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COMPUTER PROGRAM FOR CALCULATING AERODYNAMIC CHARACTERISTICS OF UPPER-SURFACE-BLOWING AND OVER-WING-BLOWING CONFIGURATIONS

BY

Dr. C. Edward Lan and Greg L. Fillman, University of Kansas and
Charles H. Fox, Jr., NASA Langley Research Center

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16. Abstract This document describes in detail the necessary information for using a computer program to calculate the aerodynamic characteristics of upper-surface-blowing (USB) and over-wing-blowing (OWB) configurations. The program is based on the inviscid wing-jet interaction theory of Lan and Campbell, and the jet entrainment theory of Lan. In the interaction theory, the flow perturbations are computed both inside and outside the jet, separately, and then matched on the jet surface to satisfy the jet-boundary conditions. The jet Mach number is allowed to be different from the freestream value (Mach number nonuniformity). These jet-boundary conditions require that the static pressure be continuous across the jet surface which must always remain as a stream surface. These conditions, as well as the wing-surface tangency condition, are satisfied only in the linearized sense. The detailed formulation of these boundary conditions is based on the quasi-vortex-lattice method of Lan.

The main assumptions used in developing the theory are as follows: (1) the flow perturbations, both inside and outside the jet, satisfy the Prandtl-Glauert equation and all boundary conditions have been linearized; (2) the jet is either of the rectangular or circular shape with constant cross section and constant properties in the unperturbed flow for the purpose of interaction calculations; and (3) no fuselage, nacelles, or wing thickness are accounted for.

The program is written in Fortran language and runs on CDC 6600 and Honeywell 66/60 computers. It is available from COSMIC of the University of Georgia, Athens, Georgia.

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C. Edward Lan

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INTRODUCTION

This document describes in detail the necessary information for using a computer program to calculate the aerodynamic characteristics of upper-surface-blowing (USB) and over-wing-blowing (OWB) configurations. The program is based on the inviscid wing-jet interaction theory described in references 1 and 2, and the jet entrainment theory developed in reference 3. In the interaction theory, the flow perturbations are computed both inside and outside the jet, separately, and then matched on the jet surface to satisfy the jet-boundary conditions. The jet Mach number is allowed to be different from the freestream value (Mach number nonuniformity). These jet-boundary conditions require that the static pressure be continuous across the jet surface which must always remain as a stream surface. These conditions, as well as the wing-surface tangency condition, are satisfied only in the linearized sense. The detailed formulation of these boundary conditions is based on the quasi-vortex-lattice method (reference 4).

The main assumptions used in developing the theory are as follows: (1) the flow perturbations, both inside and outside the jet, satisfy the Prandtl-Glauert equation and all boundary conditions have been linearized; (2) the jet is either of the rectangular or circular shape with constant cross section and constant properties in the unperturbed flow for the purpose of interaction calculations; and (3) no fuselage, nacelles, or wing thickness are accounted for.

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SYMBOLS

A_j	cross sectional area of the jet
C_T	thrust coefficient = V_j/qS_W
M_j	Mach number of the jet
M_∞	Mach number of the freestream
p_{tj}	jet total pressure
p_∞	freestream total pressure
q	freestream dynamic pressure
S_W	wing area
T_j	temperature of the jet (total)
T_∞	freestream total temperature
V_j	jet velocity
V_∞	freestream velocity
AR	wing aspect ratio
L.E.	leading edge
T.E.	trailing edge
ρ_j	jet density
ρ_∞	freestream density
γ	ratio of specific heats

COMPUTER PROGRAM DESCRIPTION

Program Capabilities

This computer program provides a theoretical method for determining the aerodynamic characteristics of arbitrary wings under the influence of a single centered jet or a pair of jets blowing on or above the plane of the wing. The program is applicable to both USB and OWB configurations. The most important characteristic of the program is the ability to account for both the jet entrainment and the inviscid wing-jet interaction processes in calculating the aerodynamic characteristics of the wing. The entrainment theory is applicable to compressible heated jets and the interaction theory can be applied to jets with Mach number nonuniformity. The following is a list of the aerodynamic characteristics the program will calculate:

1. Spanwise and chordwise pressure distributions, ΔC_p, across the wing for both the jet-on and wing-alone cases.
2. The spanwise distribution of sectional lift, induced-drag and pitching moment coefficients due to circulation for both the jet-on and wing alone cases.
3. The total lift, induced-drag and moment coefficients due to circulation when both entrainment and interaction are accounted for.
4. For OWB configurations, the total lift, drag and moment coefficients due to circulation are calculated recognizing only entrainment effects, thus establishing the relative importance of entrainment and interaction for a particular configuration.

5. For USB configurations, the force and moment coefficients due to coanda turning of the jet.
6. The total force and moment coefficients for the wing alone case.

Wing-Jet Geometry Limitations

As already mentioned, this program can be applied to configurations which employ a single jet centered on or above the root chord of the planform or two jets symmetrically located on the left and right wing, respectively. The jet cross-section shape may be round or rectangular. The jet exit may be located in any position relative to the wing so long as the bottom edge of the exit is on or above the plane of the wing. It is always assumed that the jet is blowing parallel to the root chord of the wing. No spanwise jet-velocity components can be accounted for. The jet may have any Mach number or temperature, although the freestream velocity must be subsonic.

The program has purposely been constructed so that a wide variety of wing planform geometries can be input. The wing may have linear twist and any conceivable camber desired. The camber may vary linearly from root to tip. The effect of wing thickness is unaccounted for, and the wing cannot have dihedral or anhedral. The wing may have as many as five separate flaps (all plain) and each may have its own shape and size as well as its own deflection angle (always positive). The root and tip chords of the wing and flaps must be parallel to the freestream. The wing leading and trailing edges may not have any curvature but can consist of a series of straight lines. These edges may have slope-discontinuities or step shifts. This last statement also applies to the relative position of various flap hinge lines to each other. However, too many points of slope discontinuities would complicate the geometry input.

Preparation of Wing Planform Geometry

In order to prepare the wing planform geometry, the top-view of the right half of wing must be plotted in an X-Y coordinate system (see Fig. 1). The X axis is located at the root chord and oriented in the streamwise direction. The position of the wing relative to the Y-axis is arbitrary, but all pitching moments are calculated relative to the Y-axis. Even if the wing has camber and flap deflections the wing should be plotted as a flat plate with zero flap deflection. (see Figure 1(a))

The wing should now be divided into a number of individual panels by drawing in break lines, which should be parallel to the X-axis and extend across the entire wing. (See figure 1(b)). These break lines should be drawn from such discontinuities as a slope change in the leading or trailing edge or the inboard and outboard edges of flaps. In addition, lines should extend from the inboard and outboard edges of the jet exit. If the exit is above the X-Y plane of the wing then the top-view projection of the exit onto the wing plane must be used. The portion of the wing between these two lines i.e. (the part of the wing under the jet) will be

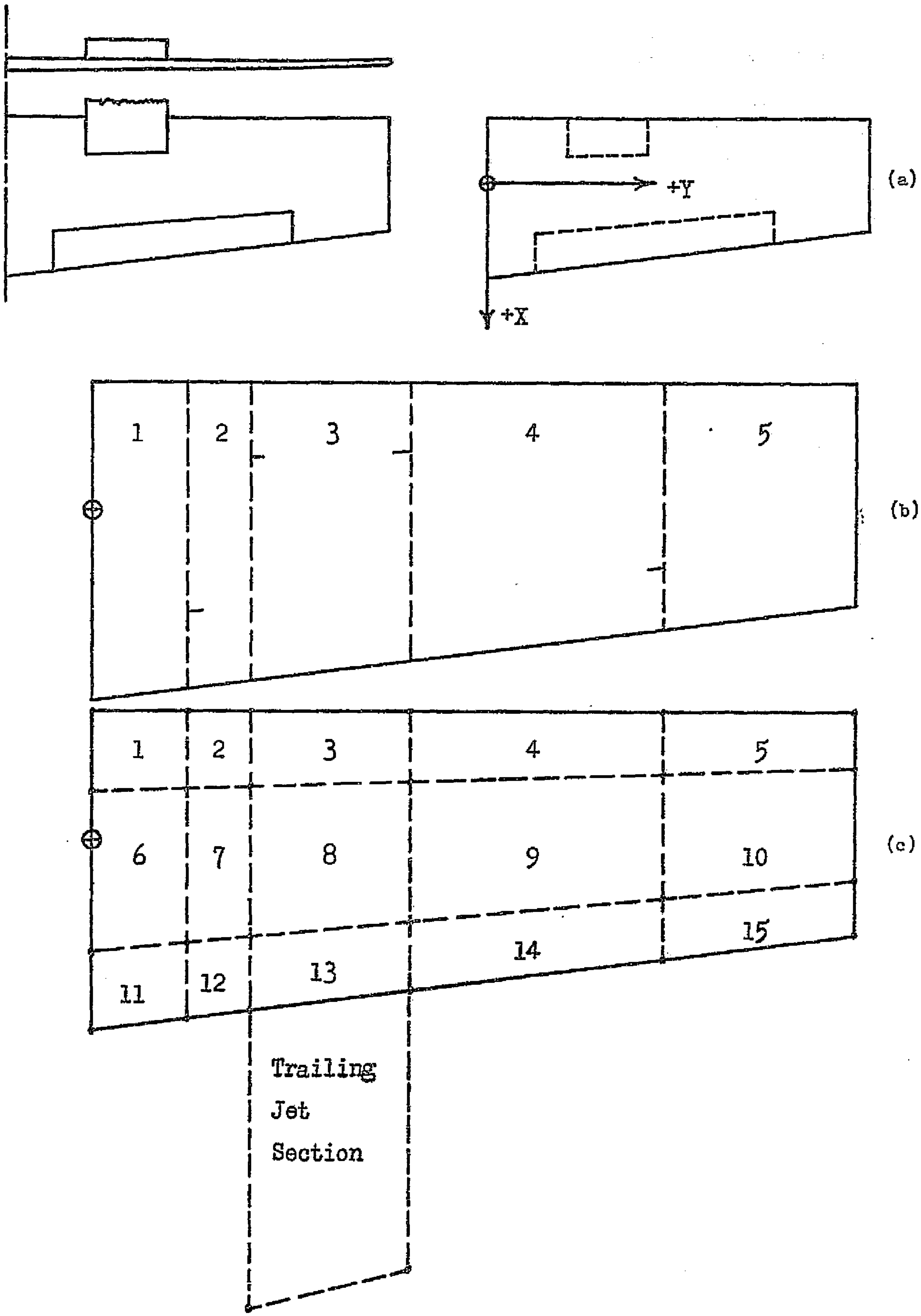
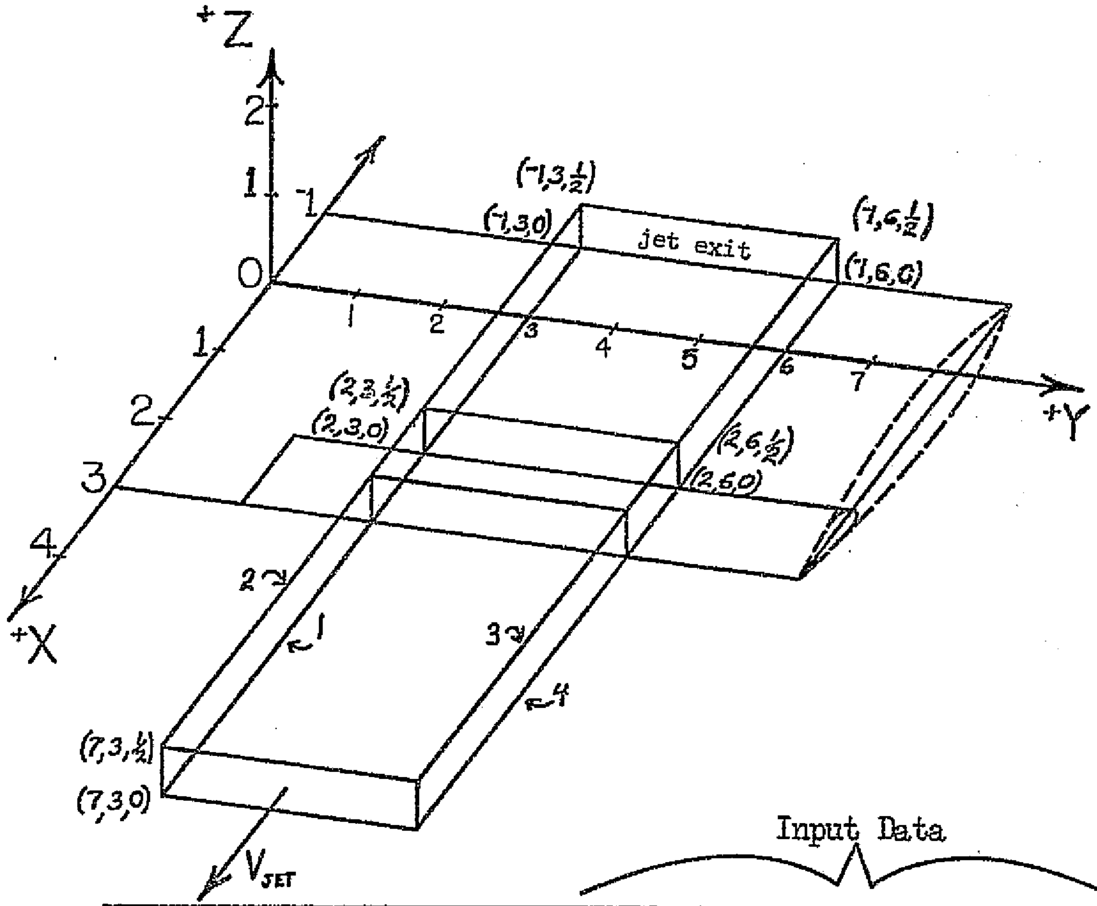


Figure 1 Preparation of the Wing Planform Geometry

referred to as the jet span. In figure 1(b) there are 3 spans within the influence of the flap, so there will be 3 flap sections (NFP=3) even though they represent only 1 flap. The spans are always numbered from inboard to outboard and the numerical order of the flap and jet spans amongst the spanwise sections is 2, 3, 4 in figure 1(b). Of these 3 spans the jet span is the second from the left so the numerical order of the jet span is 2,(NJP = 2). The number NJP should not be confused with the numerical order of the flap and jet spans <u>amongst the other spans</u>. The wing may be divided spanwise into as many as 8 individual spans.(Variables NFP, NJP, are defined in the input data format)

Once this is done the spans must be subdivided in the chordwise direction into individual wing sections. In the chordwise direction the wing can be divided into a maximum of three sections. (See Fig. 1(c)). Break lines should be drawn from the root chord to the tip chord along such dicontinuities as the flap hinges or the aft edge of the jet exit. These break lines may exhibit slope changes or a step jump at the border of each wing span. This would be the case if a wing has two or more flaps whose hinge lines do not lie upon the same line. If it is possible, it is best to draw the chordwise break lines such that they lie along a constant percentage of the wing chords. This helps to make the distribution of wing vortex elements more uniform. This is the case in figure 1(c), where both the jet exit and the flap hinge are constant percentage chordwise lines.



Card	Jet Section	Edge (I)	XXL(I)	XXT(I)	YL(I)	ZL(I)
1	1st	1	-1	2	3	0
2		2	-1	2	3	.5
3		3	-1	2	6	.5
4		4	-1	2	6	0
5	2nd	1	2	3	3	0
6		2	2	3	3	.5
7		3	2	3	6	.5
8		4	2	3	6	0
9	3rd	1	3	7	3	0
10		2	3	7	3	.5
11		3	3	7	6	.5
12		4	3	7	6	0

Figure 2 Input Coordinates For USB Jet Sections

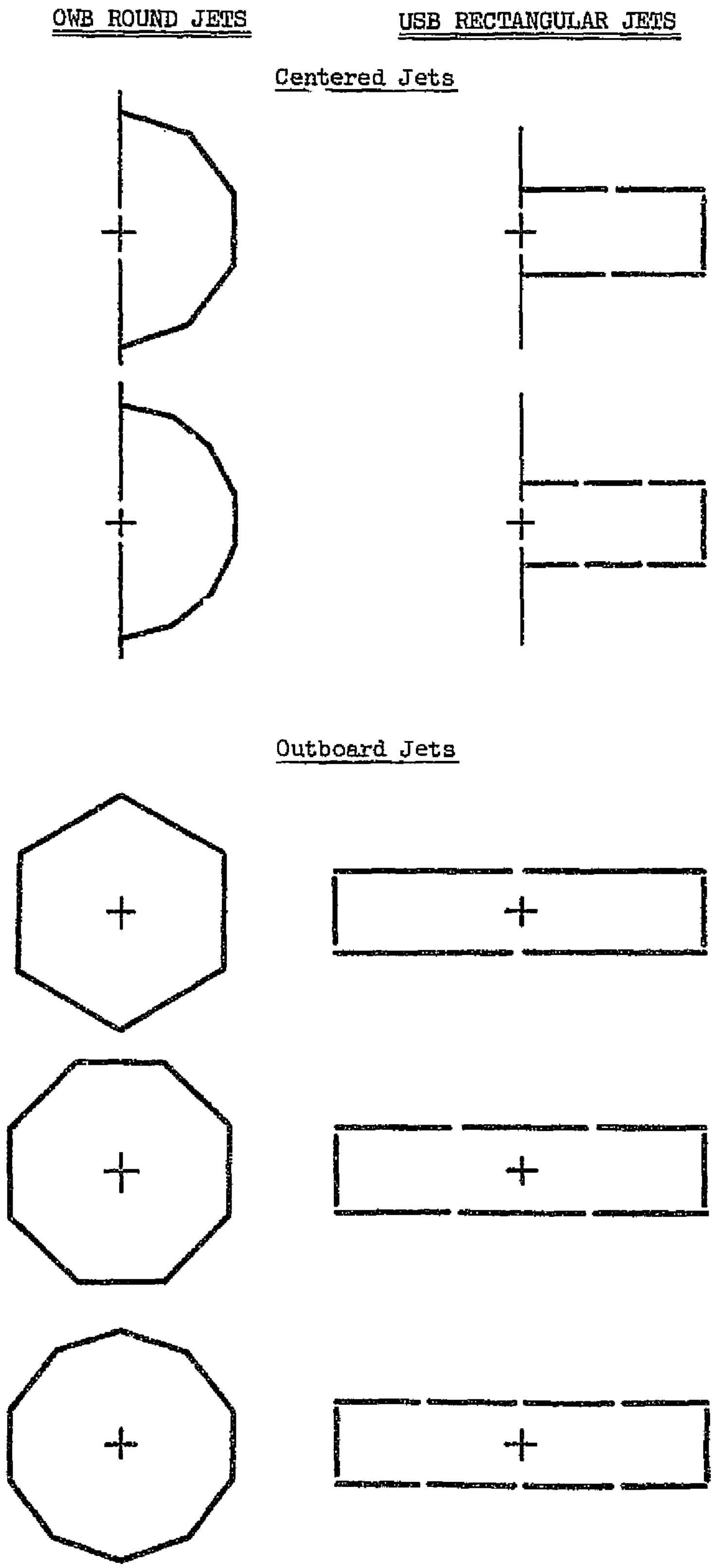
The wing sections should be numbered from inboard to outboard starting with the most forward row. The jet span of figure 1(c) has been divided into three sections and, although the jet exit lies on the boundary between section 3 and section 8, all three sections are considered jet sections. Another jet section must always be added downstream of the wing with a streamwise length of at least one local chord length. This section is referred to as the trailing jet section. The only instance when the jet sections do not extend to the leading edge is when the jet exit is located on or above the trailing edge. In this case only the trailing jet section is considered a jet section. If the jet exit is forward of the leading edge, another jet section must be added to include the area between the jet exit and the leading edge. A maximum of 4 jet sections are allowed. If the job to be run is an OWB configuration, then only the X-Y coordinates of the jet section corner points need be defined. However, if the job is an USB configuration, then the jet sections must be thought of as rectangular parallelepipeds whose lower surfaces are on or above the plane of the wing, and whose thickness is that of the rectangular jet exit. Coordinates for each of the four edges of these parallelepipeds must be input as shown in figure 2. There will be four cards per jet section. The jet sections will be defined starting with the most forward section and working toward the trailing jet section. Even if the trailing jet is deflected down by a flap deflection, the coordinates for this section must be input as if there is no deflection of the jet and its lower surface remains on the X-Y plane. If the jet exit is on the wing plane, the Z co-ordinates of the lower surface of each section must always be zero, even if the wing surface is cambered.

