITE (6, 157) KK,XI,ETA,CPL,CPR
      GO TO  125
  124 WRITE (6, 157) KK,XI,ETA,CP(LL)
  125 CONTINUE
      JJ1=(NCW-NW(2))*I
      K1=K1+NCW
  126 CONTINUE
      WRITE (6, 158)
      HAB=HALFB
      DO  129 I=1,NCS
      IF  (IWGLT .EQ. 0) GO TO  127
      IF  (I .EQ. (JWING+1)) WRITE (6, 160)
      GO TO  128
  127 CONTINUE
      IF  (JWING .NE. 0 .AND. I .EQ. (JWING+1)) WRITE (6, 159)
  128 CONTINUE
      IF  (IWING .NE. 0 .AND. I .GT. IWING) HAB=HALFBH
      IF  (I .GT. IWING .AND. IWGLT .EQ. 2) HAB=HALFB
      YE=YLE(I)/HAB
      CLPT=CL(I)+CLS(I)
      CLLT=CL(I)-CLS(I)
  129 WRITE (6,161) YE,CLPT,CLLT,CM(I),CD(I),CT(I),CAVS(I)
      WRITE (6, 162) CLT
      WRITE (6, 163) CDT
      WRITE (6, 164) CDCL2
      WRITE (6, 165) CMT
  130 CONTINUE
      IF  (IALP .EQ. 0) GO TO  131
      WRITE (6, 144)
```

```
      WRITE (6, 168)
      WRITE (6, 166) CLT,CSL,CTIP
      WRITE (6, 167) XBP,XLEBAR,CTX
      WRITE (6, 144)
  131 CONTINUE
      IF (IPT.EQ.0) GO TO  133
      IF  (IWING .NE. 0) GO TO  132
      IF  (ABS(CLT) .LE. 0.001) GO TO  133
      IF  (IDIH .NE. 0) GO TO  133
C     CALCULATE FAR-FIELD DRAG IN SUBSONIC PLANAR FLOW
      IF (AM.LT.1.) CALL DRAG (CLT,YBREAK,NC,TFLP,NAL)
      GO TO  133
  132 WRITE (6, 169) CLW
      WRITE (6, 170) CDW
      WRITE (6, 171) CMW
      CLTLW=CLT-CLW
      CLTLH=CLTLW*HALFSW/HALFSH
      CMTAIL=CMT-CMW
      WRITE (6, 172) CLTLW,CLTLH
      WRITE (6, 173)
      WRITE (6, 174) CMTAIL
      WRITE (6, 175)
  133 CONTINUE
      HW=2.*HALFSW
      HSH=2.*HALFSH
      WRITE (6, 176) HW,HALFB
      HAB=HALFB
      IF  (IPT .EQ. 0) GO TO  137
      WRITE (6, 177)
      DO  136 I=1,NCS
      IF  (IWGLT .EQ. 0) GO TO  134
      IF  (I .EQ. (JWING+1)) WRITE (6, 179) HW,HALFB
      GO TO  135
  134 CONTINUE
      IF  (JWING .NE. 0 .AND. I .EQ. (JWING+1)) WRITE (6, 178) HSH,HALFB
     1H
  135 CONTINUE
      IF  (JWING .NE. 0 .AND. I .EQ. (JWING+1)) WRITE (6, 180)
      IF  (IWING .NE. 0 .AND. I .GT. IWING) HAB = HALFBH
      IF  (I .GT. IWING .AND. IWGLT .EQ. 2) HAB = HALFB
      YE = YLE(I) / HAB
  136 WRITE (6, 161) YE,BMR(I),BML(I)
```

```
 137  CONTINUE
      WRITE (6, 180)
      WRITE (6, 181) CBMR,CBML
      IF  (IWGLT .EQ. 2) WRITE (6, 182)
      WRITE (6, 180)
      IF  (IWING .NE. 0 .AND. IWGLT . NE. 1) WRITE (6, 183) CBTR,CBTL
      IF  (IWGLT .EQ. 1) WRITE (6, 184) CBTR,CBTL
      X(4,JP) = ALPHAQ * 180. / PI
      X(5,JP) = CLT
      X(6,JP) = CDT
      X(7,JP) = CMT
      X(8,JP) = CBMR
      Y(1,JP) = CLPP
      Y(2,JP) = CSL
      Y(3,JP) = CLVS
      Y(4,JP) = CDPP
      Y(5,JP) = CDVL
      Y(6,JP) = CDVS
      Y(7,JP) = CMT
      Y(8,JP) = CSXL
      Y(9,JP) = CMVS
      Y(10,JP) = CAV
      ALP = ALPHAQ + ALPIN
      IWING = JWING
 138  CONTINUE
      IF  (IALP .EQ. 1) GO TO  1
      CALL OUPT (X,Y,NALP)
      GO TO  1
 139  STOP
C
 140  FORMAT (8F10.6)
 141  FORMAT (8(6X,I4))
 142  FORMAT (10X,8HHALF SW=,E12.5,10X,5HCREF=,E12.5)
 143  FORMAT (6F10.5)
 144  FORMAT (1H0,40H****************************************)
 145  FORMAT (1H0,10HINPUT DATA)
 146  FORMAT (1H0,44HPANEL ENDPOINT COORDINATES AND EDGE SLOPES = )
 147  FORMAT (1H0,26HCONTROL POINT COORDINATES=)
 148  FORMAT (/4X,3HXCP,7X,3HYCP,7X,3HZCP,7X,3HXCP,7X,3HYCP,7X,3HZCP)
 149  FORMAT (/4X,2HX1,8X,2HX2,8X,2HY1,8X,2HY2,8X,2HBP,6X,2HBP)
 150  FORMAT (13A6)
 151  FORMAT (/6X,31HATTACHED POTENTIAL FLOW RESULTS )
```

```
152  FORMAT (/20X,42HXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX)
153  FORMAT (/20X,32HPRESSURE DISTRIBUTION AT ALPHA =,F8.3,2X,4HDEG.)
154  FORMAT (/20X,43HPRESSURE DISTRIBUTION AT ALPHA = 1.0 RADIAN)
155  FORMAT (/3X,6HVORTEX,14X,2HXV,17X,2HYV,19X,2HCP)
156  FORMAT (/3X,6HVORTEX,14X,2HXV,17X,2HYV,17X,8HCP(LEFT),12X, 9HCP(RI
    1GHT))
157  FORMAT (6X,I3,4(10X,F10.5))
158  FORMAT(/9X,3HY/S,11X,9HCL(RIGHT),6X,8HCL(LEFT),10X,2HCM,12X,3HCDI,
    112X,4HCS*C,11X,3HCAV)
159  FORMAT (/4X,42HTHE FOLLOWING ARE THE TAIL CHARACTERISTICS)
160  FORMAT (/4X,45HTHE FOLLOWING ARE THE WINGLFT CHARACTERISTICS)
161  FORMAT (8(5X,F10.5))
162  FORMAT (/2X,24HTOTAL LIFT COEFFICIENT =,F10.5)
163  FORMAT (/2X,32HTOTAL INDUCED DRAG COEFFICIENT =,F10.5)
164  FORMAT (/2X,28HTHE INDUCED DRAG PARAMETER =,F10.5)
165  FORMAT (/2X,35HTOTAL PITCHING MOMENT COEFFICIENT =,F10.5)
166  FORMAT (/2X,4HKP =,F10.5,3X,6HKVLE =,F10.5,3X,6HKVSE =,F10.5)
167  FORMAT (/2X,5HXBP =,F10.5,3X,6HXBLE =,F10.5,3X,6HXBSE =,F10.5)
168  FORMAT (/66HTHE FOLLOWING PARAMETERS ARE USED IN THE METHOD OF SUC
    1TION ANALOGY)
169  FORMAT (/5X,27HTHE WING LIFT COEFFICIENT =,F10.5)
170  FORMAT (/5X,35HTHE WING INDUCED DRAG COEFFICIENT =,F10.5)
171  FORMAT (/5X,38HTHE WING PITCHING MOMENT COEFFICIENT =,F10.5)
172  FORMAT (/5X,27HTHE TAIL LIFT COEFFICIENT =,F10.5,21H(BASED ON WING
    1 AREA),,2X,1H=,F10.5,20H(BASED ON TAIL AREA))
173  FORMAT (/5X,65HTHE TAIL PITCHING MOMENT COEFFICIENT BASED ON REFER
    1ENCE WING AREA)
174  FORMAT (/10X,49HAND MEAN WING CHORD, AND REFERRED TO THE Y-AXIS =,
    1 F10.5)
175  FORMAT (/5X,68H(NOTE. THE INDUCED DRAG COMPUTATION IS FOR SYMMETRI
    1CAL LOADING ONLY))
176  FORMAT (//2X,63HTHE FOLLOWING BENDING MOMENT COEFFICIENT IS BASED
    1ON Q*S*(B/2),,/15X,9HWHERE S =,F10.5,2X,9HAND B/2 =,F10.5)
177  FORMAT (/9X,3HY/S,11X,9HBM(RIGHT),6X,8HBM(LEFT))
178  FORMAT (/4X,66HTHE FOLLOWING ARE THE TAIL CHARACTERISTICS BASED ON
    1 TAIL GEOMETRY,,/10X,9HWHERE S =,F10.5,2X,9HAND B/2 =,F10.5)
179  FORMAT (/4X,68HTHE FOLLOWING ARE THE WINGLET CHARACTERISTICS BASED
    1 ON WING GEOMETRY,/10X,9HWHERE S =,F10.5,2X,9HAND B/2 =,F10.5)
180  FORMAT (1H0)
181  FORMAT (2X,68HTHE BENDING MOMENT COEFFICIENT BASED ON WING HALF SP
    1AN AND WING AREA, /15X,18HAT THE WING ROOT =,F10.6,2X,8H(RIGHT),,
    22X,1H=,F10.6,2X,6H(LEFT))
182  FORMAT (/2X,65H(NOTE. EFFECT OF WINGLET ON WING-ROOT BENDING MOMEN
    1T HAS NOT BEEN/8X,22HINCLUDED IN THE ABOVE))
183  FORMAT (2X,68HTHE BENDING MOMENT COEFFICIENT BASED ON TAIL HALF SP
    1AN AND TAIL AREA,/15X,18HAT THE TAIL ROOT =,F10.6,2X,8H(RIGHT),,
    22X,1H=,F10.6,2X,6H(LEFT))
184  FORMAT (2X,68HTHE BENDING MOMENT COEFFICIENT BASED ON WING HALF SP
    1AN AND WING AREA/10X,21HAT THE WINGLET ROOT =,F10.6,2X,8H(RIGHT),,
    2 2X,1H=,F10.6,2X,6H(LEFT))
     END
```