Vortex Element Distribution

Small horseshoe vortex elements must be distributed across the entire wing as evenly as possible. This is done by allotting each wing section a certain number of vortex elements according to the relative size of the sections. The bound portion of the vortices are aligned in a matrix pattern of columns and rows within each wing section. Each wing section must have at least 2 bound elements in the spanwise direction and 2 elements in the chordwise direction; i.e. each wing section must be allocated at least 4 vortex elements.

The wing sections are also arranged in columns and rows. All wing sections in the same row must have the same chordwise distribution of vortex elements. For example, in fig. 1(c) if NW(1) = 2, then wing sections 1 thru 5 all have 2 chordwise vortex elements. If the wing is divided into 3 sections in the chordwise direction, then setting NW(1) = 2, NW(2) = 3, NW(3) = 2 should produce good results. If a wing has no flap and the jet exit is forward of the leading edge, then there will be no chordwise divisions of the wing, and NW(1) = 5 should produce good results. In this case NW(2) and NW(3) would be set equal to 0.

All wing sections in the same column must have the same spanwise vortex element distribution. If, for example, in fig. 1(c) M1(4) = 5, then sections 4, 9, and 14 all have 4 spanwise vortex strips. M1(I)



Vortex Strips	NSJ	M1(I)
5	6	3
7	8	4
6	5	3
8	7	4
10	9	5

Figure 3 Vortex Models of Circular and Rectangular Jets

is always equal to the number of vortex strips plus 1. Narrow wing sections should have only 2 or 3 vortex strips while wide wing sections should have 4 (M1(I) = 5) to 6 (MI(I) = 7) strips.

The jet circumference is covered with vortex strips in the manner indicated in Fig. 3. Vortex strips are arranged either in a rectangular pattern for USB jets or to form a regular polygon for OWB circular jets. In either case, the inboard and outboard edges of the jet are always normal to the wing plane. Referring to figure 3, if 8 vortex strips are used to model a non-centered jet, in either a rectangular or circular shape, 2 of the strips will be positioned to form the inboard and outboard edges leaving 3 strips to span the top of the jet and 3 strips to span the bottom. In this case the blown wing sections (jet sections) must also have 3 vortex strips (M1(I) = 4). Wing and jet vortex strips must always be coordinated in this manner. The centered jet configurations must also exhibit the same spanwise coordination of vortex strips. The following equations can be used as a check:

Centered Jet	Outboard Jet
$M1(1) = \frac{NSJ}{2}$	$M1(I)_{JET} = \frac{NSJ + 1}{2}$

The chordwise distribution of vortex elements for the wing sections and jet sections must also be identical. The trailing jet section should have 6 elements in the chordwise direction if it is deflected. If it is undeflected, 4 elements will suffice. The maximum number of vortex elements that can be used to model the wing is 100. The total number of vortices representing the wing can be determined with the following equation:

$$LPANEL = [NW(1) + NW(2) + NW(3)] x [\sum_{I=1}^{NC} (M1(I) - 1)]$$

A maximum of 100 elements can be used to model the jet surface. However, an equal number of jet vortices is used to represent perturbations inside the jet region. Thus, the total number of unknowns allowed for both the wing and jet is 300.

The number of vortex elements used to represent the outside (or inside) of the jet surface can be computed as follows:

Centered jet

$$JPANEL = [\sum_{I=1}^{NNJ} NCJ(I)] \times [NSJ - 1]$$

Outboard jet

$$JPANEL = [\sum_{I=1}^{NNJ} NCJ(I)] \times [NSJ + 1]$$

The total number of unknowns to be solved, including the jet vortices for the jet flow in the present two-vortex-sheet representation of the jet interaction, is then

$$LTOTAL = LPANEL + 2 \times JPANEL$$

<u>INPUT DATA FORMAT</u>

Group 1. Format 13A6 1 card

Any title identifying the cases to be run.

Group 2. Format 3(6X,I4) 1 card

ICASE	Number of cases to be run.
NG	= 0 if all cases have the same geometry other than the angle of attack.
	= 1 if new configurations or different freestream-jet velocity ratios are to be treated.
ISYM	= 0 for a centered jet
	= 1, otherwise.

Group 3. Format 8F10.5 1 card.

AM1	Mach number of the freestream
AM2	Mach number of the jet flow
VMU	Freestream velocity divided by jet velocity.
TEMP	Jet total temperature divided by freestream total temperature. Assumed to be the same as ratio of freestream density and jet density.
ALP	Angle of attack in degrees.
XEL	X-coordinate of the wing L.E. at the jet centerline.
XET	X-coordinate of the wing T.E. at the jet centerline.

<u>Note:</u> If the thrust coefficient is given, VMU may be computed as

$$\frac{V_j}{V_\infty} = \frac{1}{2}\{ 1 + [1 + \frac{2C_T (S_W/2)}{A_j(\rho_j/\rho_\infty)}]^{1/2} \}$$

$$VMU = V_\infty/V_j$$

where C_T = thrust coefficient

S_W = wing area used to define C_T.

A_j = jet cross-sectional area

If the nozzle pressure ratio, $p_{t,j}/p_\infty$, is given, the following isentropic relations <u>may</u> be used.

$$M_j^2 = \frac{2}{\gamma-1}\left[\left(\frac{p_{t,j}}{p_\infty}\right)^{\frac{\gamma-1}{\gamma}} - 1\right]$$

$$\frac{T_j}{T_\infty} = \frac{1 + \frac{\gamma-1}{2} M_\infty^2}{1 + \frac{\gamma-1}{2} M_j^2}$$

$$\frac{V_\infty}{V_j} = VMU = \frac{M_\infty}{M_j} \frac{1}{\left(\frac{T_j}{T_\infty}\right)^{1/2}}$$

Group 4. Format 2(6X, I4) 5F10.5

NFP Number of flap sections, including the jet span, A maximum of five flap sections may be input.

NJP Numerical order of the jet span among the NFP sections.

DF(I) I=1, NFP Flap deflection angles in degrees for the flap sections.

Group 5. Format 7F10.5 1 card

HALFSW One half of the reference wing area.

TWIST Difference in angles of attack at the tip and the root in deg. Negative for washout.

TWISTR Incidence angle of the root chord in degrees.

XJ X, Y, and Z-coordinates of the midpoint of the jet cross-

YJ section at the exit.

ZJ

RJ Jet radius.

Note: The last four variables are needed only for over-wing-blowing applications. They may be any non-zero numbers for USB applications, unless the rectangular jet is not on the wing surface and the entrainment effect is to be accounted for. For the latter case, these variables are used to define the equivalent circular jet.

Group 6. Format 7F10.5 1 card

TEANGL Trailing-edge half angle of the airfoil at the jet centerline in deg. For USB applications, it may be arbitrary.

PTIAL = 0. for clean or full-span flap configuration

= 1. for partial-span flap deflection.

USB = 1. for USB applications

= 0. for OWB applications

CAMLER L.E. camber slope at the root leading edge

CAMLET L.E. camber slope at the tip leading edge.

CAMTER T.E. camber slope at the root trailing edge

CAMTET T.E. camber slope at the tip trailing edge.

Note: For USB applications, TEANGL may be any value. If the camber ordinates are to be read in, the leading edge and trailing edge camber slopes may be arbitrary numbers.

Note: The following card must be omitted for OWB applications.

Group 7   Format 3F10.5   1 card

CMU   Jet thrust coefficient

DFJ   Jet deflection angle in degrees at the trailing edge relative to the chord line. At small flap angles, it may be taken as the sum of flap angle and the airfoil trailing edge half angle. At large flap angles, experimental values should be used.

TNJ   = 0. if the entrainment is not to be accounted for. Usually this is the case if the jet is on the wing surface.

= 1. if the entrainment due to an equivalent round jet is to be accounted for when a rectangular jet is not on the wing surface.

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

NC   Number of spanwise sections. A natural way of dividing a planform into sections is to follow lines of discontinuity, such as edges of partial-span flap, jet boundaries, wing edge discontinuities, etc. See Figure 1. NC is limited to 8.

M1(1)
.
.
.
I-1,NC   Number of vortex strips in each spanwise section, plus one. Minimum value for each is 3. Maximum for each M1(I) is 31. The total number of spanwise strips is limited to 30.

Group 9   5(6X, I4) 1 card

NJW(I)
I=1,NFP   The numerical order of the flap and jet spans among the spanwise sections.

Group 10 Format 5(6X, I4) 1 card

NW(1) Number of chordwise vortex elements in each chordwise section.

NW(2) The planform is divided into chordwise sections according

NW(3) to such lines of discontinuity as jet exit, flap hinge, etc. If there is only one section, SET NW(2) = NW(3) = 0. For 2 sections, SET NW(3) = 0.

ICAM = 1 if the camber ordinates of the airfoils are to be read in.

= 0, otherwise. In this case, the camber functions $(\frac{dZ_c}{dx})$ in close-form expressions are to be inserted manually into subprograms ZCR(x) and ZCT(X), the root chord and tip chord camber functions, respectively.

IM Number of camber ordinates to be read in. (Limited to eleven). Arbitrary if ICAM = 0.

<u>Note</u>: Group 11 must be deleted if ICAM = 0.

Group 11. Format 8F10.5 4 or 8 cards

XT(1,J), J=1,IM Non-dimensional x-coordinates to define root camber.

ZC(1,J), J=1,IM Non-dimensional camber ordinates of the root chord.

XT(2,J), J=1,IM Non-dimensional x-coordinates to define tip camber.

ZC(2,J), J=1,IM Non-dimensional camber ordinates of the tip chord.

Group 12. Format 6F10.5 1 card for each wing section.

XXL(1) x-coordinate of the leading edge of the inboard boundary chord of a given spanwise section.

XXT(1) x-coordinate of the trailing edge of the inboard boundary chord of the same spanwise section.

YL(1) y-coordinate of the inboard boundary chord.

XXL(2) x-coordinate of the leading edge of the outboard boundary chord of the same spanwise section.

XXT(2) x-coordinate of the trailing edge of the outboard boundary chord

YL(2) y-coordinate of the outboard boundary chord.

Group 13. Format 6(6X, I4), 1 card

NNJ Number of jet sections.

Note. The jet region above or on the wing must be divided into streamwise sections by following the divided planform pattern. It is important to start the jet sections always from the wing leading edge even if the jet exit is downstream of the leading edge. The only exception is when the jet exit is at the trailing edge. In this case, NNJ=1 and the jet section starts from the trailing edge. NNJ is limited to 4. For the configuration of Figure 1, NNJ=4.

NSJ = Number of jet circumferential strips minus one for a non-centered jet (always use odd numbers).

= Number of jet circumferential strips on the half jet plus one for a centered jet (always use even numbers). See figure 3.

NCJ(I), I=1,NNJ No. of streamwise vortex elements in each section. There should be NNJ numbers. For those jet sections above the wing, these numbers should agree with the corresponding numbers of wing vortices. See NW(1). NW(2), NW(3) in Group 10.

Note: Group 14 must be deleted for USB applications

Group 14. Format 6F10.5 NNJ cards

XXL(1)	
XXT(1)	
YL(1)	
XXL(2)	Coordinates of bounding chords of the jet section
XXT(2)	projected on the x-y plane. For definition, see Group 12.
YL(2)	

Note. Group 15 is to be deleted for OWB applications.

Group 15. Format 4F10.5 (4xNNJ) cards.

XXL(I)	Coordinates of the bounding lines defining the
XXT(I)	rectangular jet sections in USB applications.
YL(I)	They are the x-coordinates of the leading and
ZL(I)	trailing edges, the y-coordinate and the z-
I=1,...,4	coordinate of the bounding line. The 4 stream-wise edges of each section are defined in the order illustrated in figure 2. There are 4 cards for each jet section. The jet section behind the trailing edge, (trailing jet section), should be at least one local chord in length.

Group 16 Format F10.5 (ICASE-1) cards

ALP angles of attack in degrees. These cards are to be included only if additional angles of attack for the same configuration and VMU (NG=0) are to be run.

Note: The read statements for the input data in group 3 thru group 15 can be seen in subroutine "GEOMTY" of the program listing along with a short definition of the parameters to be read in. The read statements for groups 1, 2, and 16 along with the corresponding parameter definitions can be seen near the beginning of the program listing in the main routine.

Pre-Run Check List

Before the program is run, the following checklist should be completed:

(1) The array, GAMMA, defined in the subroutine "SOLUTN", should be dimensioned to have at least $(N+1)^2/4$ elements, where N is the total number of unknowns (= LTOTAL).

(2) For N = 283, the minimum memory needed is 42K (decimal). For any other N, the required memory can be computed accordingly, based on the change in GAMMA array.

(3) The root and tip camber slope functions should be defined manually in the subprograms ZCR(X), ZCT(X) respectively, otherwise the root and tip camber ordinates should be read in. The camber slope function, dz_c/dx, is defined with respect to a unit chord length.

(4) Two temporary files or tapes must be provided, one being designated as (01) and the other (02).

(5) Check input data.

OUTPUT DATA FORMAT

First the title of the job and the input data will be printed in the same format as it was input. If the job is an over-wing blowing configuration the computed jet entrainment will be printed after the fourth line of input data as follows:

XJET	Downstream distance of a given cross-section from the jet exit divided by the jet radius at the exit (r_o).
R_{JET}	the radius of the jet cross section divided by the original jet radius (r_o).
$\frac{DM}{DX}$	Values printed are actually the nondimensionalized entrainment function $E(\bar{x})$ (see equation 33 of reference 3)
HALF SW	the reference half-wing area
CREF	the reference mean chord = $\frac{S_{wing}}{b} = \frac{\text{HALF SW}}{b/2}$
LPANEL	the number of wing vortices
JPANEL	the number of outer (or inner) jet vortices
LAST	the number of wing vortices plus the number of outer jet vorticies. LAST = LPANEL + JPANEL
LTOTAL	LTOTAL is the total number of vortices used which is also the total number of unknowns to be solved. LTOTAL=LPANEL + 2 (JPANEL) = LAST + JPANEL

If the job is an OWB configuration a note will be printed at this time indicating the shape of the equivalent jet cross-section used for the interaction computations along with 3 parameters defined below.

1. x-coordinate where the equivalent jet properties are evaluated.

2. Equivalent Jet Radius: the radius of the jet at the x location listed above

3. $\frac{V_o}{V_j}$ the velocity ratio of the equivalent jet.

Vortex Element Endpoint Coordinates

(X_1, Y_1, Z_1) coordinates for the inboard endpoint of a bound vortex element

(X_2, Y_2, Z_2) coordinates for the corresponding outboard endpoint. Wing elements are listed first and then jet elements. The number of elements listed should equal (LAST).

Control Point Coordinates

2 columns of control point coordinates, one point for each vortex element. Number of points listed should equal (LAST).

Sectional Pressure and Force Data

XV	Percent chord location
YV	Percent span location
CP	the total ΔC_p at the given (XV, YV) point due to both wing and jet induced circulation
CPW	The ΔC_p that would occur at that same point for the wing alone case
Y/SP	the y-coordinate of the chord in question divided by the half-span
CL	The sectional lift coefficient due to circulation (jet on), nondimensionalized with $q_\infty c$.
CM	The sectional pitching moment coefficient about the Y-axis, nondimensionalized with $q_\infty c^2$.
CT	The sectional leading edge thrust coefficient, nondimensionalized with $q_\infty c$.
CDI	The sectional induced drag coefficient, nondimensionalized with $q_\infty c$.
CLW	The sectional lift coefficient for the wing alone case
CMW	The sectional pitching moment about the Y-axis for the wing alone case
CDW	The sectional induced drag coefficient for the wing alone case.

Total Force and Moment Data

The Lift Coefficient - The total circulation lift coefficient due to the wing, wing-jet interaction and entrainment (if any).

Total Induced Drag Coefficient - Total induced drag coeff. for the jet on case

Induced drag parameter = $\dfrac{C_{D_I}}{C_L^2}$ or $\dfrac{1}{\pi e AR}$

Total Pitching Moment Coefficient = Pitching moment coefficient due to all circulation forces, about the Y-axis. Nondimensionalized with CREF.

<u>Note</u>: In the case of OWB jobs, these coefficients reflect the total jet-on forces and moments, but for USB jobs the coanda force and moment coefficients must be added to these; see below.

USB Jobs

Coanda Lift Coefficient - The lift coefficient due to the lift component of the jet reaction force

Coanda Drag Coefficient - Drag coefficient due to the drag component of the jet reaction.

The Coanda Moment Coeff. - Pitching moment coefficient due to the pitching moment caused by the jet reaction force (about Y-axis).

O.W.B. Jobs

In the case of O.W.B. jobs the next three coefficients listed have the same definition as the first three except that the effects of wing-jet interaction have been ommitted from the computation.

All Jobs

The last four coefficients printed are due to aerodynamic forces and moments generated solely by the wing without any jet effects. (jet off)

EXAMPLE INPUT AND OUTPUT

The following is an example of a simple over-wing blowing configuration including a listing of the input data cards and the corresponding output. (See figure 4) Following this is an example of an upper surface blowing job; see figure 5. Figure 6 is a plot of the wing and jet vortices for this USB job, which was made with the listing of the vortex endpoint coordinates in the output. Finally figure 7 is an illustration of one way of breaking down a more complicated wing into individual wing and jet sections.

Listing of Input Data Cards for the OWB Example Job

card							
1	*** FALK'S WING 1 WITH VMU=0.250***						
2		1	1	0			
3	0.	0.	0.250	1.	6.	0.	0.
4		1	1	0.0			
5	1.	0.	0.	-1.39536	0.	.17442	0.11628
6	5.25	0.	0.	0.	0.	0.	0.
7		2	3	9			
8		1					
9		5	0	0	0	0	
10	0.	1.	0.	0.	1.	0.11628	
11	0.	1.	0.11628	0.	1.	1.	
12		3	6	4	5	4	
13	-1.39536	0.	0.	-1.39536	0.	0.11628	
14	0.	1.	0.	0.	1.	0.11628	
15	1.	2.	0.	1.	2.	0.11628	

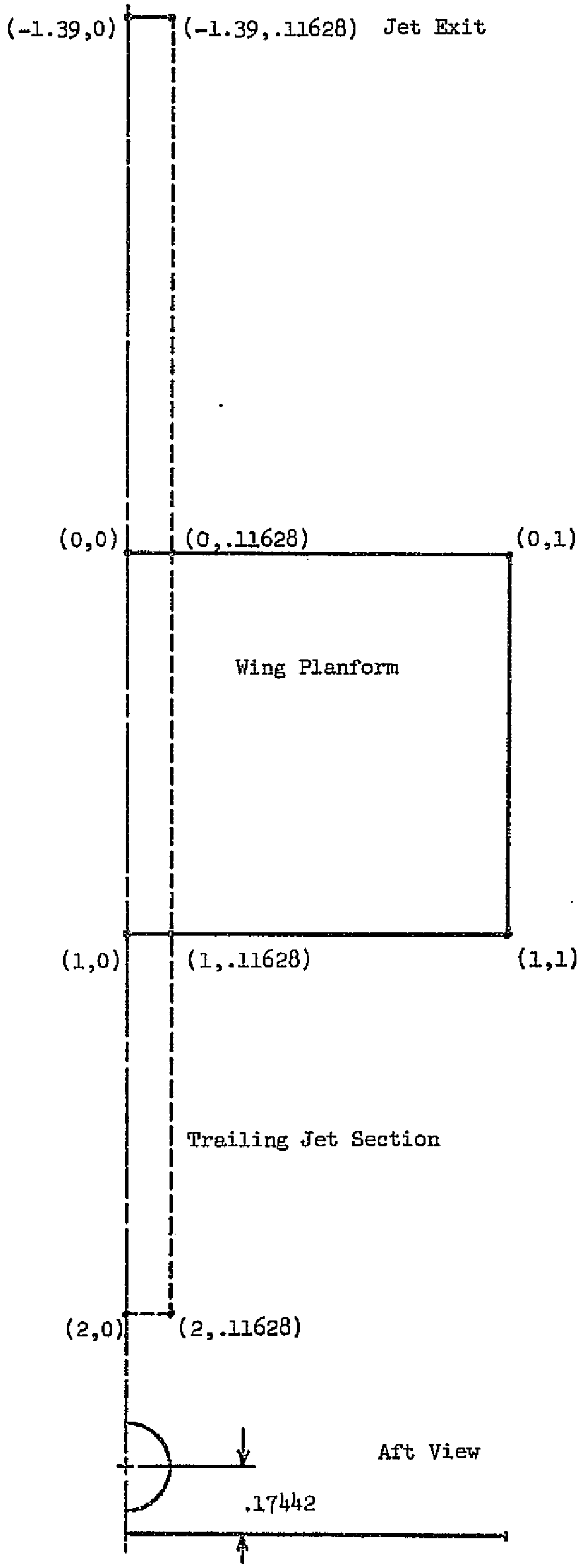


Figure 4 Wing and Jet Sections For The OWB Example

```
****************************************
 *** FALK"S WING I WITH VMU=0.250***
****************************************
        1         1         0
```

OUTPUT FOR THE OWB TEST CASE

```
                    XXXXXXXXXXXXXXXXXXXXXXXX

                        CASE NUMBER = 1

                    XXXXXXXXXXXXXXXXXXXXXXXX
```

INPUT DATA

0.00000	0.00000	.25000	1.00000	6.00000	0.00000	0.00000
1	1		0.00000			
1.00000	0.00000	0.00000	-1.39536	0.00000	.17442	.11628
5.25000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000

THE COMPUTED JET ENTRAINMENT ARE AS FOLLOWS

XJET	RJET	DN/DX
9.50930	2.70463	.08796
10.25930	2.70463	.08796
11.75930	2.70571	.08792
13.25930	2.72650	.08707
14.75930	2.78574	.08469
16.25930	2.87620	.08118
17.75930	2.98591	.07713
19.25930	3.10629	.07293
20.75930	3.23305	.06877
22.25930	3.36106	.06482
23.75930	3.48925	.06110
25.25930	3.61646	.05764
26.75930	3.74197	.05442
28.25930	3.86537	.05144
29.75930	3.98643	.04869
31.25930	4.10501	.04614
32.75930	4.22110	.04379
34.25930	4.33467	.04161
35.75930	4.44578	.03959
37.25930	4.55448	.03772
38.75930	4.66083	.03597
40.25930	4.76491	.03435
41.75930	4.86681	.03284
43.25930	4.96659	.03143
44.75930	5.06434	.03011
46.25930	5.16014	.02888
47.75930	5.25405	.02772
49.25930	5.34616	.02664
50.75930	5.43653	.02562

```
 52.25930   5.52523    .02466
 53.75930   5.61233    .02376
        2         3         5
        1
        5         0         0         0         0
  0.00000   1.00000   0.00000   0.00000   1.00000    .11628
  0.00000   1.00000    .11628   0.00000   1.00000   1.00000
        3         6         4         5         4
 -1.39536   0.00000   0.00000  -1.39536   0.00000    .11628
  0.00000   1.00000   0.00000   0.00000   1.00000    .11628
  1.00000   2.00000   0.00000   1.00000   2.00000    .11628
       HALF SW=  .10000E+01          CREF=  .10000E+01

LPANEL= 50   JPANEL= 65   LAST=115   LTOTAL=180

                    XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX

                    A RECTANGULAR JET WITH LATERAL EXTENT EQUAL
                    TO THE EQUIVALENT JET DIAMETER IS USED FOR
                    INTERACTION COMPUTATION

                    NOTE. CHECK WHETHER THE WING IS IMMERSED IN THE JET

                    XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX

THE EQUIVALENT JET PROPERTIES ARE EVALUATED AT    -.00000

THE EQUIVALENT JET RADIUS IS     .22168

THE VELOCITY RATIO OF THE EQUIVALENT JET,VO/VJ,IS     .41935

VORTEX ELEMENT ENDPOINT COORDINATES=

    X1         X2         Y1         Y2         Z1         Z2
   .02447     .02447    0.00000     .11084    0.00000    0.00000
   .20611     .20611    0.00000     .11084    0.00000    0.00000
   .50000     .50000    0.00000     .11084    0.00000    0.00000
   .79389     .79389    0.00000     .11084    0.00000    0.00000
   .97553     .97553    0.00000     .11084    0.00000    0.00000
   .02447     .02447     .11084     .22168    0.00000    0.00000
   .20611     .20611     .11084     .22168    0.00000    0.00000
   .50000     .50000     .11084     .22168    0.00000    0.00000
   .79389     .79389     .11084     .22168    0.00000    0.00000
   .97553     .97553     .11084     .22168    0.00000    0.00000
   .02447     .02447     .22168     .27381    0.00000    0.00000
   .20611     .20611     .22168     .27381    0.00000    0.00000
   .50000     .50000     .22168     .27381    0.00000    0.00000
   .79389     .79389     .22168     .27381    0.00000    0.00000
   .97553     .97553     .22168     .27381    0.00000    0.00000
   .02447     .02447     .27381     .36069    0.00000    0.00000
```

.20611	.20611	.27381	.36069	0.00000	0.00000
.50000	.50000	.27381	.36069	0.00000	0.00000
.79389	.79389	.27381	.36069	0.00000	0.00000
.97553	.97553	.27381	.36069	0.00000	0.00000
.02447	.02447	.36069	.47774	0.00000	0.00000
.20611	.20611	.36069	.47774	0.00000	0.00000
.50000	.50000	.36069	.47774	0.00000	0.00000
.79389	.79389	.36069	.47774	0.00000	0.00000
.97553	.97553	.36069	.47774	0.00000	0.00000
.02447	.02447	.47774	.61084	0.00000	0.00000
.20611	.20611	.47774	.61084	0.00000	0.00000
.50000	.50000	.47774	.61084	0.00000	0.00000
.79389	.79389	.47774	.61084	0.00000	0.00000
.97553	.97553	.47774	.61084	0.00000	0.00000
.02447	.02447	.61084	.74394	0.00000	0.00000
.20611	.20611	.61084	.74394	0.00000	0.00000
.50000	.50000	.61084	.74394	0.00000	0.00000
.79389	.79389	.61084	.74394	0.00000	0.00000
.97553	.97553	.61084	.74394	0.00000	0.00000
.02447	.02447	.74394	.86099	0.00000	0.00000
.20611	.20611	.74394	.86099	0.00000	0.00000
.50000	.50000	.74394	.86099	0.00000	0.00000
.79389	.79389	.74394	.86099	0.00000	0.00000
.97553	.97553	.74394	.86099	0.00000	0.00000
.02447	.02447	.86099	.94786	0.00000	0.00000
.20611	.20611	.86099	.94786	0.00000	0.00000
.50000	.50000	.86099	.94786	0.00000	0.00000
.79389	.79389	.86099	.94786	0.00000	0.00000
.97553	.97553	.86099	.94786	0.00000	0.00000
.02447	.02447	.94786	.99409	0.00000	0.00000
.20611	.20611	.94786	.99409	0.00000	0.00000
.50000	.50000	.94786	.99409	0.00000	0.00000
.79389	.79389	.94786	.99409	0.00000	0.00000
.97553	.97553	.94786	.99409	0.00000	0.00000
-1.34225	-1.34225	0.00000	.11084	.34821	.34821
-.96467	-.96467	0.00000	.11084	.34821	.34821
-.43069	-.43069	0.00000	.11084	.34821	.34821
-.05311	-.05311	0.00000	.11084	.34821	.34821
-1.34225	-1.34225	.11084	.22168	.34821	.34821
-.96467	-.96467	.11084	.22168	.34821	.34821
-.43069	-.43069	.11084	.22168	.34821	.34821
-.05311	-.05311	.11084	.22168	.34821	.34821
-1.34225	-1.34225	.22168	.22168	.34821	0.00000
-.96467	-.96467	.22168	.22168	.34821	0.00000
-.43069	-.43069	.22168	.22168	.34821	0.00000
-.05311	-.05311	.22168	.22168	.34821	0.00000
-1.34225	-1.34225	0.00000	.11084	0.00000	0.00000
-.96467	-.96467	0.00000	.11084	0.00000	0.00000
-.43069	-.43069	0.00000	.11084	0.00000	0.00000

-.05311	-.05311	0.00000	.11084	0.00000	0.00000
-1.34225	-1.34225	.11084	.22168	0.00000	0.00000
-.96467	-.96467	.11084	.22168	0.00000	0.00000
-.43069	-.43069	.11084	.22168	0.00000	0.00000
-.05311	-.05311	.11084	.22168	0.00000	0.00000
.02447	.02447	0.00000	.11084	.34821	.34821
.20611	.20611	0.00000	.11084	.34821	.34821
.50000	.50000	0.00000	.11084	.34821	.34821
.79389	.79389	0.00000	.11084	.34821	.34821
.97553	.97553	0.00000	.11084	.34821	.34821
.02447	.02447	.11084	.22168	.34821	.34821
.20611	.20611	.11084	.22168	.34821	.34821
.50000	.50000	.11084	.22168	.34821	.34821
.79389	.79389	.11084	.22168	.34821	.34821
.97553	.97553	.11084	.22168	.34821	.34821
.02447	.02447	.22168	.22168	.34821	0.00000
.20611	.20611	.22168	.22168	.34821	0.00000
.50000	.50000	.22168	.22168	.34821	0.00000
.79389	.79389	.22168	.22168	.34821	0.00000
.97553	.97553	.22168	.22168	.34821	0.00000
.02447	.02447	0.00000	.11084	0.00000	0.00000
.20611	.20611	0.00000	.11084	0.00000	0.00000
.50000	.50000	0.00000	.11084	0.00000	0.00000
.79389	.79389	0.00000	.11084	0.00000	0.00000
.97553	.97553	0.00000	.11084	0.00000	0.00000
.02447	.02447	.11084	.22168	0.00000	0.00000
.20611	.20611	.11084	.22168	0.00000	0.00000
.50000	.50000	.11084	.22168	0.00000	0.00000
.79389	.79389	.11084	.22168	0.00000	0.00000
.97553	.97553	.11084	.22168	0.00000	0.00000
1.03806	1.03806	0.00000	.11084	.34821	.34821
1.30866	1.30866	0.00000	.11084	.34821	.34821
1.69134	1.69134	0.00000	.11084	.34821	.34821
1.96194	1.96194	0.00000	.11084	.34821	.34821
1.03806	1.03806	.11084	.22168	.34821	.34821
1.30866	1.30866	.11084	.22168	.34821	.34821
1.69134	1.69134	.11084	.22168	.34821	.34821
1.96194	1.96194	.11084	.22168	.34821	.34821
1.03806	1.03806	.22168	.22168	.34821	0.00000
1.30866	1.30866	.22168	.22168	.34821	0.00000
1.69134	1.69134	.22168	.22168	.34821	0.00000
1.96194	1.96194	.22168	.22168	.34821	0.00000
1.03806	1.03806	0.00000	.11084	0.00000	0.00000
1.30866	1.30866	0.00000	.11084	0.00000	0.00000
1.69134	1.69134	0.00000	.11084	0.00000	0.00000
1.96194	1.96194	0.00000	.11084	0.00000	0.00000
1.03806	1.03806	.11084	.22168	0.00000	0.00000
1.30866	1.30866	.11084	.22168	0.00000	0.00000
1.69134	1.69134	.11084	.22168	0.00000	0.00000
1.96194	1.96194	.11084	.22168	0.00000	0.00000

CONTROL POINT COORDINATES=

XCP	YCP	ZCP	XCP	YCP	ZCP
.09549	.05542	0.00000	.34549	.05542	0.00000
.65451	.05542	0.00000	.90451	.05542	0.00000
1.00000	.05542	0.00000	.09549	.16626	0.00000
.34549	.16626	0.00000	.65451	.16626	0.00000
.90451	.16626	0.00000	1.00000	.16626	0.00000
.09549	.24514	0.00000	.34549	.24514	0.00000
.65451	.24514	0.00000	.90451	.24514	0.00000
1.00000	.24514	0.00000	.09549	.31272	0.00000
.34549	.31272	0.00000	.65451	.31272	0.00000
.90451	.31272	0.00000	1.00000	.31272	0.00000
.09549	.41626	0.00000	.34549	.41626	0.00000
.65451	.41626	0.00000	.90451	.41626	0.00000
1.00000	.41626	0.00000	.09549	.54326	0.00000
.34549	.54326	0.00000	.65451	.54326	0.00000
.90451	.54326	0.00000	1.00000	.54326	0.00000
.09549	.67842	0.00000	.34549	.67842	0.00000
.65451	.67842	0.00000	.90451	.67842	0.00000
1.00000	.67842	0.00000	.09549	.80542	0.00000
.34549	.80542	0.00000	.65451	.80542	0.00000
.90451	.80542	0.00000	1.00000	.80542	0.00000
.09549	.90895	0.00000	.34549	.90895	0.00000
.65451	.90895	0.00000	.90451	.90895	0.00000
1.00000	.90895	0.00000	.09549	.97653	0.00000
.34549	.97653	0.00000	.65451	.97653	0.00000
.90451	.97653	0.00000	1.00000	.97653	0.00000
-1.19101	.05542	.34821	-.69768	.05542	.34821
-.20435	.05542	.34821	0.00000	.05542	.34821
-1.19101	.16626	.34821	-.69768	.16626	.34821
-.20435	.16626	.34821	0.00000	.16626	.34821
-1.19101	.22168	.17410	-.69768	.22168	.17410
-.20435	.22168	.17410	0.00000	.22168	.17410
-1.19101	.05542	0.00000	-.69768	.05542	0.00000
-.20435	.05542	0.00000	0.00000	.05542	0.00000
-1.19101	.16626	0.00000	-.69768	.16626	0.00000
-.20435	.16626	0.00000	0.00000	.16626	0.00000
.09549	.05542	.34821	.34549	.05542	.34821
.65451	.05542	.34821	.90451	.05542	.34821
1.00000	.05542	.34821	.09549	.16626	.34821
.34549	.16626	.34821	.65451	.16626	.34821
.90451	.16626	.34821	1.00000	.16626	.34821
.09549	.22168	.17410	.34549	.22168	.17410
.65451	.22168	.17410	.90451	.22168	.17410
1.00000	.22168	.17410	.09549	.05542	0.00000
.34549	.05542	0.00000	.65451	.05542	0.00000
.90451	.05542	0.00000	1.00000	.05542	0.00000
.09549	.16626	0.00000	.34549	.16626	0.00000
.65451	.16626	0.00000	.90451	.16626	0.00000

1.00000	.16626	0.00000	1.14645	.05542	.34821
1.50000	.05542	.34821	1.85355	.05542	.34821
2.00000	.05542	.34821	1.14645	.16626	.34821
1.50000	.16626	.34821	1.85355	.16626	.34821
2.00000	.16626	.34821	1.14645	.22168	.17410
1.50000	.22168	.17410	1.85355	.22168	.17410
2.00000	.22168	.17410	1.14645	.05542	0.00000
1.50000	.05542	0.00000	1.85355	.05542	0.00000
2.00000	.05542	0.00000	1.14645	.16626	0.00000
1.50000	.16626	0.00000	1.85355	.16626	0.00000
2.00000	.16626	0.00000			

XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX

ALPHA = 6.000 DEGREES

XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX

VORTEX	XV	YV	CP	CPW
1	.02447	.05542	4.19144	1.46219
2	.20611	.05542	1.10949	.41118
3	.50000	.05542	.43299	.17943
4	.79389	.05542	.20702	.08080
5	.97553	.05542	.43452	.02380
6	.02447	.16626	2.06471	1.45205
7	.20611	.16626	.78838	.40701
8	.50000	.16626	.27282	.17689
9	.79389	.16626	.07586	.07952
10	.97553	.16626	.41985	.02341
11	.02447	.24514	2.25578	1.43773
12	.20611	.24514	.54247	.40100
13	.50000	.24514	.25654	.17329
14	.79389	.24514	.14245	.07775
15	.97553	.24514	.06023	.02288
16	.02447	.31272	2.04471	1.41836
17	.20611	.31272	.54242	.39279
18	.50000	.31272	.24903	.16845
19	.79389	.31272	.13046	.07539
20	.97553	.31272	.04762	.02220
21	.02447	.41626	1.83521	1.37963
22	.20611	.41626	.51211	.37635
23	.50000	.41626	.22991	.15896
24	.79389	.41626	.11360	.07084
25	.97553	.41626	.03724	.02088
26	.02447	.54326	1.64156	1.31156
27	.20611	.54326	.45673	.34743
28	.50000	.54326	.20091	.14305
29	.79389	.54326	.09626	.06345
30	.97553	.54326	.02989	.01875
31	.02447	.67842	1.44226	1.20253

32	.20611	.67842	.38300	.30144
33	.50000	.67842	.16420	.11988
34	.79389	.67842	.07774	.05315
35	.97553	.67842	.02390	.01585
36	.02447	.80542	1.20880	1.03763
37	.20611	.80542	.29228	.23554
38	.50000	.80542	.12232	.09081
39	.79389	.80542	.05828	.04071
40	.97553	.80542	.01826	.01245
41	.02447	.90895	.90654	.79296
42	.20611	.90895	.16906	.15404
43	.50000	.90895	.07939	.05941
44	.79389	.90895	.03866	.02728
45	.97553	.90895	.01293	.00893
46	.02447	.97653	.49804	.44017
47	.20611	.97653	.06684	.07249
48	.50000	.97653	.03863	.02898
49	.79389	.97653	.01923	.01363
50	.97553	.97653	.00742	.00515

Y/SP	CL	CM	CT	CDI	CLW	CMW	CDW
.05542	.91630	-.21781	.01545	.08077	.32617	-.07136	.01230
.16626	.54377	-.14334	.00185	.05526	.32296	-.07043	.01225
.24514	.48800	-.10981	.08780	-.03700	.31839	-.06912	.01218
.31272	.45449	-.10266	.04390	.00363	.31221	-.06735	.01205
.41626	.41430	-.09323	.03375	.00961	.29997	-.06388	.01180
.54326	.36677	-.08119	.02722	.01118	.27886	-.05804	.01134
.67842	.31155	-.06686	.02139	.01124	.24632	-.04943	.01053
.80542	.24693	-.05061	.01559	.01027	.20082	-.03825	.00924
.90895	.17216	-.03337	.00976	.00828	.14262	-.02550	.00726
.97653	.08870	-.01640	.00491	.00439	.07423	-.01256	.00381