```
      FUNCTION PMWAVE(ALP,AM)
      SIX = 2.4494897
      AM2 = SQRT(AM*AM-1.)
      BETAI = ATAN(1./AM2)
      TANBI = SIN(BETAI)/COS(BETAI)
      ATB = ATAN(SIX*TANBI)
      BETA = BETAI - ABS(ALP)
      N = 1
   10 TANB = SIN(BETA)/COS(BETA)
      F = -ABS(ALP)+BETA-BETAI-SIX*(ATAN(SIX*TANB)-ATB)
      FP = -5./(1.+6.*TANB*TANB)
      BET = BETA -F/FP
      IF (N .GE. 10) GO TO 20
      IF (ABS(BET-BETA) .LE. 1.E-4) GO TO 20
      N = N + 1
      BETA = BET
      GO TO 10
   20 SB = SIN(BET)**2/(1.4-COS(2.*BET))
      SBI = SIN(BETAI)**2/(1.4-COS(2.*BETAI))
      PMWAVE = 2./(1.4*AM*AM)*((SB/SBI)**3.5-1.)
      RETURN
      END
```

```
      SUBROUTINE CONTRL (F,N1,N2,E,DETA,ALP,XK,NCON,KZ)                 CON   2
      DIMENSION F(5,20), XK(1), XI(20), CPN(20), CPX(20), CP(20), C(20), CON   3
     1 XJ(20)                                                           CON   4
      DIMENSION A(20,20), B(20,20), S(20), D(20)                        CON   5
      DIMENSION KARRAY(7)                                               ASH 125
      PI = 3.14159265                                                   CON   6
C     SETDIM IS TO SET UP APRAY TABLES FOR MATRIX INVERSION, AND MAY NOT CON   7
C     BE NEEDED IN OTHEP COMPUTER SYSTEMS                               CON   8
      LC = 5                                                            CON  10
      SINA = SIN (ALP)                                                  CON  11
      IF (N2.NE.0) LC = 6                                               CON  12
      N = N1+N2                                                         CON  13
      IF (N2.NE.0) GO TO  3                                             CON  14
      DO   1 I = 1,N                                                    CON  15
      F(KZ,I) = .95                                                     CON  16
 1    XJ(I)=XK(I)/100.                                                  CON  17
      XJ(N+1)=1.                                                        CON  18
      DO  2 I=1,N                                                       CON  19
      XP= 0.5*(1.-COS((2.*I-1.)*PI/(2.*N)))                             CON  20
 2    CPN(I)=4.*SQRT((1.-XP)/XP)                                        CON  21
      GO TO  8                                                          CON  22
3     TAU=ACOS(2.*E-1.)                                                 ASH 126
      DO  4 I= 1,N                                                      CON  24
 4    F(KZ,I) = .95                                                     CON  25
      XF = 0.                                                           CON  26
      E1 = E                                                            CON  27
      NW = N1                                                           CON  28
      IN = 1                                                            CON  29
      JJ = 0                                                            CON  30
 5    CONTINUE                                                          CON  31
      DO  7 I = 1,NW                                                    CON  32
      J1 = I+JJ                                                         CON  33
      XJ(J1) = XE + 0.5*(1.-COS((I-1.)*PI/NW))*E1                       CON  34
      XP = XE+0.5*(1.-COS((2.*I-1.)*PI/(2.*NW)))*E1                     CON  35
      IF (NCON.EQ.0) GO TO  6                                           CON  36
      PHI=ACOS(2.*XP-1.)                                                ASH 127
      CPN(J1) =4.*DETA/PI*(TAU*SQRT((1.-XP)/XP)+ALOG(ABS(SIN((PHI+TAU)/2 CON  38
     1.))/ABS(SIN((PHI-TAU)/2.))))+4.*SINA*SQRT((1.-XP)/XP)             CON  39
      GO TO  7                                                          CON  40
 6    CPN(J1) = 4. * SQRT((1. - XP) / XP)                               CON  41
 7    CONTINUE                                                          CON  42
      IF  (IN.EQ.2) GO TO  8                                            CON  43
```

```
      IN = IN+1                                                        CON  44
      JJ = NW                                                          CON  45
      NW = N2                                                          CON  46
      XE = E                                                           CON  47
      E1 = 1.-E                                                        CON  48
      GO TO  5                                                         CON  49
  8   XJ(N+1) = 1.                                                     CON  50
      L = 1                                                            CON  51
  9   CONTINUE                                                         CON  52
      DO  10 J = 1,N                                                   CON  53
 10   XI(J) = XJ(J) + F(KZ,J) * (XJ(J+1) - XJ(J))                      CON  54
      DO  11 I = 1,N                                                   CON  55
      DO  11 J=1,N                                                     CON  56
      R = ABS((XJ(J)-XI(I))/(XJ(J+1)-XI(I)))                           CON  57
      B(I,J) = ALOG(R)                                                 CON  58
 11   CONTINUE                                                         CON  59
C     HEMINV IS A MATRIX INVERSION ROUTINE.  B IS THE MATRIX TO BE     CON  60
C     INVERTED, N IS THE MATRIX SIZE, AND D IS A WORKING ARRAY.  THE   CON  61
C     INVERTED MATRIX IS RETURNED IN B.                                CON  62
      KARRAY(1) = 10                                                   ASH 128
      KARRAY(2) = N                                                    ASH 129
      KARRAY(3) = N                                                    ASH 130
      KARRAY(4) = 0                                                    ASH 131
      KARRAY(5) = 20                                                   ASH 132
      KARRAY(6) = 0                                                    ASH 133
      KARRAY(7) = 0                                                    ASH 134
      CALL MATOPS(KARRAY,B,J,JEL)                                      ASH 135
      DO  13 I=1,N                                                     CON  64
      CP(I) = 0.                                                       CON  65
      DO  13 J=1,N                                                     CON  66
      IF (NCON.NE.0) GO TO  12                                         CON  67
      W = 4.*PI                                                        CON  68
      GO TO  13                                                        CON  69
 12   W = SINA * 4. * PI                                               CON  70
      IF (J.EQ.N1) W=W+2.*PI*DETA                                      CON  71
      IF  (J .GT. N1) W = 4. * PI * (DETA + SINA)                      CON  72
 13   CP(I) = CP(I)+B(I,J)*W                                           CON  73
      SUM = 0.                                                         CON  74
      DO  14 I=1,N                                                     CON  75
 14   SUM = SUM + (CPN(I)-CP(I))*(CPN(I)-CP(I))                        CON  76
      S(L) = SQRT(SUM)                                                 CON  77
      IF  (L. EQ . 1) GO TO  15                                        CON  78
```

```
      IF (S(L).GE.S(L-1)) GO TO  21                                     CON  79
15    CONTINUE                                                          CON  80
      DO  16 I=1,N                                                      CON  81
      CPX(I) = 0.                                                       CON  82
      DO  16 K = 1,N                                                    CON  83
16    CPX(I) = CPX(I) + CP(K)*(1./(XJ(K)-XI(I))-1./(XJ(K+1)-XI(I)) )    CON  84
      DO  18 I = 1,N                                                    CON  85
      DO  17 J = 1,N                                                    CON  86
      A(J,I) = 0.                                                       CON  87
      DO  17 K =1,N                                                     CON  88
      W = 0.                                                            CON  89
      IF  (K.EQ.I) W = CPX(I)                                           CON  90
17    A(J,I) = A(J,I)+B(J,K)*W                                          CON  91
18    CONTINUE                                                          CON  92
      CALL MATOPS(KARRAY,A,J,JEL)                                       ASH 136
      DO  19 I = 1,N                                                    CON  94
      C(I) = 0.                                                         CON  95
      DO  19 K = 1,N                                                    CON  96
19    C(I)=C(I)+A(I,K)*(CPN(K)-CP(K))                                   CON  97
      DO  20 I = 1,N                                                    CON  98
      XI(I) = XI(I)+C(I)                                                CON  99
      F(KZ,I) = -(XI(I)-XJ(I))/(XJ(I+1)-XJ(I))                          CON 100
      IF  (F(KZ,I) .GT. 1.) F(KZ,I) = .95                               CON 101
      IF  (F(KZ,I) .LT. 0.) F(KZ,I) = .85                               CON 102
20    CONTINUE                                                          CON 103
      L = L + 1                                                         CON 104
      IF  (L.LE.LC) GO TO  9                                            CON 105
21    RETURN                                                            CON 106
      END                                                               CON 107
```

```
      SUBROUTINE SOLUTN (GAMMA,AW,CA,LPANEL,LPAN1,SSD,CSD,TA,ALPH,ZBDX,    SOL   2
     1ZBDY,IALP,COSA,SINA,COSAT,SINAT,IWING,XCP,YCP,NW,JP,KNT,DUM,DQ,IQ)  ASH 137
      DIMENSION GAMMA(1), AW(1), CA(1), SSD(1), CSD(1), TA(1), ALPH(1),    SOL   5
     1ZBDX(1), XCP(1), YCP(1), NW(1), BW(200)                             SOL   6
      DIMENSION DUM(1), DQ(IQ,IQ)                                          SOL   7
      DIMENSION KAPPAY(7)                                                  ASH 138
      REWIND 03                                                            SOL   8
      REWIND 02                                                            SOL   9
      IZ = 1                                                               SOL  11
      L1 = LPANEL + 1                                                      SOL  12
      NCW=NW(1)+NW(2)                                                      SOL  13
      MM=NCW                                                               SOL  14
      NN=NCW                                                               SOL  15
      NJ=LPANEL                                                            SOL  16
      DO  13 NI=1,LPANEL                                                   SOL  17
      IA=NI-MM+NCW                                                         SOL  18
      IF (IA.GT.NW(1)) GO TO  1                                            SOL  19
      I=NI-NW(2)*(IZ-1)                                                    SOL  20
      GO TO  2                                                             SOL  21
    1 I=NI+LPAN1-NW(1)*IZ                                                  SOL  22
    2 CONTINUE                                                             SOL  23
      CSX = CSD(IZ)                                                        SOL  24
      CZY = SSD(IZ)                                                        SOL  25
      IF  (KNT .EQ. 1 .AND. JP .NE. 1) GO TO  4                            SOL  26
      READ (02) (AW(K),K=1,LPANEL)                                         SOL  27
      READ (02) (BW(K),K=1,LPANEL)                                         SOL  28
      M1 =NCW                                                              SOL  29
      N1=NCW                                                               SOL  30
      IP=1                                                                 SOL  31
      DO  3 K=1,LPANEL                                                     SOL  32
      CD= CSD(IP)                                                          SOL  33
      SD = SSD(IP)                                                         SOL  34
      DWASH = AW(K)*CD + BW(K)*SD                                          SOL  35
      SWASH = -AW(K)*SD + BW(K)*CD                                         SOL  36
      AW(K) = CSX*DWASH - SWASH*CZY                                        SOL  37
      IF  (K .LT. M1) GO TO  3                                             SOL  38
      M1 = M1 + N1                                                         SOL  39
      IP = IP + 1                                                          SOL  40
    3 CONTINUE                                                             SOL  41
    4 CONTINUE                                                             SOL  42
      IF  (IALP.EQ.1) GO TO  6                                             SOL  43
      FAC = 1.                                                             SOL  44
```