THE LIFT COEFFICIENT = .39681

TOTAL INDUCED DRAG COEFFICIENT = .01854

THE INDUCED DRAG PARAMETER = .11772

TOTAL PITCHING MOMENT COEFFICIENT = -.09077

THE LIFT COEFFICIENT WITH JET ENTRAINMENT ALONE = .28960

THE INDUCED DRAG COEFFICIENT WITH JET ENTRAINMENT ALONE = .00866

THE PITCHING MOMENT COEFFICIENT WITH JET ENTRAINMENT ALONE = -.05961

THE LIFT COEFFICIENT FOR THE WING ALONE= .25238

THE INDUCED DRAG COEFFICIENT FOR THE WING ALONE= .01030

```
THE PITCHING MOMENT COEFFICIENT FOR THE WING ALONE=   -.05255

THE INDUCED DRAG PARAMETER FOR THE WING ALONE=     .16169

ERROR SUMMARY
    ERROR      TIMES
     0115      0151
```

```
4ARAKET.   76/10/07.NASA/LRC CY175-T   NOS 1.1 (T11)

10.12.10.USHOWB,T500,CM10000.
10.12.10.E1212      FILLMAN (USER##)
10.12.10.USER,274200E.
10.12.10.CHARGE,101429,LRC.
10.12.10.GET,OLDPL=USR.
10.12.13.UPDATE,Q,C,P,I,L=A1234.
10.12.18. UPDATE COMPLETE.
10.12.18.FTN,I,L=L.
10.33.42.    10.336 CP SECONDS COMPILATION TIME
10.33.42.LDSET,PRESET=NGINF,MAP=SB.
10.33.42.LGO.
10.33.48.     NON-FATAL LOADER ERRORS - SEE MAP
10.33.50.     NON-FATAL LOADER ERRORS - SEE MAP
10.40.24.    STOP
10.40.24.    18.334 CP SECONDS EXECUTION TIME
10.40.24.UEPF,       0.098KUNS.
10.40.24.UEMS,      22.784KUNS.
10.40.24.UECP,      30.190SECS.
10.40.24.AESR,     340.347UNTS.
```

Input Data for the USB Test Case

card							
1	*** USB TEST CASE, SEE TN D-7526						
2		1	1	1			
3	0.	0.	0.1288	1.	6.	-1.968	3.2927
4		3	2	60.0	60.0	60.0	
5	89.7435	-3.0	1.5	-0.9158	4.8	0.0	0.5
6	0.0	1.0	1.0	0.11638	0.23277	-0.02532	-0.05064
7	2.0	62.0	0.0				
8		5	3	3	4	4	4
9		2	3	4			
10		2	3	2	0	5	
11	-1.968	-0.8276	0.0	-1.968	-0.8681	2.2	
12	-1.968	-0.8681	2.2	-1.968	-0.8921	3.51	
13	-1.968	-0.8921	3.51	-1.968	-0.9396	6.09	
14	-1.968	-0.9396	6.09	-1.968	-1.0429	11.70	
15	-1.968	-1.0429	11.70	-1.968	-1.168	18.50	
16	-0.8276	2.3085	0.0	-0.8681	2.1567	2.2	
17	-0.8681	2.1567	2.2	-0.8921	2.0665	3.51	
18	-0.8921	2.0665	3.51	-0.9396	1.8885	6.09	
19	-0.9396	1.8885	6.09	-1.0429	1.5012	11.70	
20	-1.0429	1.5012	11.7	-1.168	1.032	18.50	
21	2.3085	3.734	0.0	2.1567	3.5316	2.2	
22	2.1567	3.5316	2.2	2.0665	3.4114	3.51	
23	2.0665	3.4114	3.51	1.8885	3.174	6.09	
24	1.8885	3.174	6.09	1.5012	2.6576	11.7	
25	1.5012	2.6576	11.7	1.032	2.032	18.5	
26		4	7	2	3	2	5
27	-1.968	-.8921	3.51	0.0			
28	-1.968	-.8921	3.51	0.6458			
29	-1.968	-.9396	6.09	0.6458			
30	-1.968	-.9396	6.09	0.0			
31	-.8921	2.0665	3.51	0.0			
32	-.8921	2.0665	3.51	0.6458			
33	-.9396	1.8885	6.09	0.6458			
34	-.9396	1.8885	6.09	0.0			
35	2.0665	3.4114	3.51	0.0			
36	2.0665	3.4114	3.51	0.6458			
37	1.8885	3.174	6.09	0.6458			
38	1.8885	3.174	6.09	0.0			
39	3.4114	8.4114	3.51	0.0			
40	3.4114	8.4114	3.51	0.6458			
41	3.174	8.174	6.09	0.6458			
42	3.174	8.174	6.09	0.0			

In addition to the input data listed in the previous page, the root and tip camber slope funtions must be inserted manually in subprograms ZCR and ZCT respectively. An alternative to this is to input the camber ordinates with the input data,(see group 11,input data format).

Also, "GAMMA" must be dimensioned in subroutine "SOLUTN". See the prerun check list for determining the size of GAMMA.

Root Camber Funtion

```
ZCR = 0.0212207*(-2.*(0.5-X)*ALOG(ABS(0.5-X))+2.*(1.-X)*ALOG(1.-X)
1-ALOG(X)-0.5)
```

Tip Camber Funtion

```
ZCT = 2.*ZCR(X)
```

GAMMA

```
DIMENSION AW(300),CA(300),GAMMA(20170)
```

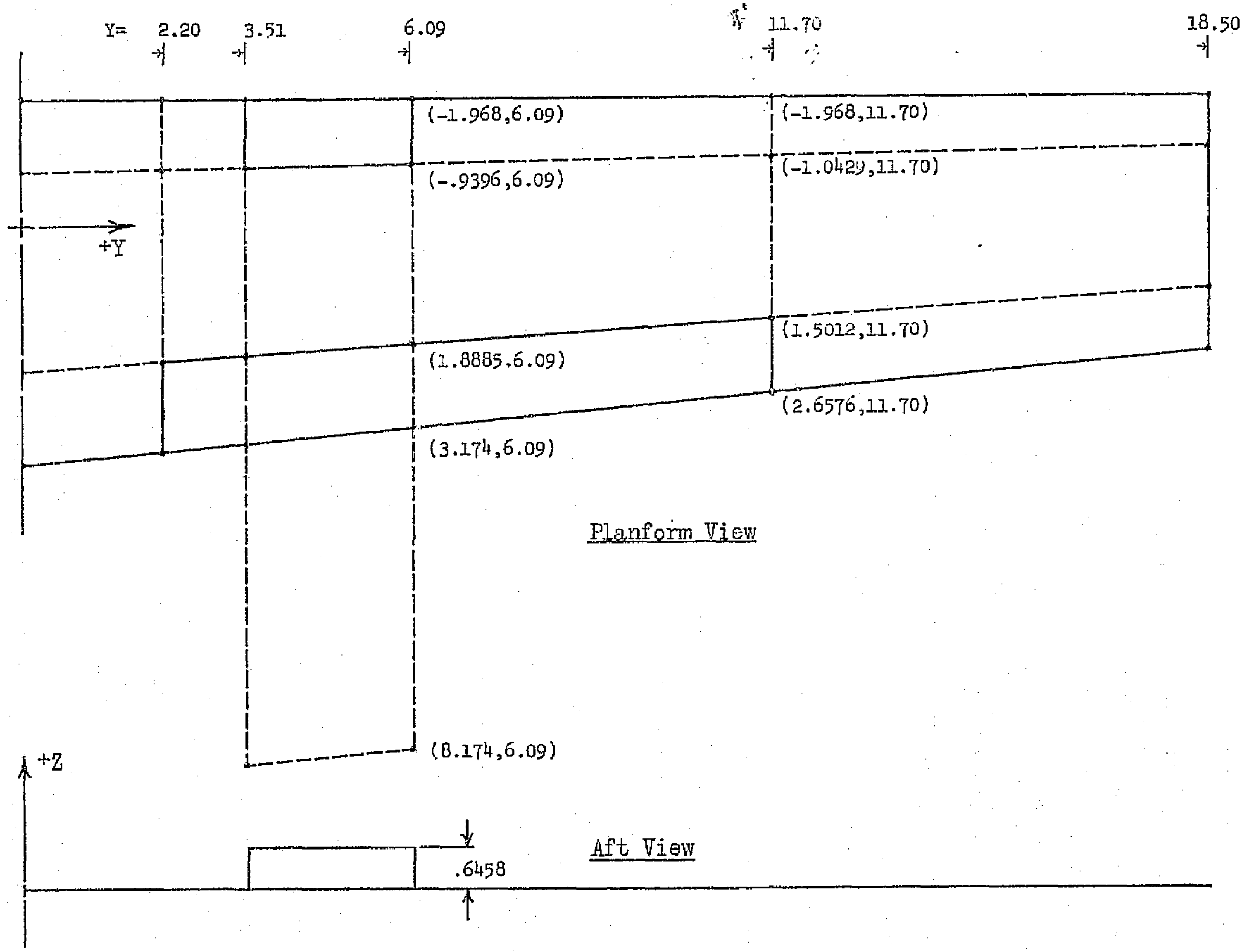


Figure 5 Wing and Jet Sections For The USB Example

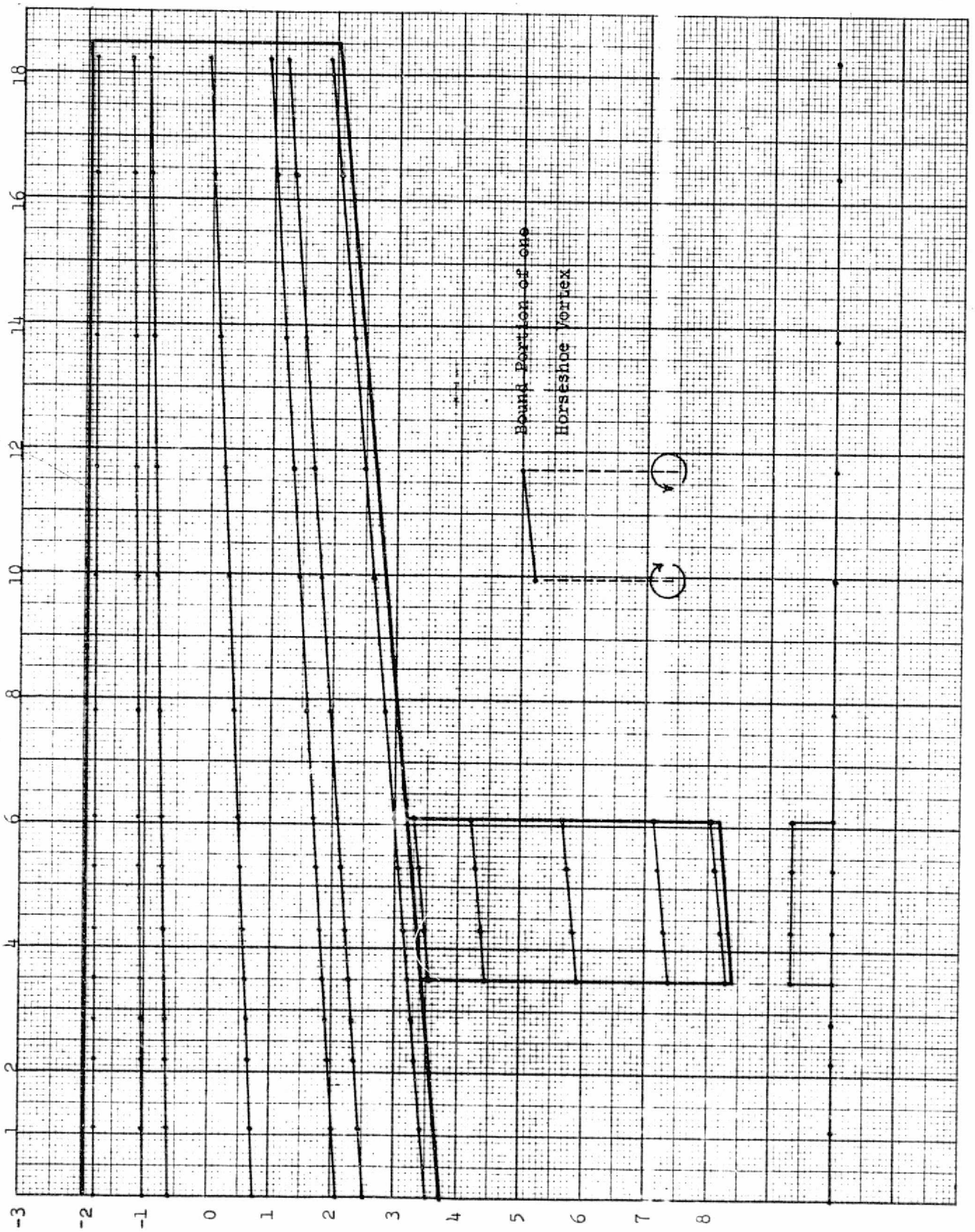


Figure 6 Wing and Jet Vortex Distribution

OUTPUT FOR THE USB TEST CASE

```
***************************************
*** USB TEST CASE, SEE TN D-7526
***************************************
        1          1          1

                XXXXXXXXXXXXXXXXXXXXXXXXX

                     CASE NUMBER = 1

                XXXXXXXXXXXXXXXXXXXXXXXXX

INPUT DATA
   0.00000    0.00000     .12880    1.00000    6.00000   -1.56800    3.29270
         3          2              60.00000   60.00000   60.00000
  85.74350   -3.00000    1.50000    -.91580    4.80000    0.00000     .50000
   0.00000    1.00000    1.00000     .11638     .23277    -.02532    -.05064
   2.00000   62.00000    0.00000
         5          3          3          4          4          4
         2          3          4
         2          3          2          0          5
  -1.96800    -.82760    0.00000   -1.96800    -.86810    2.20000
  -1.96800    -.86810    2.20000   -1.96800    -.89210    3.51000
  -1.96800    -.89210    3.51000   -1.96800    -.93960    6.09000
  -1.96800    -.93960    6.09000   -1.96800   -1.04290   11.70000
  -1.96800   -1.04290   11.70000   -1.96800   -1.16800   16.50000
   -.82760    2.30850    0.00000    -.86810    2.15670    2.20000
   -.86810    2.15670    2.20000    -.89210    2.06650    3.51000
   -.89210    2.06650    3.51000    -.93960    1.88850    6.09000
   -.93960    1.88850    6.09000   -1.04290    1.50120   11.70000
  -1.04290    1.50120   11.70000   -1.16800    1.03200   16.50000
   2.30850    3.73400    0.00000    2.15670    3.53160    2.20000
   2.15670    3.53160    2.20000    2.06650    3.41140    3.51000
   2.06650    3.41140    3.51000    1.88850    3.17400    6.09000
   1.88850    3.17400    6.09000    1.50120    2.65760   11.70000
   1.50120    2.65760   11.70000    1.03200    2.03200   16.50000
         4          7          2          3          2          5
  -1.96800    -.89210    3.51000    0.00000
  -1.96800    -.89210    3.51000     .64580
  -1.96800    -.93960    6.09000     .64580
  -1.96800    -.93960    6.09000    0.00000
   -.89210    2.06650    3.51000    0.00000
   -.89210    2.06650    3.51000     .64580
   -.93960    1.88850    6.09000     .64580
   -.93960    1.88850    6.09000    0.00000
   2.06650    3.41140    3.51000    0.00000
   2.06650    3.41140    3.51000     .64580
   1.88850    3.17400    6.09000     .64580
   1.88850    3.17400    6.09000    0.00000
   3.41140    3.41140    3.51000    0.00000
```

3.41140	8.41140	3.51000	.64580
3.17400	8.17400	6.09000	.64580
3.17400	8.17400	6.09000	0.00000

HALF SW= .85744E+02 CREF= .48510E+01

LPANEL= 91 UPANEL= 96 LAST=187 LTOTAL=283

VORTEX ELEMENT ENDPOINT COORDINATES=

X1	X2	Y1	Y2	Z1	Z2
-1.80095	-1.80356	0.00000	1.10000	0.00000	0.00000
-.99461	-1.01189	0.00000	1.10000	0.00000	0.00000
-1.80396	-1.80692	1.10000	2.20000	0.00000	0.00000
-1.01189	-1.02916	1.10000	2.20000	0.00000	0.00000
-1.80692	-1.80868	2.20000	2.85500	0.00000	0.00000
-1.02916	-1.03942	2.20000	2.85500	0.00000	0.00000
-1.80868	-1.81044	2.85500	3.51000	0.00000	0.00000
-1.03942	-1.04966	2.85500	3.51000	0.00000	0.00000
-1.81044	-1.81259	3.51000	4.30634	0.00000	0.00000
-1.04966	-1.06218	3.51000	4.30634	0.00000	0.00000
-1.81259	-1.81525	4.30634	5.29366	0.00000	0.00000
-1.06218	-1.07765	4.30634	5.29366	0.00000	0.00000
-1.81525	-1.81739	5.29366	6.09000	0.00000	0.00000
-1.07765	-1.09021	5.29366	6.09000	0.00000	0.00000
-1.81739	-1.82206	6.09000	7.82157	0.00000	0.00000
-1.09021	-1.11742	6.09000	7.82157	0.00000	0.00000
-1.82206	-1.82785	7.82157	9.96843	0.00000	0.00000
-1.11742	-1.15116	7.82157	9.96843	0.00000	0.00000
-1.82785	-1.83252	9.96843	11.70000	0.00000	0.00000
-1.15116	-1.17838	9.96843	11.70000	0.00000	0.00000
-1.83252	-1.83818	11.70000	13.79888	0.00000	0.00000
-1.17838	-1.21134	11.70000	13.79888	0.00000	0.00000
-1.83818	-1.84519	13.79888	16.40112	0.00000	0.00000
-1.21134	-1.25220	13.79888	16.40112	0.00000	0.00000
-1.84519	-1.85015	16.40112	18.24119	0.00000	0.00000
-1.25220	-1.28109	16.40112	18.24119	0.00000	0.00000
-.61752	-.64150	0.00000	1.10000	0.00000	0.00000
.74045	.69237	0.00000	1.10000	0.00000	0.00000
2.09842	2.02625	0.00000	1.10000	0.00000	0.00000
-.64150	-.66548	1.10000	2.20000	0.00000	0.00000
.69237	.64430	1.10000	2.20000	0.00000	0.00000
2.02625	1.95408	1.10000	2.20000	0.00000	0.00000
-.66548	-.67969	2.20000	2.85500	0.00000	0.00000
.64430	.61575	2.20000	2.85500	0.00000	0.00000
1.95408	1.91119	2.20000	2.85500	0.00000	0.00000
-.67969	-.69391	2.85500	3.51000	0.00000	0.00000
.61575	.58720	2.85500	3.51000	0.00000	0.00000
1.91119	1.86831	2.85500	3.51000	0.00000	0.00000
-.69391	-.71127	3.51000	4.30634	0.00000	0.00000
.58720	.55240	3.51000	4.30634	0.00000	0.00000