```
      CS = COSA                                                         SOL  45
      SS = SINA                                                         SOL  46
      IF  (IWING.NE.0.AND.IZ.GT.IWING) GO TO  5                         SOL  47
      GO TO  7                                                          SOL  48
 5    CS = COSAT                                                        SOL  49
      SS = SINAT                                                        SOL  50
      GO TO  7                                                          SOL  51
 6    CS = 0.                                                           SOL  52
      SS = 1.                                                           SOL  53
      FAC = 1.                                                          SOL  54
      CDZDX = 0.                                                        ASH 139
      GO TO 22                                                          ASH 140
 7    CDZDX = (-TA(IZ)+ZBDX(I)*ALPH(IZ))/(ALPH(IZ)+ZBDX(I)*TA(IZ))      ASH 141
 22   CONTINUE                                                          ASH 142
      AW(L1) = (-CDZDX*CS + CSX*SS)*2.                                  ASH 143
      DUM(NI)=AW(L1)                                                    SOL  56
      IF  (KNT .EQ. 0) GO TO  9                                         SOL  57
      IF  (JP .NE. 1) GO TO  12                                         SOL  58
      DO  8 K = 1,LPANEL                                                SOL  59
 8    DQ(NI,K)=AW(K)                                                    SOL  60
      GO TO  12                                                         SOL  61
 9    CONTINUE                                                          SOL  62
      IF (NI.EQ.1) GO TO  10                                            SOL  63
      IK=NI                                                             SOL  64
C                                                                       SOL  65
C     VMSEQN IS A SURROUTINE TO SOLVE SIMUTANEOUS EQUATIONS BY VECTOR   SOL  66
C     METHOD. WHILE THE MATRIX IS NOT INVERTED.                         SOL  67
C                                                                       SOL  68
      CALL VMSEQN (NJ,IK,AW,GAMMA,CA)                                   SOL  69
      GO TO  12                                                         SOL  70
 10   DO  11 K = 1,LPANEL                                               SOL  71
 11   GAMMA(K) = -AW(K+1)/AW(1)                                         SOL  72
 12   NJ = NJ-1                                                         SOL  73
      IF (NI.LT.MM) GO TO  13                                           SOL  74
      MM = MM+NN                                                        SOL  75
      IZ = IZ + 1                                                       SOL  76
 13   CONTINUE                                                          SOL  77
      IF  (KNT .EQ. 0) GO TO  17                                        SOL  78
      IF  (JP .NE. 1) GO TO  15                                         SOL  79
      IJQ = IQ                                                          SOL  80
      KARRAY(1)=10                                                      ASH 144
      KARRAY(2)=LPANEL                                                  ASH 145
```

```
      KARRAY(3)=LPANEL                                                  ASH 146
      KARRAY(4)=0                                                       ASH 147
      KARRAY(5)=IJQ                                                     ASH 148
      KARRAY(6)=0                                                       ASH 149
      KARRAY(7)=0                                                       ASH 150
      CALL MATOPS(KARRAY,DQ,J,JEL)                                      ASH 151
      DO  14 I = 1,LPANEL                                               SOL  83
   14 WRITE (03) (DQ(I,K),K=1,LPANEL)                                   SOL  84
   15 REWIND 03                                                         SOL  85
      DO  16 I = 1,LPANEL                                               SOL  86
      GAMMA(I) = 0.                                                     SOL  87
      READ (03) (AW(K),K=1,LPANEL)                                      SOL  88
      DO  16 J = 1,LPANEL                                               SOL  89
   16 GAMMA(I) = GAMMA(I) - AW(J) * DUM(J)                              SOL  90
   17 CONTINUE                                                          SOL  91
      DO  18 I=1,LPANEL                                                 SOL  92
   18 AW(I)=GAMMA(I)                                                    SOL  93
      MM=NCW                                                            SOL  94
      IZ=1                                                              SOL  95
      DO  21 NI=1,LPANEL                                                SOL  96
      IA=NI-MM+NCW                                                      SOL  97
      IF (IA.GT.NW(1)) GO TO  19                                        SOL  98
      I=NI-NW(2)*(IZ-1)                                                 SOL  99
      GO TO  20                                                         SOL 100
   19 I=NI+LPAN1-NW(1)*IZ                                               SOL 101
   20 GAMMA(I)=AW(NI)                                                   SOL 102
      IF (NI.LT.MM) GO TO  21                                           SOL 103
      MM=MM+NN                                                          SOL 104
      IZ=IZ+1                                                           SOL 105
   21 CONTINUE                                                          SOL 106
      RETURN                                                            SOL 107
      END                                                               SOL 108
```

```
      SUBROUTINE OUPT (X,Y,NALP)
      DIMENSION X(21,41), Y(21,41)
      WRITE (6, 5)
      WRITE (6, 6)
      WRITE (6, 5)
      WRITE (6, 7)
      WRITE (6, 8)
      DO  1 I = 1,NALP
    1 WRITE (6, 9) X(4,I),X(5,I),X(6,I),X(7,I),X(8,I)
      WRITE (6, 10)
      WRITE (6, 11)
      DO  2 I = 1,NALP
      T = Y(1,I) + Y(2,I) + Y(3,I)
    2 WRITE (6, 9) X(4,I),Y(1,I),Y(2,I),Y(3,I),T
      WRITE (6, 12)
      DO  3 I = 1,NALP
      T = Y(4,I) + Y(5,I) + Y(6,I)
    3 WRITE (6, 9) X(4,I),Y(4,I),Y(5,I),Y(6,I),T,Y(10,I)
      WRITE (6, 13)
      DO  4 I = 1,NALP
      T = Y(7,I) + Y(8,I) + Y(9,I)
    4 WRITE (6, 9) X(4,I),Y(7,I),Y(8,I),Y(9,I),T
      RETURN
C
    5 FORMAT (/5X,40HXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX)
    6 FORMAT (/7X,36HOVER-ALL AEPODYNAMIC CHARACTEPISTICS)
    7 FOPMAT (//18X,13HATTACHED FLOW)
    8 FORMAT (/4X,5HALPHA,7X,2HCL,7X,3HCDI,8X,2HCM,8X,2HCB/)
    9 FOPMAT (3X,F8.4,5(2X,F8.5))
   10 FORMAT (//18X,14HSFPARATED FLOW)
   11 FORMAT (/4X,5HALPHA,5X,3HCLP,7X,6HCLV,LE,5X,6HCLV,SE,6X,3HCL /)
   12 FORMAT (/4X,5HALPHA,5X,3HCDP,7X,6HCDV,LE,5X,6HCDV,SE,6X,3HCDI,7X,
     13HCAV/)
   13 FORMAT (/4X,5HALPHA,5X,3HCMP,7X,6HCMV,LE,5X,6HCMV,SE,6X,3HCM /)
      END
```

```
      SUBROUTINE ZCDX (X,Y,ZC,ZCX,ZCY)
C
C     CAMBER SURFACE FOR L.C. SQUIRE'S WING 7 IN ARC CP-924
      F1 = 4.*Y/X
      F2 = F1**6
      F3 = F2*F1
      ZC = -.075*X*F3
      ZCX = .45*F3
      ZCY = -2.1*F2
      RETURN
      END
```

```
      SUBROUTINE TWST(Y,ATW)                                            ASH 152
      COMMON /TWST1/ NYM,YTS(21),AY(1,20),BY(1,20),CCY(1,20),DY(1,20)   TWS   3
      PI = 3.14159265                                                   TWS   4
      K = 1                                                             TWS   5
1     IF  (Y .GE. YTS(K) .AND. Y .LT. YTS(K+1)) GO TO  2                TWS   6
      K = K + 1                                                         TWS   7
      IF  (K .GE. NYM) GO TO  3                                         TWS   8
      GO TO  1                                                          TWS   9
2     SM = Y - YTS(K)                                                   TWS  10
      ATW = AY(1,K) *SM*SM*SM + BY(1,K) *SM*SM + CCY(1,K) * SM + DY(1,K)TWS  11
      ATW = ATW * PI / 180.                                             TWS  13
      GO TO  5                                                          TWS  15
3     IF  (Y .LT. YTS(1)) GO TO  4                                      TWS  16
      K = NYM - 1                                                       TWS  17
      GO TO  2                                                          TWS  18
4     K = 1                                                             TWS  19
      GO TO  2                                                          TWS  20
5     CONTINUE                                                          TWS  21
      RETURN                                                            TWS  22
      END                                                               TWS  23
```

```
      SUBROUTINE ZCR (X,Y,ZCX,ZR,ICAM,X1,X2,CHORD,DZDY,IMT,IST)         ASH 153
      COMMON /LEFLP/ YLEF(10,2),XNF(10),YNF(10),ZNF(10),XLF(10,4),YLF(10 ZCR   3
     1,4),SLP1(10)                                                      ZCR   4
      KK=ZR                                                             ZCR   5
      ZR = 0.                                                           ZCR   6
      ZCX=0.                                                            ZCR   7
      DZDY = 0.                                                         ZCR   8
      IF  (ICAM .EQ. 1) GO TO  5                                        ZCR   9
      IF  (ICAM .NE. 3) GO TO  6                                        ZCR  10
      I = 1                                                             ZCR  11
1     IF  (Y .GE. YLEF(I,1) .AND. Y .LT. YLEF(I,2)) GO TO  2            ZCR  12
      IF( I .GE. IST) GO TO 6                                           ASH 154
      I = I + 1                                                         ZCR  13
      IF  (I .EQ. 11) GO TO  6                                          ZCR  14
      GO TO  1                                                          ZCR  15
2     YB=YLF(I,1)+SLP1(I)*(X-XLF(I,1))                                  ZCR  16
      KCON=0                                                            ZCR  17
      IF (KK.NE.100) GO TO  3                                           ZCR  18
      XB=XLF(I,1)                                                       ZCR  19
      IF (SLP1(I).GT.1.E-18) XB=XLF(I,1)+(Y-YLF(I,1))/SLP1(I)           ZCR  20
      DX=X2/(XB-X1)                                                     ZCR  21
      IF (ABS(1.-DX).LE.0.1) KCON=1                                     ZCR  22
      IF (KCON.EQ.1) GO TO  4                                           ZCR  23
3     CONTINUE                                                          ZCR  24
      IF  (Y .LT. YB) RETURN                                            ZCR  25
4     CONTINUE                                                          ZCR  26
      TEST1=PNLEF(X,Y,XLF,YLF,I,1,2)                                    ZCR  27
      IF (ABS(TEST1) .LT. 1.E-8 .AND. Y .GE. YLF(I,1)) TEST1 = 1.E-8    ASH 155
      IF (TEST1.LT.0.) RETURN                                           ZCR  28
      TEST2=PNLEF(X,Y,XLF,YLF,I,4,3)                                    ZCR  29
      IF (ABS(TEST2) .LT. 1.E-8 .AND. Y .LE. YLF(I,3)) TEST2 = -1.E-8   ASH 156
      IF (TEST2.GT.0.) RETURN                                           ZCR  30
      ZR = -XNF(I)/ZNF(I)                                               ZCR  31
      DZDY = -YNF(I)/ZNF(I)                                             ZCR  32
      D=-XNF(I)*XLF(I,1)-YNF(I)*YLF(I,1)                                ZCR  33
      ZCX = -(D + XNF(I)*X + YNF(I)*Y) / ZNF(I)                         ZCR  34
      IF (KCON.EQ.0) GO TO  6                                           ZCR  35
      ZR=0.5*ZR                                                         ZCR  36
      DZDY=0.5*DZDY                                                     ZCR  37
      ZCX=0.                                                            ZCR  38
      GO TO  6                                                          ZCR  39
5     CALL ZCAM(X,Y,ZR,ZCX,X1,X2,CHORD,IMT,IST)                         ASH 157
                                                                        ZCR  41
6     RETURN                                                            ZCR  42
      END
```