1.86831	1.81607	3.51000	4.30634	0.00000	0.00000
-.71127	-.73279	4.30634	5.29366	0.00000	0.00000
.55240	.50925	4.30634	5.29366	0.00000	0.00000
1.81607	1.75130	4.30634	5.29366	0.00000	0.00000
-.73279	-.75015	5.29366	6.09000	0.00000	0.00000
.50925	.47445	5.29366	6.09000	0.00000	0.00000
1.75130	1.69905	5.29366	6.09000	0.00000	0.00000
-.75015	-.78791	6.09000	7.82157	0.00000	0.00000
.47445	.39874	6.09000	7.82157	0.00000	0.00000
1.69905	1.58538	6.09000	7.82157	0.00000	0.00000
-.78791	-.83472	7.82157	9.96843	0.00000	0.00000
.39874	.30466	7.82157	9.96843	0.00000	0.00000
1.58538	1.44445	7.82157	9.96843	0.00000	0.00000
-.83472	-.87248	9.96843	11.70000	0.00000	0.00000
.30466	.22915	9.96843	11.70000	0.00000	0.00000
1.44445	1.33078	9.96843	11.70000	0.00000	0.00000
-.87248	-.91821	11.70000	13.79888	0.00000	0.00000
.22915	.13743	11.70000	13.79888	0.00000	0.00000
1.33078	1.19307	11.70000	13.79888	0.00000	0.00000
-.91821	-.97490	13.79888	16.40112	0.00000	0.00000
.13743	.02372	13.79888	16.40112	0.00000	0.00000
1.19307	1.02234	13.79888	16.40112	0.00000	0.00000
-.97490	-1.01499	16.40112	18.24119	0.00000	0.00000
.02372	-.05669	16.40112	18.24119	0.00000	0.00000
1.02234	.90161	16.40112	18.24119	0.00000	0.00000
2.51726	2.43765	0.00000	1.10000	0.00000	0.00000
3.52524	3.42775	0.00000	1.10000	0.00000	0.00000
2.43765	2.35805	1.10000	2.20000	0.00000	0.00000
3.42775	3.33025	1.10000	2.20000	0.00000	0.00000
2.35805	2.31075	2.20000	2.85500	0.00000	0.00000
3.33025	3.27235	2.20000	2.85500	0.00000	0.00000
2.31075	2.26346	2.85500	3.51000	0.00000	0.00000
3.27235	3.21444	2.85500	3.51000	0.00000	0.00000
2.26346	2.20583	3.51000	4.30634	0.00000	0.00000
3.21444	3.14385	3.51000	4.30634	0.00000	0.00000
2.20583	2.13438	4.30634	5.29366	0.00000	0.00000
3.14385	3.05633	4.30634	5.29366	0.00000	0.00000
2.13438	2.07676	5.29366	6.09000	0.00000	0.00000
3.05633	2.98574	5.29366	6.09000	0.00000	0.00000
2.07676	1.95138	6.09000	7.82157	0.00000	0.00000
2.98574	2.83219	6.09000	7.82157	0.00000	0.00000
1.95138	1.79593	7.82157	9.96843	0.00000	0.00000
2.83219	2.64180	7.82157	9.96843	0.00000	0.00000
1.79593	1.67055	9.96843	11.70000	0.00000	0.00000
2.64180	2.48825	9.96843	11.70000	0.00000	0.00000
1.67055	1.51866	11.70000	13.79888	0.00000	0.00000
2.48825	2.30222	11.70000	13.79888	0.00000	0.00000
1.51866	1.33034	13.79888	16.40112	0.00000	0.00000
2.30222	2.07158	13.79888	16.40112	0.00000	0.00000

1.33034	1.19718	16.40112	18.24119	0.00000	0.00000
2.07156	1.90649	16.40112	18.24119	0.00000	0.00000
-1.81044	-1.81044	3.51000	3.51000	0.00000	.64580
-1.04966	-1.04966	3.51000	3.51000	0.00000	.64580
-1.81044	-1.81259	3.51000	4.30634	.64580	.64580
-1.04966	-1.06218	3.51000	4.30634	.64580	.64580
-1.81259	-1.81525	4.30634	5.29366	.64580	.64580
-1.06218	-1.07769	4.30634	5.29366	.64580	.64580
-1.81525	-1.81739	5.29366	6.09000	.64580	.64580
-1.07769	-1.09021	5.29366	6.09000	.64580	.64580
-1.81739	-1.81739	6.09000	6.09000	.64580	0.00000
-1.09021	-1.09021	6.09000	6.09000	.64580	0.00000
-1.81044	-1.81259	3.51000	4.30634	0.00000	0.00000
-1.04966	-1.06218	3.51000	4.30634	0.00000	0.00000
-1.81259	-1.81525	4.30634	5.29366	0.00000	0.00000
-1.06218	-1.07769	4.30634	5.29366	0.00000	0.00000
-1.81525	-1.81739	5.29366	6.09000	0.00000	0.00000
-1.07769	-1.09021	5.29366	6.09000	0.00000	0.00000
-.69391	-.69391	3.51000	3.51000	0.00000	.64580
.58720	.58720	3.51000	3.51000	0.00000	.64580
1.86831	1.86831	3.51000	3.51000	0.00000	.64580
-.69391	-.71127	3.51000	4.30634	.64580	.64580
.58720	.55240	3.51000	4.30634	.64580	.64580
1.86831	1.81607	3.51000	4.30634	.64580	.64580
-.71127	-.73279	4.30634	5.29366	.64580	.64580
.55240	.50925	4.30634	5.29366	.64580	.64580
1.81607	1.75130	4.30634	5.29366	.64580	.64580
-.73279	-.75015	5.29366	6.09000	.64580	.64580
.50925	.47445	5.29366	6.09000	.64580	.64580
1.75130	1.69905	5.29366	6.09000	.64580	.64580
-.75015	-.75015	6.09000	6.09000	.64580	0.00000
.47445	.47445	6.09000	6.09000	.64580	0.00000
1.69905	1.69905	6.09000	6.09000	.64580	0.00000
-.69391	-.71127	3.51000	4.30634	0.00000	0.00000
.58720	.55240	3.51000	4.30634	0.00000	0.00000
1.86831	1.81607	3.51000	4.30634	0.00000	0.00000
-.71127	-.73279	4.30634	5.29366	0.00000	0.00000
.55240	.50925	4.30634	5.29366	0.00000	0.00000
1.81607	1.75130	4.30634	5.29366	0.00000	0.00000
-.73279	-.75015	5.29366	6.09000	0.00000	0.00000
.50925	.47445	5.29366	6.09000	0.00000	0.00000
1.75130	1.69905	5.29366	6.09000	0.00000	0.00000
2.26346	2.26346	3.51000	3.51000	0.00000	.64580
3.21444	3.21444	3.51000	3.51000	0.00000	.64580
2.26346	2.20583	3.51000	4.30634	.64580	.64580
3.21444	3.14385	3.51000	4.30634	.64580	.64580
2.20583	2.13438	4.30634	5.29366	.64580	.64580
3.14385	3.05633	4.30634	5.29366	.64580	.64580
2.13438	2.07676	5.29366	6.09000	.64580	.64580
3.05633	2.98574	5.29366	6.09000	.64580	.64580

2.07676	2.07676	6.09000	6.09000	.64580	0.00000
2.98574	2.98574	6.09000	6.09000	.64580	0.00000
2.26346	2.20583	3.51000	4.30634	0.00000	0.00000
3.21444	3.14385	3.51000	4.30634	0.00000	0.00000
2.20583	2.13438	4.30634	5.29366	0.00000	0.00000
3.14385	3.05633	4.30634	5.29366	0.00000	0.00000
2.13438	2.07676	5.29366	6.09000	0.00000	0.00000
3.05633	2.98574	5.29366	6.09000	0.00000	0.00000
3.53376	3.53376	3.51000	3.51000	0.00000	.64580
4.44194	4.44194	3.51000	3.51000	0.00000	.64580
5.91140	5.91140	3.51000	3.51000	0.00000	.64580
7.38086	7.38086	3.51000	3.51000	0.00000	.64580
8.28904	8.28904	3.51000	3.51000	0.00000	.64580
3.53376	3.46048	3.51000	4.30634	.64580	.64580
4.44194	4.36866	3.51000	4.30634	.64580	.64580
5.91140	5.83812	3.51000	4.30634	.64580	.64580
7.38086	7.30759	3.51000	4.30634	.64580	.64580
8.28904	8.21577	3.51000	4.30634	.64580	.64580
3.46048	3.36963	4.30634	5.29366	.64580	.64580
4.36866	4.27781	4.30634	5.29366	.64580	.64580
5.83812	5.74728	4.30634	5.29366	.64580	.64580
7.30759	7.21674	4.30634	5.29366	.64580	.64580
8.21577	8.12492	4.30634	5.29366	.64580	.64580
3.36963	3.29636	5.29366	6.09000	.64580	.64580
4.27781	4.20454	5.29366	6.09000	.64580	.64580
5.74728	5.67400	5.29366	6.09000	.64580	.64580
7.21674	7.14346	5.29366	6.09000	.64580	.64580
8.12492	8.05164	5.29366	6.09000	.64580	.64580
3.29636	3.29636	6.09000	6.09000	.64580	0.00000
4.20454	4.20454	6.09000	6.09000	.64580	0.00000
5.67400	5.67400	6.09000	6.09000	.64580	0.00000
7.14346	7.14346	6.09000	6.09000	.64580	0.00000
8.05164	8.05164	6.09000	6.09000	.64580	0.00000
3.53376	3.46048	3.51000	4.30634	0.00000	0.00000
4.44194	4.36866	3.51000	4.30634	0.00000	0.00000
5.91140	5.83812	3.51000	4.30634	0.00000	0.00000
7.38086	7.30759	3.51000	4.30634	0.00000	0.00000
8.28904	8.21577	3.51000	4.30634	0.00000	0.00000
3.46048	3.36963	4.30634	5.29366	0.00000	0.00000
4.36866	4.27781	4.30634	5.29366	0.00000	0.00000
5.83812	5.74728	4.30634	5.29366	0.00000	0.00000
7.30759	7.21674	4.30634	5.29366	0.00000	0.00000
8.21577	8.12492	4.30634	5.29366	0.00000	0.00000
3.36963	3.29636	5.29366	6.09000	0.00000	0.00000
4.27781	4.20454	5.29366	6.09000	0.00000	0.00000
5.74728	5.67400	5.29366	6.09000	0.00000	0.00000
7.21674	7.14346	5.29366	6.09000	0.00000	0.00000
8.12492	8.05164	5.29366	6.09000	0.00000	0.00000

48 CONTROL POINT COORDINATES=

XCP	YCP	ZCP	XCP	YCP	ZCP
-1.40286	.55000	0.00000	-.83772	.55000	0.00000
-1.41299	1.65000	0.00000	-.85797	1.65000	0.00000
-1.42105	2.52750	0.00000	-.87410	2.52750	0.00000
-1.42705	3.18250	0.00000	-.88610	3.18250	0.00000
-1.43353	3.88783	0.00000	-.89906	3.88783	0.00000
-1.44193	4.80000	0.00000	-.91585	4.80000	0.00000
-1.45032	5.71217	0.00000	-.93264	5.71217	0.00000
-1.46136	6.91157	0.00000	-.95473	6.91157	0.00000
-1.47963	8.89500	0.00000	-.99125	8.89500	0.00000
-1.49789	10.87843	0.00000	-1.02777	10.87843	0.00000
-1.51461	12.69584	0.00000	-1.06122	12.69584	0.00000
-1.53673	15.10000	0.00000	-1.10545	15.10000	0.00000
-1.55884	17.50416	0.00000	-1.14968	17.50416	0.00000
-.06066	.55000	0.00000	1.49348	.55000	0.00000
2.27055	.55000	0.00000	-.05482	1.65000	0.00000
1.43149	1.65000	0.00000	2.19465	1.65000	0.00000
-.12204	2.52750	0.00000	1.38209	2.52750	0.00000
2.13415	2.52750	0.00000	-.14231	3.18250	0.00000
1.34526	3.18250	0.00000	2.08905	3.18250	0.00000
-.16418	3.88783	0.00000	1.30556	3.88783	0.00000
2.04043	3.88783	0.00000	-.19251	4.80000	0.00000
1.25416	4.80000	0.00000	1.97750	4.80000	0.00000
-.22084	5.71217	0.00000	1.20276	5.71217	0.00000
1.91457	5.71217	0.00000	-.25810	6.91157	0.00000
1.13515	6.91157	0.00000	1.83178	6.91157	0.00000
-.31973	8.89500	0.00000	1.02332	8.89500	0.00000
1.69485	8.89500	0.00000	-.38135	10.87843	0.00000
.91150	10.87843	0.00000	1.55792	10.87843	0.00000
-.43779	12.69584	0.00000	.80906	12.69584	0.00000
1.43249	12.69584	0.00000	-.51244	15.10000	0.00000
.67359	15.10000	0.00000	1.26660	15.10000	0.00000
-.58708	17.50416	0.00000	.53811	17.50416	0.00000
1.10071	17.50416	0.00000	2.97657	.55000	0.00000
3.68340	.55000	0.00000	2.88842	1.65000	0.00000
3.58220	1.65000	0.00000	2.81785	2.52750	0.00000
3.50155	2.52750	0.00000	2.76525	3.18250	0.00000
3.44145	3.18250	0.00000	2.70853	3.88783	0.00000
3.37663	3.88783	0.00000	2.63510	4.80000	0.00000
3.29270	4.80000	0.00000	2.56167	5.71217	0.00000
3.20877	5.71217	0.00000	2.46508	6.91157	0.00000
3.09837	6.91157	0.00000	2.30532	8.89500	0.00000
2.91580	8.89500	0.00000	2.14557	10.87843	0.00000
2.73323	10.87843	0.00000	1.99924	12.69584	0.00000
2.56598	12.69584	0.00000	1.80570	15.10000	0.00000
2.34480	15.10000	0.00000	1.61216	17.50416	0.00000
2.12362	17.50416	0.00000	-1.43005	3.51000	.32290
-.89210	3.51000	.32290	-1.43353	3.88783	.64580

-.89906	3.88783	.64580	-1.44193	4.80000	.64580
-.91585	4.80000	.64580	-1.45032	5.71217	.64580
-.93264	5.71217	.64580	-1.45380	6.09000	.32290
-.93960	6.09000	.32290	-1.42353	3.88783	0.00000
-.89906	3.88783	0.00000	-1.44193	4.80000	0.00000
-.91585	4.80000	0.00000	-1.45032	5.71217	0.00000
-.93264	5.71217	0.00000	-.15245	3.51000	.32290
1.32685	3.51000	.32290	2.06650	3.51000	.32290
-.16418	3.88783	.64580	1.20556	3.88783	.64580
2.04043	3.88783	.64580	-.19251	4.80000	.64580
1.25416	4.80000	.64580	1.97750	4.80000	.64580
-.22084	5.71217	.64580	1.20276	5.71217	.64580
1.91457	5.71217	.64580	-.22258	6.09000	.32290
1.18147	6.09000	.32290	1.88850	6.09000	.32290
-.16418	3.88783	0.00000	1.20556	3.88783	0.00000
2.04043	3.88783	0.00000	-.19251	4.80000	0.00000
1.25416	4.80000	0.00000	1.97750	4.80000	0.00000
-.22084	5.71217	0.00000	1.20276	5.71217	0.00000
1.91457	5.71217	0.00000	2.73895	3.51000	.32290
3.41140	3.51000	.32290	2.70853	3.88783	.64580
3.37663	3.88783	.64580	2.63510	4.80000	.64580
3.29270	4.80000	.64580	2.56167	5.71217	.64580
3.20877	5.71217	.64580	2.53125	6.09000	.32290
3.17400	6.09000	.32290	2.70853	3.88783	0.00000
3.37663	3.88783	0.00000	2.63510	4.80000	0.00000
3.29270	4.80000	0.00000	2.56167	5.71217	0.00000
3.20877	5.71217	0.00000	3.88886	3.51000	.32290
5.13886	3.51000	.32290	6.68394	3.51000	.32290
7.93394	3.51000	.32290	8.41140	3.51000	.32290
3.85409	3.88783	.64580	5.10409	3.88783	.64580
6.64918	3.88783	.64580	7.89918	3.88783	.64580
8.37663	3.88783	.64580	3.77016	4.80000	.64580
5.02016	4.80000	.64580	6.56524	4.80000	.64580
7.81524	4.80000	.64580	8.29270	4.80000	.64580
3.68622	5.71217	.64580	4.93622	5.71217	.64580
6.48131	5.71217	.64580	7.73131	5.71217	.64580
8.20877	5.71217	.64580	3.65146	6.09000	.32290
4.90146	6.09000	.32290	6.44654	6.09000	.32290
7.69654	6.09000	.32290	8.17400	6.09000	.32290
3.85409	3.88783	0.00000	5.10409	3.88783	0.00000
6.64918	3.88783	0.00000	7.89918	3.88783	0.00000
8.37663	3.88783	0.00000	3.77016	4.80000	0.00000
5.02016	4.80000	0.00000	6.56524	4.80000	0.00000
7.81524	4.80000	0.00000	8.29270	4.80000	0.00000
3.68622	5.71217	0.00000	4.93622	5.71217	0.00000
6.48131	5.71217	0.00000	7.73131	5.71217	0.00000
8.20877	5.71217	0.00000			

XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX

ALPHA = 6.000 DEGREES

XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX

VORTEX	XV	YV	CP	CPW
1	.02929	.02973	6.60437	5.49923
2	.17071	.02973	2.70624	2.25016
3	.23684	.02973	2.50390	2.07023
4	.47500	.02973	2.11562	1.72474
5	.71316	.02973	1.43795	1.13516
6	.78661	.02973	1.23544	.96269
7	.96339	.02973	.51702	.38583
8	.02929	.08919	6.68462	5.57971
9	.17071	.08919	2.77727	2.31434
10	.23684	.08919	2.59084	2.14695
11	.47500	.08919	2.31055	1.89708
12	.71316	.08919	1.82619	1.45924
13	.78661	.08919	1.61229	1.26884
14	.96339	.08919	.67112	.49370
15	.02929	.13662	6.72328	5.66487
16	.17071	.13662	2.85721	2.38557
17	.23684	.13662	2.70322	2.23550
18	.47500	.13662	2.53748	2.14482
19	.71315	.13662	3.65151	3.13625
20	.78661	.13662	3.45475	2.94679
21	.96339	.13662	1.00804	.70294
22	.02929	.17203	6.65214	5.73053
23	.17071	.17203	2.88749	2.44307
24	.23684	.17203	2.90422	2.30725
25	.47500	.17203	2.53914	2.32825
26	.71315	.17203	4.38978	3.61630
27	.78661	.17203	4.17481	3.43437
28	.96339	.17203	1.43857	.84529
29	.02929	.21015	6.07996	5.79260
30	.17071	.21015	2.19241	2.49699
31	.23685	.21015	12.21128	2.37214
32	.47500	.21015	19.54695	2.46926
33	.71315	.21015	40.67512	3.84452
34	.78660	.21015	48.74731	3.66305
35	.96339	.21015	4.39806	.93494
36	.02929	.25946	5.92933	5.84514
37	.17071	.25946	2.13467	2.54851
38	.23684	.25946	20.01870	2.43522
39	.47500	.25946	8.27234	2.58541
40	.71315	.25946	50.39235	3.98349
41	.78661	.25946	49.38227	3.79791
42	.96339	.25946	6.19498	.99448
43	.02929	.30877	6.08179	5.84277
44	.17071	.30877	2.20347	2.56953
45	.23684	.30877	13.85713	2.46377