```
      FUNCTION PNLEF (X,Y,XLF,YLF,I,J,K)
      DIMENSION XLF(10,4), YLF(10,4)
      PNLEF=(X-XLF(I,J))*(YLF(I,K)-YLF(I,J))-(XLF(I,K)-XLF(I,J))*(Y-YLF(
     1I,J))
      RETURN
      END
```

```
      SUBROUTINE ZCAM(X,Y,ZR,ZCX,X1,X2,CHORD,IMT,IST)                   ASH 158
      COMMON /CAMB/ ICAM,IM(10),XT(10,21),AAM(10,20),BBM(10,20),        ZCM   3
     1CCM(10,20),DDM(10,20),YT(10),CURV(10),CHND(10)                    ZCM   4
      DIMENSION ZZ(2), ZX(2), XX(2), ZY(2), ZQ(2), C(15)                ZCM   5
      I = IMT                                                           ZCM   6
      ZZ(2) = 0.                                                        ZCM   7
      IF  (I .NE. 0) GO TO  2                                           ZCM   8
      I = 1                                                             ZCM   9
 1    IF  (Y .GE. YT(I) .AND. Y .LT. YT(I+1)) GO TO  2                  ZCM  10
      I = I + 1                                                         ZCM  11
      IF (I .GT. IST) GO TO 17                                          ASH 159
      GO TO 1                                                           ASH 160
   17 IF (Y .LT. YT(1)) I=1                                             ASH 161
      IF (Y .GT. YT(IST)) I = IST-1                                     ASH 162
 2    CONTINUE                                                          ZCM  14
      IK = 1                                                            ZCM  15
      XF = 0.                                                           ZCM  16
      YF = Y                                                            ZCM  17
      ICV = CURV(I)                                                     ZCM  18
      IF  (ICV .EQ. 1) GO TO  3                                         ZCM  19
      XF1 = XT(I,2) * CHND(I)                                           ZCM  20
      IF  (ABS(DDM(I,1)) .LE. .0001) XF1 = XT(I,1)*CHND(I)              ZCM  21
      XF2 = XT(I+1,2) * CHND(I+1)                                       ZCM  22
      YF = (Y-YT(I)) / (YT(I+1)-YT(I))                                  ZCM  23
      XF = (XF1+(XF2-XF1)*YF)/CHORD                                     ZCM  24
      IF  (X1 .GE. XF) GO TO  3                                         ZCM  25
      FAC = CHND(I+1)                                                   ZCM  26
      IF  (FAC .LE. .0001) FAC = 1.                                     ZCM  27
      DELTA = DDM(I,1)*CHND(I)  + (DDM(I+1,1)*FAC - DDM(I,1)*CHND(I))*YF ZCM  28
      DELTA = DELTA/CHORD                                               ZCM  29
      IF  (IM(I) .GT. 2) ZQ(1) = DDM(I,2) * CHND(I)                     ZCM  30
      IF  (IM(I) .LE. 2) ZQ(1) = (CCM(I,1) + DDM(I,1)) * CHND(I)        ZCM  31
      IF  (IM(I+1) .GT. 2) ZQ(2) = DDM(I+1,2)*FAC                       ZCM  32
      IF  (IM(I+1) .LE. 2) ZQ(2) = (CCM(I+1,1) + DDM(I+1,1)) * FAC      ZCM  33
      DK = (ZQ(1) + (ZQ(2) - ZQ(1)) * YF) / CHORD                       ZCM  34
      DELTA = DELTA - DK                                                ZCM  35
      GO TO  10                                                         ZCM  36
 3    K = 1                                                             ZCM  37
      ZP = 0.                                                           ZCM  38
      ZCX = 0.                                                          ZCM  39
      IF  (ICV .EQ. 0) GO TO  16                                        ZCM  40
 4    IF  (X .GE. XT(I,K) .AND. X . LT. XT(I,K+1)) GO TO  5             ZCM  41
```

```
      K=K+1
      IF  (K .GE. IM(I)) GO TO  6
      GO TO  4
5     SM=X-XT(I,K)
      ZZ(IK) = 3.*AAM(I,K)*SM*SM + 2.*BBM(I,K)*SM + CCM(I,K)
      ZX(IK) = AAM(I,K)*SM*SM*SM + BBM(I,K)*SM*SM + CCM(I,K)*SM + DDM(I,
     1K)
      GO TO  8
6     IF  (X .LT. XT(I,1)) GO TO  7
      K = IM(I) - 1
      GO TO  5
7     K=1
      GO TO  5
8     IF  (IK .EQ. 2) GO TO  9
      IF  (IMT .NE. 0) GO TO  15
      I = I + 1
      IK = IK + 1
      GO TO  3
9     YF = (Y - YT(I-1)) / (YT(I) - YT(I-1))
      ZCX = ZX(1) - (ZX(1)-ZX(2))*YF
      ZR = ZZ(1) - (ZZ(1) - ZZ(2)) * YF
      GO TO  16
10    CONTINUE
      IF  (XF .GT. X1 .AND. XF .LT. X2) GO TO  11
      IF  (X2 .LE. XF) GO TO  14
      IF  (X1 .GE. XF) ZR = 0.
      GO TO  16
11    PI = 3.14159265
      IF  (X .LT. XF) ZCX = DELTA*(1.-X/XF) + DK
      IF  (X .GE. XF) ZCX = 0.
      JR = 15
      C(1) = -DELTA
      DO  12 J=2,JR
      XNPIXF = (J-1)*PI*XF
      C(J) = -2.*DELTA*SIN(XNPIXF)/XNPIXF
12    CONTINUE
      ZR = 0.
      DO  13 J=1,JR
      XNPIX = (J-1)*PI*X
      ZR = ZR + C(J)*COS(XNPIX)
13    CONTINUE
      GO TO  16
14    ZR = -DELTA/XF
      ZCX = DELTA*(1.-X/XF) + DK
      GO TO  16
15    ZR = ZZ(1)
      ZCX = ZX(1)
16    CONTINUE
      RETURN
      END
```

```
      SUBROUTINE BENDIN (NC,CL,BM,IWING,BREAK,SUMM,SUMT,NWING,HALFSH,HAL
     1FBH,DC,DS,IWGLT)
      DIMENSION A(30), BM(1), H(30), PHI(30), BREAK(1), CL(1)
      DIMENSION DC(1), DS(1)
      COMMON /GEOM/ HALFSW,XCP(200),YCP(200),ZCP(200),XLE(100),YLE(100),
     1XTE(100),PSI(30),CH(100),XV(200),YV(200),SN(20,2),XN(200,4),YN(200
     2,4),BPRIM(200,4),WIDTH(7),YCON(51),SWEEP(100),HALFB,SJ(31,7)
     3,ZN(200,4)
      COMMON /CONST/ NCS,NCW,M1(7),MJW1(2,5),MJW2(2,5),NJW(5),NFP,NW(2)
      PI=3.14159265
      NST=NCS-M1(NC)+1
      SUMF=0.
      SUMM=0.
      SUMS=0.
      AREA=HALFSH
      HAB=HALFBH
      IF  (IWGLT .EQ. 1) HAB=HALFB
      IF  (IWGLT .EQ. 2) AREA=HALFSW
      IF  (IWGLT .EQ. 2) HAB=HALFB
      DO  10 I=1,NC
      M=NC-I+1
      IF  (I.NE.NC) DIHEFC=DC(M)*DC(M-1)+DS(M)*DS(M-1)
      IF (I.NE.NC) DIHEFS=DS(M)*DC(M-1)-DC(M)*DS(M-1)
      IF  (I .EQ. NC) DIHEFC=1.
      IF  (I .EQ. NC) DIHEFS=0.
      WSPAN=WIDTH(M)*0.5
      MM=M1(M)-1
      MM1 = M1(M)
      FM = MM1
      IF  (M .EQ. NWING) AREA=HALFSW
      IF  (M .EQ. NWING) HAB=HALFB
      DO  1 J=1,MM
      FJ = J
      JJ=NST+J
      CHORD=CH(JJ)
      IF  (NW(2) .NE. 0) CHORD=CHORD+CH(JJ+NCS)
      PHI(J)=FJ*PI/FM
      H(J)=CL(JJ)*CHORD*SJ(J,M)
    1 CONTINUE
      DO  3 J=1,MM1
      A(J)=0.
      FJ = J
```

```
      DO   2 K=1,MM
2     A(J) = A(J)+H(K)*COS((FJ-1.)*PHI(K))
      IF  ( J.EQ. 1) A(J) = A(J)/FM
      IF  (J .NE. 1) A(J)=A(J)*2./FM
3     CONTINUE
      DO   6 K=1,MM1
      JK=MM1-K
      KK=JK+NST
      IF  (K .EQ. MM1) GO TO  5
      BSPAN=BREAK(M)-YLE(KK)+WSPAN
      SUM=A(1)*((PI-PHI(JK))*BSPAN+SIN(PHI(JK))*WSPAN)-0.5*A(2)*WSPAN*(
     1PI-PHI(JK)-SIN(2.*PHI(JK))/2.)-A(2)*SIN(PHI(JK))*BSPAN
      DO   4 J=2,MM
      FJ=J
4     SUM=SUM-BSPAN*A(J+1)*SIN(FJ*PHI(JK))/FJ+WSPAN*0.5*A(J+1)*(SIN((FJ+
     11.)*PHI(JK))/(FJ+1.)+SIN((FJ-1.)*PHI(JK))/(FJ-1.))
      BM(KK)=WSPAN*SUM/(2.*AREA*HAB)     +SUMM+SUMF*(BREAK(M+1)-YLE(KK))
      GO TO  6
5     BSPAN=WSPAN
      SUM=(A(1)*BSPAN-0.5*A(2)*WSPAN)*PI
      SUMM=WSPAN*SUM/(2.*AREA*HAB)     +SUMM+SUMF*(BREAK(M+1)-BREAK(M))
6     CONTINUE
      P1=A(1)*PI*WSPAN/(2.*AREA*HAB)
      SUMF=(SUMF+P1)*DIHEFC-SUMS*DIHEFS
      SUMS=(SUMF+P1)*DIHEFS+SUMS*DIHEFC
      IF  (M .EQ. (NWING+1) .AND. IWING .NE. 0) GO TO  7
      GO TO  8
7     SUMT=SUMM
      IF  (IWGLT .EQ. 1) GO TO  8
      SUMM=0.
      SUMF=0.
8     CONTINUE
      IF  (I .EQ. NC) GO TO  9
      NST=NST-M1(M-1)+1
      GO TO  10
9     NST=0
10    CONTINUE
      RETURN
      END
```

```
      SUBROUTINE ADICMX (AM,XN,YN,ZN,XCP,YCP,ZCP,N,BPRIM,AW,BW,MAX,DCOS,
     1 DSIN,YBREAK,IWGL,NC,WSTUFF,VST,NW,NCS,YLE,N1,IV,M1,ZBDY)
C
C*********************************************************************
C
C  ADICMX COMPUTES AERODYNAMIC DOWNWASH INFLUENCE COEFFICIENT MATRIX
C  USING WOODWARD'S METHOD.  AN OPTIMIZATION ALGORITHM ELIMINATES
C  REDUNDANT EVALUATIONS OF THE LIFTING SURFACE INTEGRAL AT CORNERS
C  COMMON TO TWO OR MORE PANELS
C
C*********************************************************************
C
      DIMENSION XN(200,4), YN(200,4), ZN(200,4), BPRIM(200,4), WSTUFF(20
     10,4), XCP(1), YCP(1), ZCP(1), AW(1), YBREAK(1), B(2), BW(1), V(4),
     2 DCOS(1), DSIN(1), VST(200,4), W(4), TWO(2), CON(2), A(2)
      DIMENSION NW(1), YLE(1), M1(1)
      DATA TWO/1.,-1./,CON/.25,.5/,EPSLON/1.E-8/
      PAI = 3.14159265
      PI2 = PAI/2.
      IWING = MAX
C
C  MACH NUMBER REGIME
      IJ=1
      IF (AM.GE.1.0) IJ=2
      BETA1=1.0/SQRT(ABS(1.0-AM*AM))
C
C  MULTIPLY PANEL SLOPES BY TANGENT OF MACH ANGLE
      PAIBET=1.0/(BETA1*PAI)
      DO  1 I=1,N
      DO  1 J=1,4
 1    BPRIM(I,J)=BETA1*BPRIM(I,J)
C
C  DOWNWASH MATRIX COMPUTATION
C       I IS INFLUENCED PANEL
C       J IS INFLUENCING PANEL
C       K IS CORNER OF PANEL J
C       II IS THE SIDE OF SYMMETRIC AIRPLANE BEING CONSIDERED
C
      F5=0.0
      IPN = 1
      IZ = 1
      NCW=NW(1)+NW(2)
```

```
      MM=NCW
      NN=NCW
      ZB = 0.
      YB = 0.
      YBB = 0.
      DO  46 NI=1,N
      IA=NI-MM+NCW
      IF (IA.GT.NW(1)) GO TO  2
      I=NI-NW(2)*(IZ-1)
      GO TO  3
2     I=NI+N1-NW(1)*IZ
3     CONTINUE
      IPM = 1
      IW = 1
      NL=NCW
      NM=NCW
      LZ = 1
      LCON = M1(1) - 1
      ZA = 0.
      YA = 0.
      YAA = 0.
      IY=0
      DO  42 NJ=1,N
      IB=NJ-NM+NCW
      IF (IB.GT.NW(1)) GO TO  4
      J=NJ-NW(2)*(IW-1)
      GO TO  5
4     J=NJ+N1-NW(1)*IW
5     CONTINUE
      JQ=NJ-IY
      DO  36 K=1,4
      IF  (IW.EQ.1) GO TO  10
      IF  (IW.EQ.(LCON+1)) GO TO  10
      IF  (JQ.EQ.1) GO TO  9
      IF  (K.EQ.4) GO TO  11
      IF  (K-2)  8, 7, 6
6     W(K)=WSTUFF(NJ-NL,4)
      V(K)=VST(NJ-NL,4)
      GO TO  35
7     W(K)=WSTUFF(NJ-1,4)
      V(K)=VST(NJ-1,4)
      GO TO  35
```

```
 8     W(K)=WSTUFF(NJ-1,3)
       V(K)=VST(NJ-1,3)
       GO TO  35
 9     IF  (K.EQ.2.OR.K.EQ.4) GO TO  11
       IF  (K.EQ.3) GO TO  6
       W(K)=WSTUFF(NJ-NL,2)
       V(K)=VST(NJ-NL,2)
       GO TO  35
 10    IF  (JQ.EQ.1) GO TO  11
       IF  (K.EQ.3.OR.K.EQ.4) GO TO  11
       IF  (K.EQ.1) GO TO  8
       IF  (K.EQ.2) GO TO  7
C
C  COMPUTATIONS COMMON TO SUBSONIC AND SUPERSONIC REGIMES.
 11    CONTINUE
       BPM=BPRIM(J,K)
       XIPRIM=(XCP(I)-XN(J,K))*BETA1
C
C  KK IS PANEL SLOPE SIGN FLAG
       KK=1
       IF (BPM.GE.0.0) GO TO  12
       KK=2
       BPM=-BPM
 12    IF (BPM.LE.EPSLON) BPM=0.0
       IF (ABS(BPM-1.).LE.EPSLON) BPM=1.0
       BPM2=BPM*BPM
       BB=ABS(1.-BPM2)
       IF  (IJ.EQ.2) BB=SQRT(BB)
       IF (BB.GT.EPSLON) GO TO  13
       BPM=1.0
       BB=0.0
 13    B1=XIPRIM*XIPRIM
C
C  Y-PRIME DEPENDS ON II
       ISM = 2
C      CHECK IF VERTICAL TAIL EXISTS
       IF  (IV.EQ.1.AND.IW.GT.IWING) ISM=1
       A(2) = 0.
       B(2) = 0.
       DO  34 II=1,ISM
       PS = DSIN(IW)
       PC = DCOS(IW)
```

```
      QS = DSIN(IZ)
      QC = DCOS(IZ)
      ZC = ZCP(I)+ZB+(YCP(I)-YB)*QS
      ZK = ZN(J,K)+ZA+(YN(J,K)-YA)*PS
      DELZ = ZC-ZK
      YC = YBB+(YCP(I)-YB)*QC
      YK = YAA+(YN(J,K)-YA)*PC
      DELY = TWO(II)*YC-YK
      ZPRIM = -DELY*PS+DELZ*PC
      SZ=SIGN(1.,ZPRIM)
      YPRIM =  DELY*PC+DELZ*PS
      IF  (KK.EQ.2) YPRIM=-YPRIM
      B2=YPRIM*YPRIM+ZPRIM*ZPRIM
      GO TO ( 14, 18), IJ
C
C  SUBSONIC REGIME
C
C  FOR COMPUTERS OTHER THAN THE CDC 6000 SERIES, THE FOLLOWING
C  COMPUTATIONS MAY REQUIRE DOUBLE PRECISION EVALUATION IF
C  EITHER A11 OR A4 IS LESS THAN (-1000.)
C
 14   BPM = SQRT(B2)
      DPM = SQRT(B1+B2)
      A1 = XIPRIM+DPM
      BQ = SQRT(B2)
      A11=XIPRIM/BQ
      A2=BPM*XIPRIM+YPRIM
      A3=XIPRIM-BPM*YPRIM
      A33=(BPM2+1.0)*ZPRIM*ZPRIM
      SQ = SQRT(A3*A3+A33)
      SQA3=1./SQ
      A4=A2*SQA3
      IF  (A11.GT.(-1000.)) F1 = ALOG(A11+SQRT(A11*A11+1.))
      IF  (A11.LE.(-1000.)) CALL F (XIPRIM,BQ,F1)
      IF  (A4.LE.(-1000.)) GO TO  15
      A7=SQRT(A4*A4+1)
      A8=A4+A7
      A6=ALOG(A8)
      GO TO  16
 15   CALL F (A2,SQ,A6)
 16   CONTINUE
      F2=A6/SQRT(1.+BPM2)
```

```
C  END DOUBLE PRECISION SECTION
C
      A5=BPM*SQRT(B2)*SQA3
      F5=0.0
      IF (A5.GT.EPSLON) F5=ALOG(A5)
      F6=A1/B2
      IF  (ABS(ZPRIM).LT.EPSLON) GO TO  17
      G1=BPM*BPM*BPM-XIPRIM*YPRIM
      F3 = ATAN2(ZPRIM*DPM,G1)
      F4 = -ATAN2(ZPRIM,YPRIM)
      GO TO  33
 17   AK = XIPRIM-BPM*YPRIM
      F3 = 0.
      F4 = 0.
      AKY = -YPRIM*AK
      IF  (ABS(AKY) .GE. EPSLON) F3 = ATAN2(0.,AKY)
      IF  (ABS(YPRIM) .GE. EPSLON) F4 = -ATAN2(0.,YPRIM)
      GO TO  33
C
C  SUPERSONIC REGIME
 18   A1=B2
      A2=SQRT(A1)
      F3 = 0.
      F4 = 0.
      F5 = 0.
      IF (XIPRIM.GT.A2) GO TO  22
      F1=0.0
      F2=0.0
      F6=0.0
      IF (BPM2.GE.1.) GO TO  33
      TEST=YPRIM-BPM*XIPRIM
      IF (XIPRIM.EQ.A2) GO TO  19
      IF  (YPRIM .LE. 0.) GO TO  33
      CONTL=BPM*YPRIM+BP*ABS(ZPRIM)
      IF (XIPRIM-CONTL)  33, 20, 19
 19   IF (TEST)  33, 20, 21
 20   F2=1.57079633/BB
      F3=PI2*SZ
      GO TO  33
 21   F2=PAI/BB
      F3=PAI*SZ
      GO TO  33
```