46	.47500	.30877	20.47784	2.64311
47	.71316	.30877	41.46719	4.04083
48	.78661	.30877	50.31144	3.85202
49	.96339	.30877	4.39419	1.02005
50	.02929	.37360	6.73389	5.80131
51	.17071	.37360	2.99149	2.57599
52	.23684	.37360	2.69131	2.47535
53	.47500	.37360	3.06158	2.67658
54	.71316	.37360	4.52057	4.07568
55	.78661	.37360	4.33262	3.88413
56	.96339	.37360	1.30188	1.03295
57	.02929	.48081	6.30520	5.48266
58	.17071	.48081	2.79371	2.46503
59	.23684	.48081	2.67937	2.37142
60	.47500	.48081	2.85842	2.59476
61	.71316	.48081	4.21195	4.01512
62	.78661	.48081	4.00783	3.83021
63	.96339	.48081	1.09404	1.00688
64	.02929	.58802	5.43348	4.78378
65	.17071	.58802	2.40031	2.15184
66	.23684	.58802	2.27799	2.05068
67	.47500	.58802	2.38237	2.20645
68	.71316	.58802	3.73816	3.62160
69	.78661	.58802	3.57191	3.47033
70	.96339	.58802	.89762	.85108
71	.02929	.68626	4.46906	3.95558
72	.17071	.68626	1.94846	1.75730
73	.23684	.68626	1.79768	1.62528
74	.47500	.68626	1.56693	1.44068
75	.71316	.68626	1.04103	.96176
76	.78661	.68626	.88831	.82025
77	.96339	.68626	.35315	.32284
78	.02929	.81622	3.19487	2.83246
79	.17071	.81622	1.41734	1.28674
80	.23684	.81622	1.28059	1.16449
81	.47500	.81622	1.05876	.97763
82	.71316	.81622	.60300	.55387
83	.78661	.81622	.48642	.44461
84	.96339	.81622	.16454	.14622
85	.02929	.94617	1.73791	1.53112
86	.17071	.94617	.81926	.75179
87	.23684	.94617	.71886	.66075
88	.47500	.94617	.62172	.58337
89	.71316	.94617	.32942	.30612
90	.78661	.94617	.25368	.23371
91	.96339	.94617	.06377	.05474

	Y/SP	CL	CM	CT	CDI	CLW	CMW	CDW
52	.02973	2.44334	.06746	.45663	-.20293	1.99687	.07014	-.11139

.08919	2.65245	.02016	.46666	-.19150	2.17343	.03303	-.10209
.13662	2.90923	-.01706	.46547	.37794	2.44845	-.01536	.36721
.17203	3.09351	-.07410	.45987	.54938	2.62242	-.04783	.45631
.21015	16.64215	-3.54391	.42211	8.30734	2.73177	-.05460	.49711
.25946	16.07655	-3.45327	.40332	8.52154	2.81298	-.04756	.51790
.30877	17.34766	-3.29064	.41711	8.51819	2.84611	-.03428	.52505
.37360	3.27163	-.00406	.45766	.53413	2.85875	-.01407	.52897
.48081	3.04138	.04554	.39614	.48745	2.75902	.01537	.53436
.58802	2.61171	.07233	.28913	.46280	2.41046	.04328	.50101
.68626	1.71948	.16855	.19062	-.09179	1.55979	.14666	-.05621
.81622	1.16382	.15599	.09078	-.04179	1.05645	.13860	-.02418
.94617	.65277	.09764	.02181	-.00111	.59655	.08704	.00404

THE LIFT COEFFICIENT = 4.14708

TOTAL INDUCED DRAG COEFFICIENT = 1.35032

THE INDUCED DRAG PARAMETER = .07851

TOTAL PITCHING MOMENT COEFFICIENT = -.43457

THE COANDA LIFT COEFFICIENT, CLR = 1.85437

THE COANDA DRAG COEFFICIENT, CDR = -.49161

THE COANDA MOMENT COEFFICIENT, CMR = -.73879

THE LIFT COEFFICIENT FOR THE WING ALONE= 1.95793

THE INDUCED DRAG COEFFICIENT FOR THE WING ALONE= .23336

THE PITCHING MOMENT COEFFICIENT FOR THE WING ALONE= .04101

THE INDUCED DRAG PARAMETER FOR THE WING ALONE= .06067

```
4AFAKEX.   76/10/07.NASA/LRC CY175-T   NOS 1.1 (T11)

10.19.26.LSRCWR.T500.CM10000.
10.19.26.P1212       FILLMAN (LSRCWR)
10.19.26.LSFR.274200E.
10.19.26.CHARGE.101429,LRC.
10.19.26.GET.CLOPL=LSR.
10.24.32.UPDATE,Q,C,P,I,L=A1234.
10.24.36. UPDATE COMPLETE.
10.24.36.FTN,I,L=L.
10.33.40.    10.285 CP SECONDS COMPILATION TIME
10.33.40.LDSET,PRESET=NGINF.MAP=SB.
10.33.40.LGO.
10.33.48.      NON-FATAL LOADER ERRORS - SEE MAP
10.33.51.      NON-FATAL LOADER ERRORS - SEE MAP
10.52.44.     STOP
10.52.44.     61.012 CP SECONDS EXECUTION TIME
10.52.44.LEPF,        0.098KUNS.
10.52.44.UEMS,      25.737KUNS.
10.52.44.UECP,      72.826SECS.
10.52.44.AESR,     557.039UNTS.
```

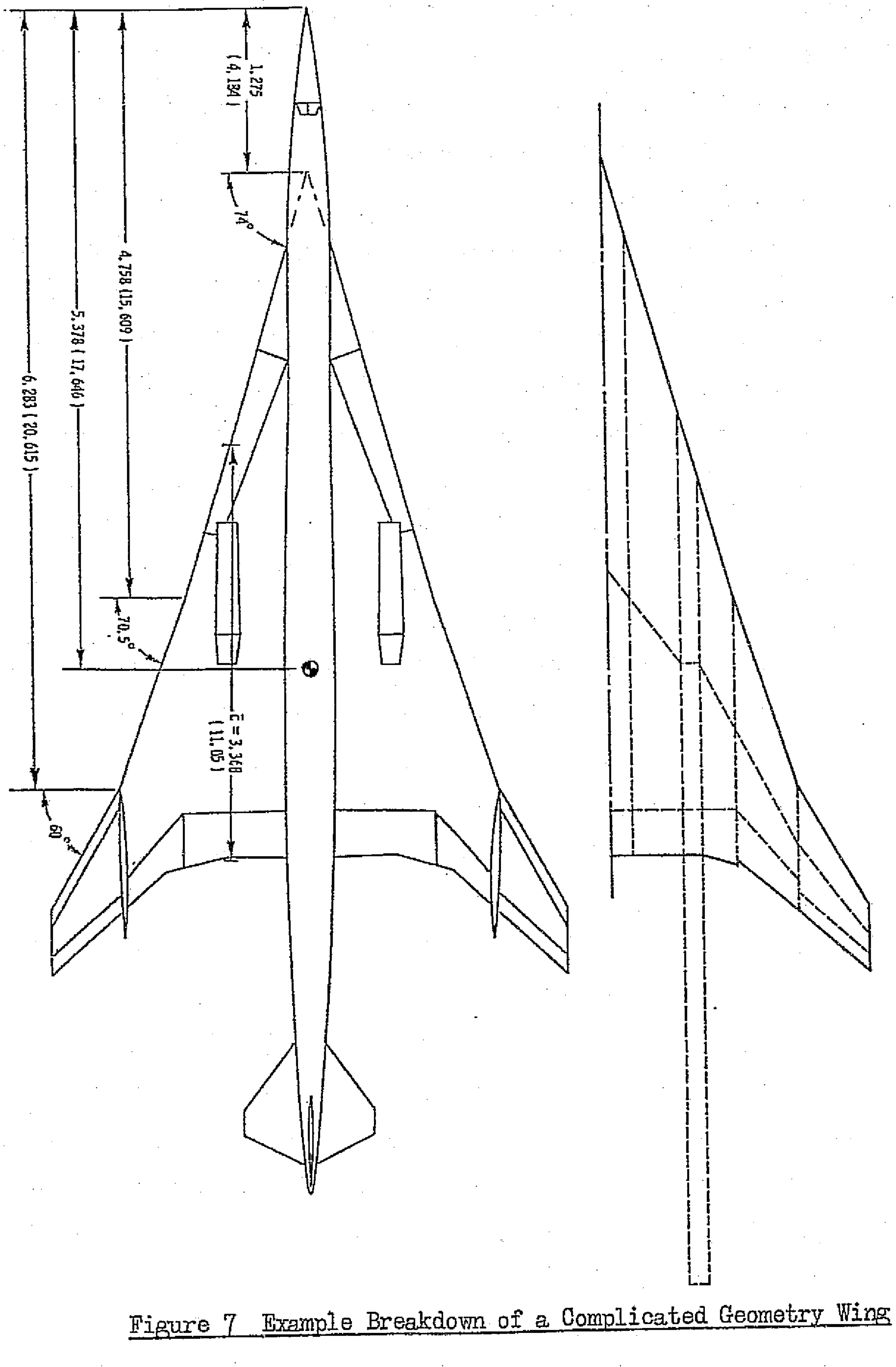


Figure 7 Example Breakdown of a Complicated Geometry Wing

REFERENCES

1. Lan, C. Edward and Campbell, James F.: Theoretical Aerodynamics of Upper-Surface-Blowing Jet-Wing Interaction. NASA TN D-7936, 1975.

2. Lan, C. Edward and Campbell, James F.: A Wing-Jet Interaction Theory for USB Configurations. AIAA Journal of Aircraft, Vol. 13, No. 9, Sept. 1976.

3. Lan, C. Edward: Theoretical Aerodynamics of Over-Wing-Blowing Configurations. NASA CR-144969, 1976.

4. Lan, C. Edward: A Quasi Vortex-Lattice Method in Thin Wing Theory. Journal of Aircraft, Vol. 11, No. 8, August 1974, pp. 491-494.