```
 22    A3=XIPRIM/A1                                                ADI 212
       SQXI=SQRT(XIPRIM*XIPRIM-A1)                                 ADI 213
       F6=SQXI/A1                                                  ADI 214
       A11=XIPRIM/A2                                               ADI 215
       F1=ALOG(A11+SQRT(A11*A11-1.0))                              ADI 216
       A4=XIPRIM-BPM*YPRIM                                         ADI 217
       A5=(BPM2-1.0)*ZPRIM*ZPRIM                                   ADI 218
       A6=SQRT(A4*A4+A5)                                           ADI 219
       A7=BPM*XIPRIM-YPRIM                                         ADI 220
       IF (BPM2.EQ.1.) GO TO  31                                   ADI 221
       IF (BPM2.GT.1.0) GO TO  32                                  ADI 222
       F2=(1./BB) * ACOS(A7/A6)                                    ASH 163
 23    G1=BPM*A1-XIPRIM*YPRIM                                      ADI 224
       IF (ZPRIM)  24, 25, 24                                      ADI 225
 24    FTR=G1/SQRT(A1*(A4*A4+A5))                                  ADI 226
       IF  (FTR .LE. -1.) GO TO  29                                ADI 227
       IF  (FTR .GE. 1.) GO TO  26                                 ADI 228
       FTR=ACOS(FTR)*S7                                            ASH 164
       GO TO  30                                                   ADI 230
 25    IF  (BPM)  26, 28, 27                                       ADI 231
 26    FTR=0.                                                      ADI 232
       GO TO  30                                                   ADI 233
 27    IF (A4)  26, 28, 29                                         ADI 234
 28    FTR=PI2                                                     ADI 235
       GO TO  30                                                   ADI 236
 29    FTR=PAI*SZ                                                  ADI 237
 30    F3=FTR                                                      ADI 238
       GO TO  33                                                   ADI 239
 31    F2=SQXI/(XIPRIM-YPRIM)                                      ADI 240
       GO TO  23                                                   ADI 241
 32    A8=A7/A6                                                    ADI 242
       F2=(1./BB)*ALOG(A8+SQRT(A8*A8-1.0))                         ADI 243
       GO TO  23                                                   ADI 244
 33    A(II)=CON(IJ)*PAIBET*((BPM2+TWO(IJ))*F2-BPM*(F1-F5)         ADI 245
      1      -YPRIM*F6)*TWO(KK)                                    ADI 246
 34    B(II)=-CON(IJ)*PAIBET*(BPM*(F3+F4)-ZPRIM*F6)                ADI 247
       SN2 = 2.*PS*PC                                              ADI 248
       CS2 = PC*PC-PS*PS                                           ADI 249
       W(K)  = A(1)+A(2)*CS2+B(2)*SN2                              ADI 250
       V(K)  = B(1)+A(2)*SN2-B(2)*CS2                              ADI 251
C                                                                  ADI 252
C  STORE W(K) IN WSTUFF TO AVOID RECOMPUTATION LATEP,              ADI 253
```

```
C
 35   CONTINUE
      WSTUFF(NJ,K)=W(K)
      VST(NJ,K)=V(K)
 36   CONTINUE
      AW(NJ)=W(1)-W(2)-W(3)+W(4)
      BW(NJ)=V(1)-V(2)-V(3)+V(4)
      IF (NJ.LT.NM.OR.NJ.EQ.N) GO TO  42
      IF  (IW.EQ.(LCON+1)) GO TO  37
      GO TO  38
 37   LZ = LZ + 1
      LCON = LCON + M1(LZ) - 1
 38   CONTINUE
      IW = IW+1
      NM = NM+NL
      IY = IY+NL
      IF (IWING.NE.0.AND.IW.EQ.(IWING+1)) GO TO  39
      IF  (IW .EQ. (NCS+1)) GO TO  42
      IF (YLE(IW).LT.YBREAK(IPM)) GO TO  42
 39   ZA = ZA + (YBREAK(IPM)-YA) * DSIN(IW-1)
      YAA = YAA + (YBREAK(IPM) - YA) * DCOS(IW-1)
      YA = YBREAK(IPM)
      IF (IWING.NE.0.AND.IW.EQ.(IWING+1)) GO TO  40
      GO TO  41
 40   IF (IWGL.EQ.1) GO TO  41
      ZA = 0.
      YA = 0.
      YAA = 0.
      IF (IWGL.NE.2) GO TO  41
      ZA = YBREAK(NC-2)*DSIN(1)
      YAA = YBREAK(NC-2) * DCOS(1)
      YA = YBREAK(NC-2)
 41   IPM = IPM+1
 42   CONTINUE
      WRITE (02) (AW(J),J=1,N)
      WRITE (02) (BW(J),J=1,N)
      IF (NI.LT.MM) GO TO  46
      IZ = IZ+1
      MM = MM+NN
      IF (IWING.NE.0.AND.IZ.EQ.(IWING+1)) GO TO  43
      IF  (IZ .EQ. (NCS+1)) GO TO  46
      IF (YLE(IZ).LT.YBREAK(IPN)) GO TO  46
 43   ZB = ZB + (YBREAK(IPN)-YB) * DSIN(IZ-1)
      YBB = YBB + (YBREAK(IPN)-YB) * DCOS(IZ-1)
      YB = YBREAK(IPN)
      IF (IWING.NE.0.AND.IZ.EQ.(IWING+1)) GO TO  44
      GO TO  45
 44   IF (IWGL.EQ.1) GO TO  45
      ZB = 0.
      YB = 0.
      YBB = 0.
      IF  (IWGL.NE.2) GO TO  45
      ZB = YBREAK(NC-2)*DSIN(1)
      YBB = YBREAK(NC-2)*DCOS(1)
      YB = YBREAK(NC-2)
 45   IPN = IPN+1
 46   CONTINUE
      RETURN
      END
```

```
SUBROUTINE F (A2,A3,FUNCT)
DOUBLE PRECISION X2,X3,A6,A7
X2=A2
X3=A3
A6=X2/DABS(X3)
A7=DSQRT(A6*A6+1.)
FUNCT=DLOG(A6+A7)
RETURN
END
```

```
      SUBROUTINE PANEL (XXL,YL,XXT,CPCWL,CPSWL,NSW,IPANEL,LPANEL,F,PERCT
     1,SWP,LR,ZS,SVP,KZ,L)
      DIMENSION XXL(1), YL(1), XXT(1), CPCWL(1), CPSWL(1), PERCT(1)
      DIMENSION SWP(20,10), SVP(20,10), F(5,20)
      COMMON /SCHEME/ C(2),X(21,41),Y(21,41),SLOPE(21),XL(2,21),XTT(41),
     1XLL(41)
      COMMON /GEOM/ HALFSW,XCP(200),YCP(200),ZCP(200),XLE(100),YLE(100),
     1XTE(100),PSI(30),CH(100),XV(200),YV(200),SN(20,2),XN(200,4),YN(200
     2,4),BPRIM(200,4),WIDTH(7),YCON(51),SWEEP(100),HALFB,SJ(31,7)
     3,ZN(200,4)
      COMMON /CONST/ NCS,NCW,M1(7),MJW1(2,5),MJW2(2,5),NJW(5),NFP,NW(2)
      PI=3.14159265
      NSW1=NSW-1
      NCW1 = NCW+1
      IP = 0
      IF  (L .EQ. 2) IP = NW(1)
      DO  1 I=1,2
      C(I)=XXT(I)-XXL(I)
      DO  1 J=1,NCW1
    1 XL(I,J)=XXL(I)+CPCWL(J)*C(I)/100.
      SPAN=YL(2)-YL(1)
      DO  2 J = 1,NCW1
      SLOPE(J) = (XL(2,J) - XL(1,J)) / SPAN
    2 CONTINUE
      DO  3 J = 1,NCW
      JJ = J + IP
      A = XL(1,J) + (XL(1,J+1) - XL(1,J)) * PERCT(J)
      B = XL(2,J) + (XL(2,J+1) - XL(2,J)) * PERCT(J)
      AB = (B - A)/SPAN
      SWP(J,LR) = ATAN(AB)
      C1 = XL(1,J) + (XL(1,J+1) - XL(1,J)) * F(KZ,JJ)
      C2 = XL(2,J) + (XL(2,J+1) - XL(2,J)) * F(KZ,JJ)
      CD = (C2 - C1) / SPAN
      SVP(J,LR) = ATAN(CD)
    3 CONTINUE
      DO  4 K=1,NSW
      YK=CPSWL(K)*SPAN/100.
      DO  4 J=1,NCW1
      Y(J,K)=YK+YL(1)
      X(J,K)=XL(1,J)+SLOPE(J)*(Y(J,K)-YL(1))
    4 CONTINUE
      XLL(1)=XXL(1)
```

```
      XTT(1)=XXT(1)
      DO  5 I=2,NSW
      XLL(I)=XLL(I-1)+(XXL(2)-XXL(1))*(Y(1,I)-Y(1,I-1))/SPAN
5     XTT(I)=XTT(I-1)+(XXT(2)-XXT(1))*(Y(1,I)-Y(1,I-1))/SPAN
      DO  8 K=1,NSW1
      KK=NCS+K
      YLE(KK)=YCON(K)*SPAN+YL(1)
      XLE(KK)=XLL(K)+(XLL(K+1)-XLL(K))*(YLE(KK)-Y(1,K))/(Y(1,K+1)-Y(1,K)
     1)
      XTE(KK)=XTT(K)+(XTT(K+1)-XTT(K))*(YLE(KK)-Y(1,K))/(Y(1,K+1)-Y(1,K)
     1)
      CH(KK)=XTE(KK)-XLE(KK)
      SWEEP(KK)=ATAN((XXL(2)-XXL(1))/SPAN)
      YK = .5 * SPAN * (1. - COS(K*PI/FLOAT(NSW)))
      DO  8 J=1,NCW
      JJ = J + IP
      NPANEL=(K-1)*NCW +J-1+IPANEL
      DO  7 I = 1,4
      KI1 = K + I - 1
      KI3 = K+I-3
      IF  (I .LE. 2) GO TO  6
      XN(NPANEL,I) = X(J+1,KI3)
      YN(NPANEL,I) = Y(J+1,KI3)
      ZN(NPANEL,I) =ZS
      BPRIM(NPANEL,I) = SLOPE(J+1)
      GO TO  7
6     XN(NPANEL,I) = X(J,KI1)
      YN(NPANEL,I) = Y(J,KI1)
      ZN(NPANEL,I) = ZS
      BPRIM(NPANEL,I) = SLOPE(J)
7     CONTINUE
      A1 = X(J+1,K)-X(J,K)
      A2 = X(J+1,K+1) - X(J,K+1)
      B = Y(J,K+1) - Y(J,K)
      YBAR = YK - CPSWL(K) * SPAN / 100.
      XBAR = X(J,K) + YBAR * (X(J,K+1) - X(J,K)) / B
      CBAR = A1 + (A2 - A1) * YBAR / B
      YCP(NPANEL) = Y(J,K) + YBAR
      XCP(NPANEL) = XBAR + F(KZ,JJ) * CBAR
      ZCP(NPANEL) = ZS
      XV(NPANEL) = XBAR + PERCT(J) * CBAR
      YV(NPANEL)=YCP(NPANEL)
8     CONTINUE
      LPANEL=NPANEL
      RETURN
      END
```