Computer Program Listing

The following is a listing of the 3,044 seperate cards which constitute the computer program.

```
      OVERLAY (USBOWB,0,0)
      PROGRAM USBOWB(INPUT,OUTPUT,TAPE5=INPUT,TAPE6=OUTPUT,TAPE1,TAPE2)
C          AERODYNAMICS OF WING-JET INTERACTION
C     BY C. EDWARD LAN OF THE UNIVERSITY OF KANSAS
C
C     THIS PROGRAM IS APPLICABLE TO BOTH UPPER-SURFACE-BLOWING AND OVER-
C     WING BLOWING CONFIGURATIONS.
C
C     NOTE. ROOT AND TIP CAMBER FUNCTIONS MAY BE DEFINED AS FUNCTION
C     SUBPROGRAMS ZCR(X) AND ZCT(X), RESPECTIVELY.
C     THE ARRAY DIMENSIONS OF THIS PROGRAM RESTRICT THE NUMBER OF WING
C     VORTICES TO BE 100 MAXIMUM AND THE TOTAL WING AND JET VORTICES TO
C     200 MAXIMUM. ALSO, CHECK THE ARRAY SIZE OF GAMMA IN SUBROUTINE
C     "SOLUTN" BEFORE USING THE PROGRAM.
      DIMENSION TITLE(13)
      COMMON /CODE/ KCODE
      COMMON /SCHEME/ C(2),X(10,41),Y(10,41),SLOPE(15),XL(2,15),XTT(41),
     1XLL(41)
      COMMON /GEOM/ HALFSW,XCP(200),YCP(200),ZCP(200),XLE(50),YLE(50),XT
     1E(50),PSI(20),CH(95),XV(200),YV(100),SN(8,8),XN(200,2),YN(200,2),Z
     2N(200,2),WIDTH(8),YCON(25),SWEEP(50),HALFB,SJ(21,8),EX(95,2),TX(95
     3,2),SC(160,5),SI(160,5),LC(3)
      COMMON /AERO/ AM1,AM2,B1,B2,CL(30),CT(30),CD(30),GAM(2,100)
      COMMON /CONST/ NCS,NCW,M1(8),NSJ,NCJ(5),LAST,MJW1(3,5),MJW2(3,5),J
     1PANEL,MJJ(5),NW(3),NNJ,NJP
      COMMON /PARAM/ ALPT,ALPC,ALPS,CDF,SDF,TH,TDF
      COMMON /JET/ PK1,XC,XJT(31),A(31),B(31)
      COMMON /ADD/ CP(100),CM(30),BREAK(8),SWP(8,15),GAL(30),ISYM,VMU,VU
     1,TEMP,FCR,CAMLER,CAMLET,CAMTER,CAMTET,XJ,YJ,ZJ,RJ,ALP,CREF,TWISTR
      COMMON /COST/ LTOTAL,LPAN1,NJW(5),LPANEL,IENTN,LPAN2,EXIT,PTIAL,TW
     1IST,DF(5),NFP
      COMMON /CAMB/ ICAM,IM,XT(2,11),ZC(2,11),AAM(2,10),BBM(2,10),CCM(2,
     110),DDM(2,10)
      DIMENSION ISPEC(6)
      DATA ISPEC/6*(-0)/
      ISPEC(4)=0
      CALL SYSTEMC (115,ISPEC)
      PI=3.14159265
      READ (5,70) (TITLE(I),I=1,13)
      WRITE (6,80)
      WRITE (6,70) (TITLE(I),I=1,13)
      WRITE (6,80)
      NCON=1
C
C     NUMBER OF CASES TO BE RUN, GEOMETRY CODE (=1 IF GEOMETRY VARIES.
C     IN THIS CASE, ALPHA MAY ALSO BE DIFFERENT. =0 FOR THE SAME GEOME-
C     TRY BUT DIFFERENT ALPHA"S) , AND SYMMETRY CODE (=0 FOR A CENTERED
C     JET, AND=1 OTHERWISE) ***
C
```

```
      READ (5,60) ICASE,NG,ISYM
      WRITE (6,60) ICASE,NG,ISYM
   10 CONTINUE
      WRITE (6,90)
      WRITE (6,100) NCON
      WRITE (6,90)
      CALL OVERLAY (6HUSBOWB,1,0)
      CALL OVERLAY (6HUSBOWB,2,0)
      CALL OVERLAY (6HUSBOWB,3,0)
   20 CONTINUE
      CALL OVERLAY (6HUSBOWB,4,0)
      CALL OVERLAY (6HUSBOWB,5,0)
      NCON=NCON+1
      IF (NCON.GT.ICASE) GO TO 40
      IF (NG.EQ.1) GO TO 10
C
C     ADDITIONAL ANGLES OF ATTACK IN DEGS. TO BE COMPUTED, TO BE READ IN
C     BEHIND THE GEOMETRY DATA DEFINED IN SUBROUTINE "GEOMTY" ***
C
      READ (5,50) ALP
      ALP=ALP*PI/180.
      ALPS=SIN(ALP)
      ALPC=COS(ALP)
      ALPT=ALPS/ALPC
      DO 30 I=1,NCS
      XLL(I)=ALP+(TWISTR+TWIST*YLE(I)/HALFB)*PI/180.
      T=XLL(I)
   30 XTT(I)=SIN(T)/COS(T)
      WRITE (6,90)
      WRITE (6,100) NCON
      WRITE (6,90)
      GO TO 20
   40 CONTINUE
      STOP
C
   50 FORMAT (5F10.5)
   60 FORMAT (7(6X,I4))
   70 FORMAT (13A6)
   80 FORMAT (40H****************************************)
   90 FORMAT (1H0,20X,25HXXXXXXXXXXXXXXXXXXXXXXXXX)
  100 FORMAT (1H0,25X,13HCASE NUMBER =,I2)
      END
      FUNCTION ZCR (X)
      COMMON /CAMB/ ICAM,IM,XT(2,11),ZC(2,11),AAM(2,10),BBM(2,10),CCM(2,
     110),DDM(2,10)
      IF (ICAM.EQ.1) GO TO 10
C
C      CAMBER FUNCTION FOR THE ROOT SECTION ***
C
```

```
      ZCR=0.0212207*(-2.*(0.5-X)*ALOG(ABS(0.5-X))+2.*(1.-X)*ALOG(1.-X)-A
     1LOG(X)-0.5)
      GO TO 20
10    ZCR=ZCAM(1,X)
20    RETURN
      END
      FUNCTION ZCT (X)
      COMMON /CAMB/ ICAM,IM,XT(2,11),ZC(2,11),AAM(2,10),BBM(2,10),CCM(2,
     110),DDM(2,10)
      IF (ICAM.EQ.1) GO TO 10
C
C      CAMBER FUNCTION FOR THE TIP SECTION ***
C
      ZCT=2.*ZCR(X)
      GO TO 20
10    ZCT=ZCAM(2,X)
20    RETURN
      END
      FUNCTION ZCAM (I,X)
      COMMON /CAMB/ ICAM,IM,XT(2,11),ZC(2,11),AAM(2,10),BBM(2,10),CCM(2,
     110),DDM(2,10)
      K=1
10    IF (X.GE.XT(I,K).AND.X.LT.XT(I,K+1)) GO TO 20
      K=K+1
      IF (K.GE.IM) GO TO 30
      GO TO 10
20    SM=X-XT(I,K)
      ZCAM=3.*AAM(I,K)*SM**2+2.*BBM(I,K)*SM+CCM(I,K)
      GO TO 50
30    IF (X.LT.XT(I,1)) GO TO 40
      K=IM-1
      GO TO 20
40    K=1
      GO TO 20
50    RETURN
      END
      SUBROUTINE VMSEQN (NC1,K,AA,A,CA)
C     TO SOLVE THE SIMULTANEOUS EQUATIONS BY PURCELL"S VECTOR METHOD
      DIMENSION AA(1), CA(1), A(1)
      NC=K*NC1
      SUM1=0.
      K1=K-1
      JJ=1
      DO 10 J=1,K1
      SUM1=SUM1+AA(J)*A(JJ)
10    JJ=JJ+NC1+1
      SUM1=SUM1+AA(K)
      DO 30 I=1,NC1
      SUM2=0.
      JJ=I+1
```

```
      DO 20 J=1,K1                                                      VSN 150
      SUM2=SUM2+AA(J)*A(JJ)                                             VSN 160
   20 JJ=JJ+NC1+1                                                       VSN 170
      KK=K+I                                                            VSN 180
      SUM2=SUM2+AA(KK)                                                  VSN 190
   30 CA(I)=-SUM2/SUM1                                                  VSN 200
      M=1                                                               VSN 210
      L=0                                                               VSN 220
      KNC=(K-1)*NC1                                                     VSN 230
      DO 60 I=1,NC                                                      VSN 240
      IF (I.GT.KNC) GO TO 50                                            VSN 250
      MM=(M-1)*NC1+1                                                    VSN 260
      IF (I.EQ.MM) GO TO 70                                             VSN 270
   40 KK=KK+1                                                           VSN 280
      IL=I+L                                                            VSN 290
      A(I)=CA(KK)*BASE+A(IL)                                            VSN 300
      GO TO 60                                                          VSN 310
   50 II=I-KNC                                                          VSN 320
      A(I)=CA(II)                                                       VSN 330
   60 CONTINUE                                                          VSN 340
      GO TO 80                                                          VSN 350
   70 II=MM+M-1                                                         VSN 360
      BASE=A(II)                                                        VSN 370
      KK=0                                                              VSN 380
      L=L+1                                                             VSN 390
      M=M+1                                                             VSN 400
      GO TO 40                                                          VSN 410
   80 CONTINUE                                                          VSN 420
      RETURN                                                            VSN 430
      END                                                               VSN 440-
      SUBROUTINE INTEG (F,NN,LJ,IZ,IJ,B,IR)                             INT  10
C     TO MAKE REFINED INTEGRATION FOR INDUCED TANGENTIAL VELOCITIES     INT  20
      COMMON /GEOM/ HALFSW,XCP(200),YCP(200),ZCP(200),XLE(50),YLE(50),XTINT  30
     1E(50),PSI(20),CH(95),XV(200),YV(100),SN(8,8),XN(200,2),YN(200,2),ZINT  40
     2N(200,2),WIDTH(8),YCON(25),SWEEP(50),HALFB,SJ(21,8),EX(95,2),TX(95INT  50
     3,2),SC(160,5),SI(160,5),LC(3)                                     INT  60
      PI=3.14159265                                                     INT  70
      J=LJ+1                                                            INT  80
      JJ=NN*16                                                          INT  90
      IF (NN.GT.6) JJ=NN*8                                              INT 100
      FJ=JJ                                                             INT 110
      C1=TX(IZ,1)-EX(IZ,1)                                              INT 120
      C2=TX(IZ,2)-EX(IZ,2)                                              INT 130
      SUM=0.                                                            INT 140
      DO 10 K=1,JJ                                                      INT 150
      XX1=EX(IZ,1)+C1*SC(K,IR)                                          INT 160
      XX2=EX(IZ,2)+C2*SC(K,IR)                                          INT 170
      X1=XX1-XCP(IJ)                                                    INT 180
      X2=XX2-XCP(IJ)                                                    INT 190
      Y1=YN(J,1)-YCP(IJ)                                                INT 200
```

```
      Y2=YN(J,2)-YCP(IJ)
      Z1=ZN(J,1)-ZCP(IJ)
      Z2=ZN(J,2)-ZCP(IJ)
      X12=XX2-XX1
      Y12=YN(J,2)-YN(J,1)
      Z12=ZN(J,2)-ZN(J,1)
      YZI=Y1*Z12-Z1*Y12
      XYK=X1*Y12-Y1*X12
      XZJ=X1*Z12-Z1*X12
      ALB=XYK*XYK+XZJ*XZJ+B*YZI*YZI
      R1=SQRT(X1*X1+B*Y1*Y1+B*Z1*Z1)
      R2=SQRT(X2*X2+B*Y2*Y2+B*Z2*Z2)
      UU=(X2*X12+B*Y2*Y12+B*Z2*Z12)/R2-(X1*X12+B*Y1*Y12+B*Z1*Z12)/R1
10    SUM=SUM+UU*YZI/ALB*SI(K,IR)
      F=SUM*CH(IZ)/(8.*FJ)
      RETURN
      END
      OVERLAY(USBOWB,1,0)
      PROGRAM GEOMTY
C     TO SET UP THE GEOMETRY OF THE VORTEX ELEMENTS AND CONTROL POINTS
      DIMENSION XXL(5), YL(5), XXT(5), ZL(5), CPCWL(31), CPSWL(31)
      COMMON /CODE/ KCODE
      COMMON /SCHEME/ C(2),X(10,41),Y(10,41),SLOPE(15),XL(2,15),XTT(41),
     1XLL(41)
      COMMON /GEOM/ HALFSW,XCP(200),YCP(200),ZCP(200),XLE(50),YLE(50),XT
     1E(50),PSI(20),CH(95),XV(200),YV(100),SN(8,8),XN(200,2),YN(200,2),Z
     2N(200,2),WIDTH(8),YCON(25),SWEEP(50),HALFB,SJ(21,8),EX(95,2),TX(95
     3,2),SC(160,5),SI(160,5),LC(3)
      COMMON /AERO/ AM1,AM2,B1,B2,CL(30),CT(30),CD(30),GAM(2,100)
      COMMON /CONST/ NCS,NCW,M1(8),NSJ,NCJ(5),LAST,MJW1(3,5),MJW2(3,5),J
     1PANEL,MJJ(5),NW(3),NNJ,NJP
      COMMON /PARAM/ ALPT,ALPC,ALPS,CDF,SDF,TH,TDF
      COMMON /ADD/ CP(100),CM(30),BREAK(8),SWP(8,15),GAL(30),ISYM,VMU,VU
     1,TEMP,FCR,CAMLER,CAMLET,CAMTER,CAMTET,XJ,YJ,ZJ,RJ,ALP,CREF,TWISTR
      COMMON /COST/ LTOTAL,LPAN1,NJW(5),LPANEL,IENTN,LPAN2,EXIT,PTIAL,TW
     1IST,DF(5),NFP
      COMMON /CAMB/ ICAM,IM,XT(2,11),ZC(2,11),AAM(2,10),BBM(2,10),CCM(2,
     110),DDM(2,10)
      RT=0.
      WRITE (6,520)
      PI=3.14159265
      NCS=0
      KL=0
      IPANEL=1
      DO 10 I=1,5
10    DF(I)=0.
C
C     MACH NUMBERS OF FREESTREAM AND JET FLOW, FREESTREAM/JET VELOCITY
C     RATIO,JET/FREESTREAM TEMPERATURE RATIO,ANGLE OF ATTACK IN DEGREE.,
```

```
C     WING L.E. AND T.E. X-COORDINATES AT THE JET AXIS LOCATION***
C
      READ (5,470) AM1,AM2,VMU,TEMP,ALP,XEL,XET
      WRITE (6,470) AM1,AM2,VMU,TEMP,ALP,XEL,XET
C
C     NUMBER OF FLAP SECTIONS (INCLUDING THE JET SPAN), THE NUMERICAL
C     ORDER OF JET SPAN AMONG THE FLAP SPANS AND THE CORRESPONDING FLAP
C     DEFLECTION ANGLES IN DEGREES ***
C
      READ (5,510) NFP,NJP,(DF(I),I=1,NFP)
      WRITE (6,510) NFP,NJP,(DF(I),I=1,NFP)
C
C     REFERENCE HALF WING AREA, TWIST IN DEG., INCIDENCE OF ROOT CORD IN
C     DEG., X-, Y- AND Z- COORDINATES OF JET CENTER AT EXIT, AND JET
C     RADIUS ***
C     NOTE. FOR USB APPLICATIONS, YJ,ZJ AND RJ MAY BE ANY NON-ZERO VALUE
C     ,UNLESS THE RECTANGULAR JET IS NOT ON THE SURFACE AND THE ENTRAIN-
C     MENT EFFECT IS TO BE ACCOUNTED FOR.
C
      READ (5,470) HALFSW,TWIST,TWISTR,XJ,YJ,ZJ,RJ
      WRITE (6,470) HALFSW,TWIST,TWISTR,XJ,YJ,ZJ,RJ
C
C     TRAILING-EDGE ANGLE IN DEG., PARTIAL-SPAN FLAP INDICATOR (=0. FOR
C     NO OR FULL-SPAN FLAP, AND =1. OTHERWISE), CONFIGURATION INDICATOR
C     (=1. FOR USB, AND =0. FOR OWB), L.E. CAMBER AT THE ROOT AND TIP,
C     AND T.E. CAMBER AT THE ROOT AND TIP ***
C     NOTE. FOR USB APPLICATIONS, TEANGL MAY BE ANY VALUE *
C
C     IF CAMBER ORDINATES ARE TO BE READ IN, THE L.E. AND T.E. CAMBER
C     SLOPES TO BE READ IN BELOW MAY BE ARBITRARY NUMBERS *
C
      READ (5,470) TEANGL,PTIAL,USB,CAMLER,CAMLET,CAMTER,CAMTET
      WRITE (6,470) TEANGL,PTIAL,USB,CAMLER,CAMLET,CAMTER,CAMTET
      IUSB=USB
      DFJ=0.
      CMU=0.
C
C     THE FOLLOWING DATA ARE NOT NEEDED FOR OWB APPLICATIONS *
      IF (IUSB.NE.1) GO TO 20
C
C      THRUST COEFFICIENT, JET DEFLECTION ANGLE IN DEG. AND ENTRAINMENT
C     CODE IF THE RECTANGULAR JET IS NOT ON THE WING SURFACE (=1. IF THE
C     ENTRAINMENT DUE TO AN EQUIVALENT ROUND JET IS TO BE INCLUDED, =0.
C     OTHERWISE)
C
      READ (5,470) CMU,DFJ,TNJ
      WRITE (6,470) CMU,DFJ,TNJ
20    CONTINUE
      DFJ=DFJ*PI/180.
```

```
      CDF=DFJ
      DO 30 I=1,5
30    DF(I)=DF(I)*PI/180.
      TDF=DF(NJP)
      ALP=ALP*PI/180.
      ALPS=SIN(ALP)
      ALPC=COS(ALP)
      ALPT=ALPS/ALPC
      DE=TEANGL*PI/180.+TDF
      IF (IUSB.EQ.1) CDF=DFJ
      EXIT=0.
      IF (XJ.GT.XEL) EXIT=1.
      XEL=(XEL-XJ)/RJ
      XET=(XET-XJ)/RJ
      Z=ZJ/RJ
      TH=0.
      M1(4)=0
      ITN=TNJ
      YCON(23)=TNJ
      IF (IUSB.EQ.1.AND.ITN.EQ.0) GO TO 40
      CALL ENTRN (VMU,AM2,TEMP,XM,CU,RT,XEL,XET,Z,KCODE,XJC)
      XEQUI=XM*RJ+XJ
      REQUI=RT*RJ
      RT=REQUI
      IF (IUSB.EQ.1) GO TO 40
      IF (XEL.LT.0..AND.ZJ.GE.(2.*RJ)) KCODE=0
      IF (ZJ.GE.(3.*RJ)) KCODE=0
      F1=-29.5428*CU*CU+33.7371*CU-8.9148
      IF (CU.GT.0.6339) F1=0.6+0.4*(CU-0.6339)/0.3661
      IF (F1.LT.0..AND.ZJ.GE.(1.9*RJ)) KCODE=0
      IF (KCODE.EQ.0) GO TO 40
      ZR=PI*RT/2.
      TH=ZR
40    CONTINUE
      IF (IUSB.EQ.1) KCODE=1
      IF (IUSB.NE.1.AND.KCODE.EQ.1) GO TO 50
      GO TO 60
50    AX=XEL*RJ
      DJX=2.*RJ
      IF (F1.LT.0.) F1=0.
      IF (ZJ.LT.(2.*RJ).AND.ZJ.GE.(1.5*RJ)) F1=F1+(1.-F1)*(2.*RJ-ZJ)/(0.
     15*RJ)
      IF (ZJ.LT.(1.5*RJ)) F1=1.
      IF (F1.GT.1.) F1=1.
      FACT=F1
      CDF=DE*FACT
60    CONTINUE
C
C      TOTAL NUMBER OF SPANWISE SECTIONS, AND THE NUMBER OF VORTEX
```

```
C     STRIPS IN EACH SECTION PLUS 1 ***
C     THE NUMBER OF VORTEX STRIPS IN THE JET REGION SHOULD BE CONSISTENT
C     WITH THAT OF JET VORTEX STRIPS *
C
      DO 70 I=1,8
70    M1(I)=0
      READ (5,480) NC,(M1(I),I=1,NC)
      WRITE (6,480) NC,(M1(I),I=1,NC)
C
C     THE NUMERICAL ORDER OF FLAP AND JET SPANS AMONG THE SPANWISE
C     SECTIONS ***
C
      READ (5,480) (NJW(I),I=1,NFP)
      WRITE (6,480) (NJW(I),I=1,NFP)
C
C      NUMBER OF CHORDWISE VORTEX ELEMENTS IN CHORDWISE SECTIONS, AND
C     CAMBER CODE (=1 IF CAMBER ORDINATES ARE TO BE READ IN, =0 IF
C     CAMBER FUNCTIONS ARE DEFINED BY CLOSED-FORM EXPRESSIONS MANUALLY
C     IN SUBPROGRAMS ZCR(X) AND ZCT(X)), AND THE NUMBER OF CAMBER ORDI-
C     NATES TO BE READ IN (ARBITRARY IF ICAM=0) ***
C     NOTE. THE MAXIMUM NUMBER OF CAMBER ORDINATES ALLOWED IS 11 *
C
      READ (5,480) (NW(I),I=1,3),ICAM,IM
      WRITE (6,480) (NW(I),I=1,3),ICAM,IM
      NCW=NW(1)
      L=1
      IF (ICAM.NE.1) GO TO 90
C
C      IF ICAM=1, READ IN THE X-COORDINATES AND THE CAMBER ORDINATES,
C     FIRST FOR THE ROOT SECTION AND THEN FOR THE TIP SECTION ***
C
      DO 80 I=1,2
      READ (5,470) (XT(I,J),J=1,IM)
80    READ (5,470) (ZC(I,J),J=1,IM)
      CALL SPLINE (IM,XT,ZC,AAM,BBM,CCM,DDM,1,2)
90    CONTINUE
100   CONTINUE
      LL=1
      FN=NCW
      DO 110 I=1,NCW
      FI=I
      CPCWL(I)=0.5*(1.-COS((2.*FI-1.)*PI/(2.*FN)))
      SN(I,L)=2.*SQRT(CPCWL(I)*(1.-CPCWL(I)))
110   CPCWL(I)=CPCWL(I)*100.
      DO 230 KK=1,NC
C
C     * COORDINATES OF BREAK CHORDS BOUNDING SPANWISE SECTIONS ***
C
      READ (5,470) (XXL(I),XXT(I),YL(I),I=1,2)
```

```
      WRITE (6,470) (XXL(I),XXT(I),YL(I),I=1,2)                         GE01790
      IF (IUSB.EQ.1) GO TO 190                                          GE01800
      IF (ISYM.EQ.0.AND.KK.EQ.1) GO TO 120                              GE01810
      IF (KK.EQ.(NJW(NJP)+1)) GO TO 130                                 GE01820
      IF (ISYM.NE.0.AND.KK.EQ.(NJW(NJP)-1)) GO TO 140                   GE01830
      IF (ISYM.NE.0.AND.KK.EQ.NJW(NJP)) GO TO 120                       GE01840
      GO TO 190                                                         GE01850
  120 XXL(2)=XXL(1)+(XXL(2)-XXL(1))*(YL(2)-YL(1)+RT-RJ)/(YL(2)-YL(1))   GE01860
      XXT(2)=XXT(1)+(XXT(2)-XXT(1))*(YL(2)-YL(1)+RT-RJ)/(YL(2)-YL(1))   GE01870
      IF (ISYM.EQ.0) GO TO 150                                          GE01880
  130 XXL(1)=XL2                                                        GE01890
      XXT(1)=XT2                                                        GE01900
      GO TO 150                                                         GE01910
  140 XXL(2)=XXL(1)+(XXL(2)-XXL(1))*(YL(2)-YL(1)-RT+RJ)/(YL(2)-YL(1))   GE01920
      XXT(2)=XXT(1)+(XXT(2)-XXT(1))*(YL(2)-YL(1)-RT+RJ)/(YL(2)-YL(1))   GE01930
  150 XL2=XXL(2)                                                        GE01940
      XT2=XXT(2)                                                        GE01950
      IF (ISYM.EQ.0.AND.KK.EQ.1) GO TO 160                              GE01960
      IF (ISYM.NE.0.AND.KK.EQ.(NJW(NJP)-1)) GO TO 160                   GE01970
      YL(1)=YL2                                                         GE01980
  160 IF (ISYM.EQ.0) GO TO 170                                          GE01990
      IF (KK.EQ.(NJW(NJP)+1)) GO TO 190                                 GE02000
      IF (KK.EQ.NJW(NJP)) YL(2)=YL(2)+RT-RJ                             GE02010
      IF (KK.EQ.(NJW(NJP)-1)) YL(2)=YL(2)-RT+RJ                         GE02020
      GO TO 180                                                         GE02030
  170 IF (KK.EQ.1) YL(2)=YL(2)+RT-RJ                                    GE02040
  180 YL2=YL(2)                                                         GE02050
  190 CONTINUE                                                          GE02060
      FM=M1(KK)                                                         GE02070
      NSW=M1(KK)                                                        GE02080
      DO 200 J=1,NSW                                                    GE02090
      FJ=J                                                              GE02100
      CPSWL(J)=0.5*(1.-COS((2.*FJ-1.)*PI/(2.*FM)))*100.                 GE02110
      YCON(J)=0.5*(1.-COS(FJ*PI/FM))                                    GE02120
      SJ(J,KK)=SIN(FJ*PI/FM)                                            GE02130
  200 CONTINUE                                                          GE02140
      IF (KK.EQ.NC) GO TO 210                                           GE02150
      CPSWL(1)=0.                                                       GE02160
      CPSWL(NSW)=100.                                                   GE02170
      GO TO 220                                                         GE02180
  210 CPSWL(1)=0.                                                       GE02190
  220 IF (KK.EQ.NJW(LL)) MJW1(L,LL)=IPANEL                              GE02200
      IF (KK.EQ.NJW(NJP)) LC(L)=KL+1                                    GE02210
      LR=(L-1)*NC+KK                                                    GE02220
      CALL PANEL (XXL,YL,XXT,CPCWL,CPSWL,NSW,IPANEL,LPANEL,KL,LR,SWP)   GE02230