```
      SUBROUTINE DRAG (CLT,YBREAK,NC,TFLP,NAL)
      DIMENSION ALPHI(50), YBREAK(1), TFLP(1), XXV(50), YYV(50)
      COMMON /GEOM/ HALFSW,XCP(200),YCP(200),ZCP(200),XLE(100),YLE(100),
     1XTE(100),PSI(30),CH(100),XV(200),YV(200),SN(20,2),XN(200,4),YN(200
     2,4),BPRIM(200,4),WIDTH(7),YCON(51),SWEEP(100),HALFB,SJ(31,7)
     3,ZN(200,4)
      COMMON /AERO/ AM,B,CL(50),CT(50),CD(50),CM(50)
      COMMON /CONST/ NCS,NCW,M1(7),MJW1(2,5),MJW2(2,5),NJW(5),NFP,NW(2)
      M=41
      PI=3.14159265
      NS=(M+1)/2-1
      MM1=M-1
      FM=M
      DO  1 I=1,NS
      FI=I
      J=M-I
      XXV(I) = SIN(FI*PI/FM)
      XXV(J) = XXV(I)
      YYV(I) = -COS(FI*PI/FM)
1     YYV(J) = -YYV(I)
      DO  2 I=1,NCS
2     CM(I)=SQRT(1.-(YLE(I)/HALFB)**2)
      IC=1
      BREAK=YBREAK(1)
      MST=1
      MEND=M1(1)-1
      DO  8 I=1,NS
      YCON(I)=0.
      CD(I)=0.
      II=NS+I
      BB = YYV(II) * HALFB
      IF  (BB .LE. BREAK) GO TO  3
      NK=M1(IC)-1
      IC=IC+1
      NQ=M1(IC)-1
      BREAK=YBREAK(IC)
      MST=MST+NK
      MEND=MEND+NQ
3     CONTINUE
      DO  7 J=MST,MEND
      IF  (NW(2) .EQ. 0) GO TO  4
      J1 = J + NCS
```

```
      J1=J+NCS
      CHORD=CH(J)+CH(J1)
      GO TO  5
 4    CHORD=CH(J)
 5    CONTINUE
      A=1.
      DO  6 K=MST,MEND
      IF  (K .EQ. J) GO TO  6
      A=A*(BB-YLE(K))/(YLE(J)-YLE(K))
 6    CONTINUE
      CD(I)=CD(I)+A*CL(J)*CM(J)
 7    YCON(I)=YCON(I)+A*CHORD
      CD(I) = CD(I)/SQRT(1.-YYV(II)**2)
 8    CONTINUE
      DO  14 I=1,NS
      ALPHI(I)=0.
      IN=NS+I
      DO  13 J=1,MM1
      IF  (J .EQ. IN) GO TO  9
      INDEX=IABS(J-IN)
      FACTOR = 2.*((-1.)**INDEX-1.)*XXV(J)/(FM*(YYV(J)-YYV(IN))**2)
      GO TO  10
 9    FACTOR = FM/XXV(J)
 10   IF  (J .GT. NS) GO TO  11
      JJ=M-J-NS
      GO TO  12
 11   JJ=J-NS
 12   ALPHI(I)=ALPHI(I)+CD(JJ)*YCON(JJ)*FACTOR
 13   CONTINUE
      ALPHI(I)=ALPHI(I)/(16.*HALFB)
 14   CONTINUE
      CDI=0.
      DO  15 I=1,NS
      IN=NS+I
 15   CDI = CDI + CD(I)*YCON(I)*ALPHI(I)*XXV(IN)
      CDI=CDI*HALFB*PI/(HALFSW*FM)
      CDL2 = CDI / (CLT * CLT)
      CDL2=CDI/(CLT*CLT)
      WRITE (6, 16) CDI
      WRITE (6, 17) CDL2
      RETURN
C
 16   FORMAT (/2X,23HFAR-FIELD INDUCED DRAG=,F10.5)
 17   FORMAT (/2X,33HFAR-FIELD INDUCED DRAG PARAMETER=,F10.5)
      END
```

```
      SUBROUTINE VMSFQN (NC1,K,AA,A,CA)
      DIMENSION AA(1), CA(1), A(1)
      NC=K*NC1
      SUM1=0.
      K1=K-1
      JJ=1
      DO  1 J=1,K1
      SUM1=SUM1+AA(J)*A(JJ)
    1 JJ=JJ+NC1+1
      SUM1=SUM1+AA(K)
      DO  3 I=1,NC1
      SUM2=0.
      JJ=I+1
      DO  2 J=1,K1
      SUM2=SUM2+AA(J)*A(JJ)
    2 JJ=JJ+NC1+1
      KK=K+I
      SUM2=SUM2+AA(KK)
    3 CA(I)=-SUM2/SUM1
      M=1
      L=0
      KNC=(K-1)*NC1
      DO  6 I=1,NC
      IF  (I.GT.KNC) GO TO  5
      MM=(M-1)*NC1+1
      IF  (I.EQ.MM) GO TO  7
    4 KK=KK+1
      IL=I+L
      A(I)=CA(KK)*BASE+A(IL)
      GO TO  6
    5 II=I-KNC
      A(I)=CA(II)
    6 CONTINUE
      GO TO  8
    7 II=MM+M-1
      BASE=A(II)
      KK=0
      L=L+1
      M=M+1
      GO TO  4
    8 CONTINUE
      RETURN
      END
```

```
      SUBROUTINE GAMAX (AW,CA,LPAN1,LPANEL,GAMMA,NC,BREAK,SWP,CHORDT,IWI
     1NG,NWING,HALFBH,YCN,CTIP,CTX,IWGLT,IPOS,NCON,SVP,NC2,DYT,TP,CTDS)
      DIMENSION DYT(20,2), TP(20,2), CTDS(20,2), SWP(20,10), SVP(20,10)
      DIMENSION A(20), F(20), THETA(20), G(20,2)
      DIMENSION AW(1), CA(1), GAMMA(1), BREAK(1)
      DIMENSION CTIP(1), CHORDT(1), YCN(1)
      COMMON /GEOM/ HALFSW,XCP(200),YCP(200),ZCP(200),XLE(100),YLE(100),
     1XTE(100),PSI(30),CH(100),XV(200),YV(200),SN(20,2),XN(200,4),YN(200
     2,4),BPRIM(200,4),WIDTH(7),YCON(51),SWEEP(100),HALFB,SJ(31,7)
     3,ZN(200,4)
      COMMON /AERO/ AM,B,CL(50),CT(50),CD(50),CM(50)
      COMMON /CONST/ NCS,NCW,MI(7),MJW1(2,5),MJW2(2,5),NJW(5),NFP,NW(2)
      PI = 3.14159265
      IPS1=IPOS/10
      IPS2=IPOS-IPS1*10
      NK=0
      MK=LPAN1
      IF (NCON.NE.0) GO TO  12
      DO   11 I=1,NCS
      NA=1
      SUMI=0.
      NWW=NW(1)
      ISN=1
      FN=NW(1)
1     N1=NWW+1
      DO   2 J=1,NWW
      KK=NK+J
      IF   (NA .EQ. 2) KK=MK+J
      FJ=J
      THETA(J)=(2.*FJ-1.)*PI/(2.*FN)
      F(J) = GAMMA(KK) * SN(J,ISN) * .5
2     CONTINUE
      THETA(N1)=PI
      DO   4 J=1,N1
      A(J)=0.
      FJ=J
      DO   3 K=1,NWW
3     A(J)=A(J)+F(K)*COS((FJ-1.)*THETA(K))
      IF   (J .EQ. 1) A(J)=A(J)/FN
      IF   (J .NE. 1) A(J)=A(J)*2./FN
4     CONTINUE
      IF (NA.EQ.2) GO TO  7
```

```
      CHORD=CH(I)
      IF (NW(2).NE.0) CHORD=CH(I)+CH(I+NCS)
      RF=CH(I)/CHORD
      CT(I) = A(1)
      DO  5 J = 1,NWW
  5   CT(I) = CT(I)+A(J+1)
      SP = COS(SWEEP(I))
      AB = AM*AM*SP*SP
      IF (AB.GE.1.) GO TO  6
      AC = SQRT(1.-AB)
      CTL = PI*AC/(8.*SP)
      AKK = CT(I)
      FAC = 1.
      IF (AKK.LT.0.) FAC=-1.
      CT(I)=CTL*FAC*AKK*AKK*RF
      GO TO  7
  6   CT(I) = 0.
  7   CONTINUE
      DO  9 K=1,N1
      KK=NK+K
      IF  (NA .EQ. 2) KK=MK+K
      SUM=A(1)*THETA(K)
      DO  8 J=1,NWW
      FJ=J
  8   SUM=SUM+A(J+1)*SIN(FJ*THETA(K))/FJ
      IZ=I
      IF  (NA .EQ. 2) IZ=I+NCS
      SUM=-0.5*CH(IZ)*SUM+SUMI
      IF  (NA .EQ. 1 .AND. K .EQ. N1) GO TO  9
      AW(KK)=SUM
  9   CONTINUE
      IF  (NA .EQ. 2) GO TO  10
      IF  (NCW .EQ. NW(1)) GO TO  10
      NWW=NW(2)
      NA=NA+1
      ISN=ISN+1
      FN=NWW
      SUMI=SUM
      GO TO  1
 10   CONTINUE
      NK = NK + NW(1)
 11   MK=MK+NW(2)
```

```
12    CONTINUE
      NKW = NCW
      IF  (NCON.EQ.2) NKW = 1
      NK1=0
      NK2=LPAN1
      DO  44 I=1,NC
      M=M1(I)
      FM=M
      MM=M-1
      DO  43 J = 1, NKW
      IF  (IWING .NE. 0 .AND. I .EQ. NWING) GO TO  13
      IF  (I .EQ. NC) GO TO  13
      GO TO  14
13    CONTINUE
      IW=1
      IPZ=1
      IF  (I .GT. NWING) IW=2
      IF  (I .GT. NWING) IPZ=3
      G(J,IW)=0.
      DYT(J,IW) = 0.
14    CONTINUE
      IK=0
      IS=0
      HAB=HALFB
      AA=-1.
      BB=1.
      FT=1.
      BR=BREAK(I)
      IF  (J .GT. NW(1)) GO TO  19
      NK=NK1
      LK=0
      IR1=I
      JJ=J
      MK=NW(1)
      IF  (I .GT. NWING) GO TO  15
      IF  (IPS1 .EQ. 2) IS=1
      IF  (IPS1 .EQ. 1) GO TO  16
      IF  (IPS1 .EQ. 2) GO TO  17
      GO TO  21
15    IF  (IPS2 .EQ. 1) GO TO  18
16    HAB=HALFBH
      IF  (IWGLT .EQ. 2) HAB=WIDTH(I)
```

```
      IF  (IWGLT .EQ. 2) BR=0.
      GO TO  21
17    HAB=HALFB
      GO TO  21
18    HC=HALFBH-HALFB
      AA=HALFB/HC
      BB=HALFBH/HC
      HAB=HC
      IK=1
      FT=2.
      GO TO  21
19    NK=NK2
      MK=NW(2)
      LK=NW(1)
      IR1=I+NC
      JJ=J-NW(1)
      IF  (I .GT. NWING) GO TO  20
      IF  (IPS1 .EQ. 1) IS=1
      IF  (IPS1 .EQ. 1) GO TO  17
      IF  (IPS1 .EQ. 2) GO TO  16
      GO TO  21
20    IF  (IPS2 .EQ. 2) GO TO  18
      GO TO  16
21    IF  (J.EQ. 1 .OR. J .EQ. (NW(1)+1)) GO TO  22
      GO TO  25
22    CONTINUE
      DO  24 JP = 1,MM
      FJ=JP
      YCON(JP)=COS(FJ*PI/FM)
      IF  (NCON.NE.0) GO TO  23
      Y=0.5*WIDTH(I)*(1.-YCON(JP))+BR
      PSI(JP) = SQRT((BB-Y/HAB)*(Y/HAB-AA))*FT
      GO TO  24
23    PSI(JP) = 1.
24    CONTINUE
25    CONTINUE
      L1=NK+J-LK
      L2=L1+MK
      L3=L2+MK
      IF  (NCON .NE. 2 .AND. NC2 .EQ. 0) SP = SWP(JJ,IR1)
      IF  (NCON .NE. 2 .AND. NC2 .EQ.1) SP = SVP(JJ,IR1)
      LA = MM*(I-1)+1
```

```
      IF  (NCON.EQ.2) SP = SWEEP(LA)
      CS=COS(SP)
      TAN=SIN(SP)/CS
      SM=0.
      IF  (IK .EQ. 1) GO TO  28
      DO  27 LQ=1,MM
      LP=L1+(LQ-1)*MK
      AA=1.
      DO  26 LS=1,MM
      LN=L1+(LS-1)*MK
      IF  (LS .EQ. LQ) GO TO  26
      AA=AA*(BREAK(I)-YCP(LN))/(YCP(LP)-YCP(LN))
26    CONTINUE
27    SM=SM+AA*AW(LP)*PSI(LQ)
      GAMAO=SM
      GO TO  29
28    GAMAO=0.
29    CONTINUE
      IF  ( NCON .NE. 0) GO TO  30
      IF  (IS .EQ. 1) GO TO  33
      IF  (IWING .NE. 0 .AND. I .EQ. NWING) GO TO  33
      IF  (I .EQ. NC) GO TO  33
30    CONTINUE
      SM=0.
      DO  32 LQ=1,MM
      LP=L1+(LQ-1)*MK
      AA=1.
      DO  31 LS=1,MM
      LN=L1+(LS-1)*MK
      IF  (LS .EQ. LQ) GO TO  31
      AA=AA*(BREAK(I+1)-YCP(LN))/(YCP(LP)-YCP(LN))
31    CONTINUE
32    SM=SM+AA*AW(LP)*PSI(LQ)
      GAMAN=SM
      GO TO  34
33    GAMAN=0.
34    DO  38 K=1,MM
      LL=NK+(K-1)*MK+J-LK
      CA(LL)=0.
      DO  36 KK=1,MM
      LI=NK+(KK-1)*MK+J-LK
      IF  (KK .EQ. K) GO TO  35
```

```
      CA(LL)=CA(LL)+2.*(-1.)**(K+KK)*   AW(LI)*PSI(KK)/(WIDTH(I)*(YCON(K
     1K)-YCON(K)))
      GO TO  36
35    CA(LL)=CA(LL)+   AW(LL)*PSI(K)*YCON(K)/(WIDTH(I)*SJ(K,I)*SJ(K,I))
36    CONTINUE
      IF   (IK .EQ. 0) FK=YCP(LL)/(HAB*HAB)
      IF   (IK .EQ. 1) FK=-(1.-2.*(YCP(LL)-HALFB)/HAB)/(0.5*HAB)
      IF (NCON.NE.0) FK = 0
      CA(LL)=CA(LL)+GAMAO*(-1.)**K/(1.-YCON(K))/WIDTH(I)-GAMAN*(-1.)**(M
     1+K)/(1.+YCON(K))/WIDTH(I)+AW(LL)*FK/PSI(K)
      CA(LL)=CA(LL)/PSI(K)
      CL(K) = CA(LL)
      IF   (IWING .NE. 0 .AND. I .EQ. NWING) GO TO  37
      IF   (I .EQ. NC) GO TO  37
      GO TO  38
37    CONTINUE
      IF   (CHORDT(IPZ) .LE. 0.001) GO TO  38
      IF (NCON.NE.0) GO TO  38
      G(J,IW)=G(J,IW)+AW(LL)*PSI(K)*(-1.)**(K+M)/(1.+YCON(K))
38    CA(LL) = TAN*GAMMA(LL)*0.5+CA(LL)
      IF   (J .EQ. NW(1)) NK1=LL
      IF   (NCON .EQ. 2) NK1 = LL+NW(1)-1
      IF   (NCON .EQ. 1 .AND. NC2 .EQ. 0) GO TO  40
      IF (NCON.NE.0) GO TO  43
      IF   (I .EQ. NC) GO TO  39
      IF   (IWING .NE. 0 .AND. I .EQ. NWING) GO TO  39
      GO TO  43
39    CONTINUE
      IF   (CHORDT(IPZ) .LE. .001) GO TO  43
      G(J,IW)=2./WIDTH(I)*G(J,IW)+0.5*(-1.)**M*GAMAO/WIDTH(I)
      IF   (IK .EQ. 0) G(J,IW)=G(J,IW)*SQRT(HAB)/2.828427124
      IF   (IK .EQ. 1) G(J,IW)=G(J,IW)*SQRT(HAB)/4.
      GO TO  43
40    SM = 0.
      DO  42 LQ = 1,MM
      LP = L1+(LQ-1)*MK
      AA = 1.
      DO  41 LS=1,MM
      LN = L1+(LS-1)*MK
      IF   (LS.EQ.LQ) GO TO  41
      AA = AA*(BREAK(I+1)-YCP(LN))/(YCP(LP)-YCP(LN))
41    CONTINUE
```

```
42    SM = SM+AA*CL(LQ)
      DYT(J,IW) = SM
      TP(J,IW) = TAN
43    CONTINUE
      NK2=LL
44    CONTINUE
      IF (NCON.NE.0) GO TO  48
      DO  47 K=1,IW
      CTIP(K)=0.
      IPZ = 1
      IF  (K .EQ. 2) IPZ=3
      IF  (CHORDT(IPZ) .LE. 0.001) GO TO  47
      CHD=CHORDT(IPZ)+CHORDT(IPZ+1)
      CHORD=CH(1)
      IF  (NW(2) .NE. 0) CHORD=CH(1)+CH(1+NCS)
      DO  46 I=1,NCW
      J=I
      IF  (I .GT. NW(1)) J=LPAN1+I-NW(1)
      XC=(XV(J)-XLE(1))/CHORD
      CTDS(I,K) = 0.
      IF  (K .EQ. 2) GO TO  45
      IF  (IPS1 .EQ. 2 .AND. I .GT. NW(1)) GO TO  46
      IF  (IPS1 .EQ. 1) GO TO  46
45    CONTINUE
      FCD = 1.
      IF  (G(I,K).LT.0.) FCD = -1
      CTDS(I,K) = 2.*PI*G(I,K)*G(I,K)/CHD*FCD
46    CONTINUE
47    CONTINUE
48    RETURN
      END
```

```
      SUBROUTINE SPLINE (N,X,Y,A,B,C,D,LM,NP)
C     CUBIC SPLINE INTERPOLATION
      DIMENSION S(125), H(22), CA(22), X(1), Y(1)
      DIMENSION A(NP,20), B(NP,20), C(NP,20), D(NP,20)
      L =LM
      I=1
      NI=N+1
      N1=N-1
      H(NI)=0.
      H(1) = X(3) - X(2)
      H(2) = -X(3) + X(1)
      H(3) = X(2) - X(1)
      DO  1 K=4,N
 1    H(K)=0.
      DO  2 K=1,N
 2    S(K)=-H(K+1)/H(1)
      NJ=N-1
      DO  7 I=2,N
      IF  (I .EQ. N) GO TO  3
      H(NI) = -6.*((Y(I+1) - Y(I)) / (X(I+1) - X(I)) - (Y(I) - Y(I-1)) /
     1 (X(I) - X(I-1)))
      GO TO  4
 3    H(NI)=0.
 4    DO  6 J=1,N
      H(J)=0.
      IF  (I .EQ. N) GO TO  5
      IF  (J .LT. (I-1) .OR. J .GT. (I+1)) GO TO  6
      H(I-1) = X(I) - X(I-1)
      H(I) = 2.* (X(I+1) - X(I-1))
      H(I+1) = X(I+1) - X(I)
      GO TO  6
 5    H(N-2) = X(N) - X(N-1)
      H(N-1) = -X(N) + X(N-2)
      H(N) = X(N-1) - X(N-2)
 6    CONTINUE
      II=I
      CALL VMSEQN (NJ,II,H,S,CA)
      NJ=NJ-1
 7    CONTINUE
      DO  8 I=1,N1
      A(L,I) = (S(I+1) - S(I)) / (6. * (X(I+1) - X(I)))
      B(L,I) = S(I) / 2.
      C(L,I) = (Y(I+1) - Y(I)) / (X(I+1) - X(I)) - (X(I+1)- X(I)) * (2.*
     1S(I) + S(I+1)) / 6.
 8    D(L,I) = Y(I)
      RETURN
      END
```

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16 Abstract

This report documents a user's guide to an improved version of Woodward's chord plane aerodynamic panel computer code which is applicable to cambered wings exhibiting edge-separated vortex flow, including those with leading-edge vortex flow at subsonic and supersonic speeds. Instead of assumming the rotated suction force to be normal to the wing surface at the leading edge, new orientations for the rotated suction force are employed based on the momentum principal. The supersonic suction analogy method is improved using an effective angle of attack defined through a semi-empirical method.

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