      IPANEL=LPANEL+1                                                   GE02240
      NCS=NCS+NSW-1                                                     GE02250
      WIDTH(KK)=YL(2)-YL(1)                                             GE02260
      BREAK(KK)=YL(1)                                                   GE02270
```

```
      IF (KK.EQ.NJW(LL)) MJW2(L,LL)=LPANEL
      IF (KK.NE.NC) GO TO 230
      HALFB=YL(2)
230   IF (KK.EQ.NJW(LL)) LL=LL+1
      IF (L.EQ.3) GO TO 280
      IF (L.EQ.1) LPAN1=LPANEL
      IF (L.EQ.2) LPAN2=LPANEL
      IF (NW(2).EQ.0) GO TO 240
      L=L+1
      NCW=NW(L)
      IF (L.EQ.3.AND.NW(3).EQ.0) GO TO 260
      GO TO 100
240   DO 250 I=2,3
      DO 250 J=1,NFP
      MJW1(I,J)=0
250   MJW2(I,J)=0
      LPAN2=LPANEL
      NCS=NCS*3
      GO TO 280
260   DO 270 I=1,NFP
      MJW1(3,I)=0
270   MJW2(3,I)=0
      L=L-1
      NCS=NCS+NCS/2
280   CONTINUE
      NCS=NCS/3
      NCW=NW(1)+NW(2)+NW(3)
      VU=VMU
      IF (IUSB.EQ.1) CU=VMU
      VMU=CU
      RTJ=RJ
      ZJT=ZJ
      IF (RT.GT.ZJ.AND.KCODE.EQ.0) ZJT=RT
      IF (IUSB.EQ.1) GO TO 290
      AM2=AM1/(VMU*SQRT(TEMP))
      IF (AM2.GT.0.9) WRITE (6,560) AM2
      IF (AM2.GT.0.9) AM2=0.9
290   CONTINUE
      LAST=LPANEL
C
C      TOTAL NUMBER OF STREAMWISE JET SECTIONS, NUMBER OF JET CIRCUM-
C     FERENTIAL STRIPS MINUS ONE FOR A NON-CENTERED JET (USE ODD NUMBERS
C     ) AND PLUS ONE FOR A CENTERED JET (USE EVEN NUMBERS), AND NUMBERS
C     OF CHORDWISE JET VORTEX ELEMENTS ON EACH JET SECTION ***
C
      READ (5,480) NNJ,NSJ,(NCJ(I),I=1,NNJ)
      WRITE (6,480) NNJ,NSJ,(NCJ(I),I=1,NNJ)
      IF (KCODE.EQ.0) CALL CIRCJ (ISYM,NSJ,Y)
      IF (ISYM.EQ.0) NSJJ=NSJ/2
```

```
      IF (ISYM.NE.0) NSJJ=(NSJ+1)/2                                      GE02770
      NSYM=1-ISYM                                                        GE02780
      NSJ1=NSJJ-1                                                        GE02790
      FNJ=NSJJ                                                           GE02800
      CPSWL(1)=0.                                                        GE02810
      CPSWL(NSJJ)=1.                                                     GE02820
      YCON(1)=0.5*(1.-COS(PI/FNJ))                                       GE02830
      DO 300 I=2,NSJ1                                                    GE02840
      FI=I                                                               GE02850
      CPSWL(I)=0.5*(1.-COS((2.*FI-1.)*PI/(2.*FNJ)))                      GE02860
  300 YCON(I)=0.5*(1.-COS(FI*PI/FNJ))                                    GE02870
      IENTN=NC                                                           GE02880
      JC=NCS*L                                                           GE02890
      NJ1=NNJ-1                                                          GE02900
      DO 400 JJ=1,NNJ                                                    GE02910
      IF (IUSB.EQ.1) GO TO 350                                           GE02920
C                                                                        GE02930
C     THIS DATA IS NOT NEEDED FOR USB JOBS **                            GE02940
C     * COORDINATES OF BOUNDING LINES OF JET SECTIONS PROJECTED ON X-Y   GE02950
C      PLANE ***                                                         GE02960
C                                                                        GE02970
      READ (5,470) (XXL(I),XXT(I),YL(I),I=1,2)                           GE02980
      WRITE (6,470) (XXL(I),XXT(I),YL(I),I=1,2)                          GE02990
      IF (ISYM.EQ.0) GO TO 310                                           GE03000
      XL1=XXL(1)-(XXL(2)-XXL(1))*(RT-RTJ)/(YL(2)-YL(1))                  GE03010
      XT1=XXT(1)-(XXT(2)-XXT(1))*(RT-RTJ)/(YL(2)-YL(1))                  GE03020
  310 XL2=XXL(1)+(XXL(2)-XXL(1))*(RT+RTJ)/(YL(2)-YL(1))                  GE03030
      XT2=XXT(1)+(XXT(2)-XXT(1))*(RT+RTJ)/(YL(2)-YL(1))                  GE03040
      IF (ISYM.EQ.0) GO TO 320                                           GE03050
      XXL(1)=XL1                                                         GE03060
      XXT(1)=XT1                                                         GE03070
  320 XXL(2)=XL2                                                         GE03080
      XXT(2)=XT2                                                         GE03090
      IF (ISYM.EQ.0) GO TO 330                                           GE03100
      YL(1)=YL(1)-RT+RTJ                                                 GE03110
  330 YL(2)=YL(2)+RT-RTJ                                                 GE03120
      IF (KCODE.EQ.0) GO TO 340                                          GE03130
      XXL(4)=XXL(2)                                                      GE03140
      XXT(4)=XXT(2)                                                      GE03150
      YL(4)=YL(2)                                                        GE03160
      XXL(2)=XXL(1)                                                      GE03170
      XXT(2)=XXT(1)                                                      GE03180
      YL(2)=YL(1)                                                        GE03190
      XXL(3)=XXL(4)                                                      GE03200
      XXT(3)=XXT(4)                                                      GE03210
      YL(3)=YL(4)                                                        GE03220
      ZL(1)=0.                                                           GE03230
      ZL(2)=ZR                                                           GE03240
      ZL(3)=ZR                                                           GE03250
```

```
      ZL(4)=0.
  340 CONTINUE
      GO TO 370
C
C     COORDINATES OF BREAK POINTS DEFINING RECTANGULAR JET SECTIONS FOR
C     USB CONFIGURATIONS***
C
  350 DO 360 I=1,4
      READ (5,470) XXL(I),XXT(I),YL(I),ZL(I)
  360 WRITE (6,470) XXL(I),XXT(I),YL(I),ZL(I)
  370 CONTINUE
      II=JJ
      JJ1=JJ+L
      FNCJ=NCJ(JJ)
      NJ=NCJ(JJ)
      NMJ=NJ*16
      IF (NJ.GT.6) NMJ=NJ*8
      FNJ=NMJ
      DO 380 J=1,NMJ
      FJ=J
      SC(J,JJ)=0.5*(1.-COS((2.*FJ-1.)*PI/(2.*FNJ)))
  380 SI(J,JJ)=SIN((2.*FJ-1.)*PI/(2.*FNJ))
      DO 390 J=1,NJ
      FJ=J
      CPCWL(J)=0.5*(1.-COS((2.*FJ-1.)*PI/(2.*FNCJ)))
  390 SN(J,JJ1)=2.*SQRT(CPCWL(J)*(1.-CPCWL(J)))
      IF (KCODE.EQ.0) CALL JSHAPE (XXL,XXT,YL,YJ,ZJT,RT,CPCWL,IPANEL,NJ,
     1JC,ISYM)
      IF (KCODE.EQ.1) CALL RESHAP (XXL,XXT,YL,ZL,CPCWL,CPSWL,IPANEL,NJ,J
     1C,II,NSYM)
      MJJ(JJ)=LAST
  400 IPANEL=LAST+1
      SDF=XXT(1)-XXL(1)
      IF (IUSB.EQ.1) TH=ZL(3)-ZL(4)
      YCON(25)=ZL(4)
      YCON(24)=USB
      C(1)=CMU
      IF (KCODE.EQ.0) YCON(25)=1.
      IF (KCODE.EQ.1) CALL RECTJ (ISYM,NSJ,Y)
      CREF=HALFSW/HALFB
      WRITE (6,490) HALFSW,CREF
      JPANEL=LAST-LPANEL
      LTOTAL=LAST+JPANEL
      WRITE (6,530) LPANEL,JPANEL,LAST,LTOTAL
      IF (IUSB.EQ.1) GO TO 410
      WRITE (6,650)
      IF (KCODE.EQ.0) WRITE (6,670)
      IF (KCODE.EQ.1) WRITE (6,680)
      IF (KCODE.EQ.1) WRITE (6,690)
      WRITE (6,650)
```

```
      WRITE (6,630) XEQUI                                               GE03760
      WRITE (6,640) REQUI                                               GE03770
      WRITE (6,660) VMU                                                 GE03780
410   CONTINUE                                                          GE03790
      IF (ICAM.NE.1) GO TO 420                                          GE03800
      WRITE (6,570)                                                     GE03810
      WRITE (6,590) (XT(1,I),I=1,IM)                                    GE03820
      WRITE (6,600) (ZC(1,I),I=1,IM)                                    GE03830
      WRITE (6,580)                                                     GE03840
      WRITE (6,590) (XT(2,I),I=1,IM)                                    GE03850
      WRITE (6,600) (ZC(2,I),I=1,IM)                                    GE03860
      CAMLER=ZCR(0.)                                                    GE03870
      CAMTER=ZCR(1.)                                                    GE03880
      CAMLET=ZCT(0.)                                                    GE03890
      CAMTET=ZCT(1.)                                                    GE03900
420   CONTINUE                                                          GE03910
      WRITE (6,540)                                                     GE03920
      WRITE (6,610)                                                     GE03930
      WRITE (6,500) (XN(I,1),XN(I,2),YN(I,1),YN(I,2),ZN(I,1),ZN(I,2),I=1GE03940
     1,LAST)                                                            GE03950
      WRITE (6,550)                                                     GE03960
      WRITE (6,620)                                                     GE03970
      WRITE (6,500) (XCP(I),YCP(I),ZCP(I),I=1,LAST)                     GE03980
      IF (KCODE.EQ.1) GO TO 440                                         GE03990
      IF (ISYM.EQ.0) GO TO 430 .                                        GE04000
      FN2=(NSJ-1)/2+1                                                   GE04010
      NJH=(NSJ-1)/2+2                                                   GE04020
      ANG=PI/(2.*FN2)                                                   GE04030
      FAC=(SIN(3.*ANG)-SIN(ANG)/COS(ANG))/(1.-COS(3.*ANG))              GE04040
      PHI=PI/2.-ATAN(FAC)                                               GE04050
      NJH1=NJH-1                                                        GE04060
      NJH2=NJH+1                                                        GE04070
      Y(3,2)=SIN(PHI)                                                   GE04080
      Y(4,2)=-COS(PHI)                                                  GE04090
      Y(3,NJH1)=Y(3,2)                                                  GE04100
      Y(4,NJH1)=-Y(4,2)                                                 GE04110
      Y(3,NJH2)=-Y(3,2)                                                 GE04120
      Y(4,NJH2)=Y(4,2)                                                  GE04130
      Y(3,NSJ1)=-Y(3,2)                                                 GE04140
      Y(4,NSJ1)=-Y(4,2)                                                 GE04150
      GO TO 440                                                         GE04160
430   FN2=NSJ/2                                                         GE04170
      NJH=NSJ/2                                                         GE04180
      ANG1=1.-0.5*(1.-COS(PI/(2.*FN2)))                                 GE04190
      ANG3=1.-0.5*(1.-COS(3.*PI/(2.*FN2)))                              GE04200
      ANG1=ATAN(SQRT(1.-ANG1*ANG1)/ANG1)                                GE04210
      ANG3=ATAN(SQRT(1.-ANG3*ANG3)/ANG3)                                GE04220
      FAC=(SIN(ANG3)-SIN(ANG1)/COS(ANG1))/(1.-COS(ANG3))                GE04230
      PHI=PI/2.-ATAN(FAC)                                               GE04240
      NJH1=NJH-1                                                        GE04250
      NJH2=NSJ1                                                         GE04260
```

```
      Y(3,NJH1)=SIN(PHI)                                                GE04270
      Y(4,NJH1)=COS(PHI)                                                GE04280
      Y(3,NJH2)=-Y(3,NJH1)                                              GE04290
      Y(4,NJH2)=Y(4,NJH1)                                               GE04300
440   CONTINUE                                                          GE04310
      FNJ=NNJ                                                           GE04320
      DO 450 J=1,NNJ                                                    GE04330
      FJ=J                                                              GE04340
450   PSI(J)=SIN(FJ*PI/FNJ)                                             GE04350
      BETA1=SQRT(1.-AM1*AM1)                                            GE04360
      BETA2=SQRT(1.-AM2*AM2)                                            GE04370
      B1=BETA1*BETA1                                                    GE04380
      B2=BETA2*BETA2                                                    GE04390
      DO 460 KK=1,NCS                                                   GE04400
      XLL(KK)=ALP+(TWISTR+TWIST*YLE(KK)/HALFB)*PI/180.                  GE04410
      T=XLL(KK)                                                         GE04420
460   XTT(KK)=SIN(T)/COS(T)                                             GE04430
      RETURN                                                            GE04440
C                                                                       GE04450
470   FORMAT (8(F10.5))                                                 GE04460
480   FORMAT (8(6X,I4))                                                 GE04470
490   FORMAT (10X,8HHALF SW=,E12.5,10X,5HCREF=,E12.5)                   GE04480
500   FORMAT (6(F10.5))                                                 GE04490
510   FORMAT (2(6X,I4),10X,5(F10.5))                                    GE04500
520   FORMAT (1H0,10HINPUT DATA)                                        GE04510
530   FORMAT (1H0,7HLPANEL=,I3,3X,7HJPANEL=,I3,3X,5HLAST=,I3,3X,7HLTOTALGE04520
     1=I3)                                                              GE04530
540   FORMAT (1H0,36HVORTEX ELEMENT ENDPOINT COORDINATES=)              GE04540
550   FORMAT (1H0,26HCONTROL POINT COORDINATES=)                        GE04550
560   FORMAT (1H0,42HWARNING. THE EQUIVALENT JET MACH NUMBER IS,F10.5,41GE04560
     1HIT HAS BEEN SET TO 0.9 IN THE COMPUTATION)                       GE04570
570   FORMAT (/45H*** CAMBER ORDINATES FOR THE ROOT SECTION ***)        GE04580
580   FORMAT (/44H*** CAMBER ORDINATES FOR THE TIP SECTION ***)         GE04590
590   FORMAT (/7X,3HX/C,11F10.5)                                        GE04600
600   FORMAT (/7X,3HZ/C,11F10.5)                                        GE04610
610   FORMAT (/4X,2HX1,8X,2HX2,8X,2HY1,8X,2HY2,8X,2HZ1,6X,2HZ2)         GE04620
620   FORMAT (/4X,3HXCP,7X,3HYCP,7X,3HZCP,7X,3HXCP,7X,3HYCP,7X,3HZCP)   GE04630
630   FORMAT (1H0,46HTHE EQUIVALENT JET PROPERTIES ARE EVALUATED AT,F10.GE04640
     15)                                                                GE04650
640   FORMAT (1H0,28HTHE EQUIVALENT JET RADIUS IS,F10.5)                GE04660
650   FORMAT (/20X,50HXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXGE04670
     1)                                                                 GE04680
660   FORMAT (1H0,49HTHE VELOCITY RATIO OF THE EQUIVALENT JET,V0/VJ,IS,FGE04690
     110.5)                                                             GE04700
670   FORMAT (/20X,38HAN EQUIVALENT CIRCULAR JET IS USED FOR/20X,23HINTEGE04710
     1RACTION COMPUTATION)                                              GE04720
680   FORMAT (/20X,43HA RECTANGULAR JET WITH LATERAL EXTENT EQUAL/20X,42GE04730
     1HTO THE EQUIVALENT JET DIAMETER IS USED FOR/20X,23HINTERACTION COMGE04740
     2PUTATION)                                                         GE04750
690   FORMAT (/20X,51HNOTE. CHECK WHETHER THE WING IS IMMERSED IN THE JEGE04760
     1T)                                                                GE04770
```

```
      END
      SUBROUTINE SPLINE (N,X,Y,A,B,C,D,LM,NT)
      DIMENSION S(30), H(12), CA(10), X(2,11), Y(2,11)
      DIMENSION A(2,10), B(2,10), C(2,10), D(2,10)
      L=LM
      DO 90 NN=1,NT
      I=1
      NI=N+1
      N1=N-1
      H(NI)=0.
      H(1)=X(L,3)-X(L,2)
      H(2)=-X(L,3)+X(L,1)
      H(3)=X(L,2)-X(L,1)
      DO 10 K=4,N
10    H(K)=0.
      DO 20 K=1,N
20    S(K)=-H(K+1)/H(1)
      NJ=N-1
      DO 70 I=2,N
      IF (I.EQ.N) GO TO 30
      H(NI)=-6.*((Y(L,I+1)-Y(L,I))/(X(L,I+1)-X(L,I))-(Y(L,I)-Y(L,I-1))/(
     1X(L,I)-X(L,I-1)))
      GO TO 40
30    H(NI)=0.
40    DO 60 J=1,N
      H(J)=0.
      IF (I.EQ.N) GO TO 50
      IF (J.LT.(I-1).OR.J.GT.(I+1)) GO TO 60
      H(I-1)=X(L,I)-X(L,I-1)
      H(I)=2.*(X(L,I+1)-X(L,I-1))
      H(I+1)=X(L,I+1)-X(L,I)
      GO TO 60
50    H(N-2)=X(L,N)-X(L,N-1)
      H(N-1)=-X(L,N)+X(L,N-2)
      H(N)=X(L,N-1)-X(L,N-2)
60    CONTINUE
      II=I
      CALL VMSEQN (NJ,II,H,S,CA)
      NJ=NJ-1
70    CONTINUE
      DO 80 I=1,N1
      A(L,I)=(S(I+1)-S(I))/(6.*(X(L,I+1)-X(L,I)))
      B(L,I)=S(I)/2.
      C(L,I)=(Y(L,I+1)-Y(L,I))/(X(L,I+1)-X(L,I))-(X(L,I+1)-X(L,I))*(2.*S
     1(I)+S(I+1))/6.
80    D(L,I)=Y(L,I)
90    L=L+1
      RETURN
      END
      SUBROUTINE RESHAP (XXL,XXT,YL,ZL,CPCWL,CPSWL,IPANEL,NJ,JC,JJ,NSYM)
```

```
C     TO DEFINE THE LOCATIONS OF VORTEX AND CONTROL POINTS ON RECT. JETS
      DIMENSION XXL(1), YL(1), XXT(1), ZL(1), CPCWL(1), CPSWL(1)
      COMMON /SCHEME/ C(2),X(10,41),Y(10,41),SLOPE(15),XL(2,15),XTT(41),
     1XLL(41)
      COMMON /GEOM/ HALFSW,XCP(200),YCP(200),ZCP(200),XLE(50),YLE(50),XT
     1E(50),PSI(20),CH(95),XV(200),YV(100),SN(8,8),XN(200,2),YN(200,2),Z
     2N(200,2),WIDTH(8),YCON(25),SWEEP(50),HALFB,SJ(21,8),EX(95,2),TX(95
     3,2),SC(160,5),SI(160,5),LC(3)
      COMMON /CONST/ NCS,NCW,M1(8),NSJ,NCJ(5),LAST,MJW1(3,5),MJW2(3,5),J
     1PANEL,MJJ(5),NW(3),NNJ,NJP
      PI=3.14159265
      IF (NSYM.EQ.0) NSJJ=(NSJ+1)/2
      IF (NSYM.NE.0) NSJJ=NSJ/2
      NSJ1=NSJJ-1
      DO 10 J=1,NJ
      FJ=J
      FNJ=NJ
   10 PSI(J)=0.5*(1.-COS(FJ*PI/FNJ))
      DO 170 IS=1,4
      IF (NSYM.EQ.1.AND.IS.EQ.1) GO TO 170
      IF (IS.EQ.4) GO TO 20
      K1=IS
      K2=IS+1
      GO TO 30
   20 K1=1
      K2=4
   30 CONTINUE
      SPAN=YL(K2)-YL(K1)
      XDIF=XXL(K2)-XXL(K1)
      DO 40 I=1,2
      II=I+K1-1
      IF (IS.EQ.4.AND.I.EQ.2) II=4
      C(I)=XXT(II)-XXL(II)
      DO 40 J=1,NJ
   40 XL(I,J)=XXL(II)+CPCWL(J)*C(I)
      IF (ABS(SPAN).LE.0.001) GO TO 70
      DO 50 J=1,NJ
   50 SLOPE(J)=(XL(2,J)-XL(1,J))/SPAN
      DO 60 K=1,NSJJ
      YK=CPSWL(K)*SPAN
      DO 60 J=1,NJ
      Y(J,K)=YK+YL(K1)
      X(J,K)=XL(1,J)+SLOPE(J)*(Y(J,K)-YL(K1))
   60 CONTINUE
      NS=NSJ1
   70 IF (ABS(SPAN).LE.0.001) NS=1
      DO 160 K=1,NS
      YC=YCON(K)
      IF (ABS(SPAN).LE.0.001) YC=0.5
```

```
      KK=JC+K
      CH(KK)=C(1)-(C(1)-C(2))*YC
      IF (ABS(SPAN).LE.0.001) GO TO 80
      YC1=CPSWL(K)
      YC2=CPSWL(K+1)
      GO TO 90
80    YC1=0.
      YC2=1.
90    CONTINUE
      EX(KK,1)=XXL(K1)+XDIF*YC1
      EX(KK,2)=XXL(K1)+XDIF*YC2
      TX(KK,1)=XXT(K1)+(XXT(K2)-XXT(K1))*YC1
      TX(KK,2)=XXT(K1)+(XXT(K2)-XXT(K1))*YC2
      DO 160 J=1,NJ
      NPANEL=(K-1)*NJ+J-1+IPANEL
      NPAN1=NPANEL-1
      DO 130 I=1,2
      KI1=K+I-1
      IF (ABS(SPAN).LE.0.001) GO TO 100
      X1=X(J,KI1)
      Y1=Y(J,KI1)
      IF (J.NE.1) GO TO 110
      ZZ=ZL(K1)+(ZL(K2)-ZL(K1))*(Y1-YL(K1))/SPAN
      XX=XDIF*(Y1-YL(K1))/SPAN+XXL(K1)
      GO TO 120
100   IZN=K1
      IF (I.EQ.2) IZN=K2
      X1=XL(I,J)
      Y1=YL(K1)
      IF (J.NE.1) GO TO 110
      ZZ=ZL(IZN)
      XX=XXL(IZN)
      GO TO 120
110   ZZ=ZN(NPAN1,I)
      XX=XN(NPAN1,I)
120   XN(NPANEL,I)=X1
      YN(NPANEL,I)=Y1
      ZN(NPANEL,I)=ZZ
130   CONTINUE
      XD=XDIF*YC+XXL(K1)
      XCP(NPANEL)=XD+CH(KK)*PSI(J)
      YCP(NPANEL)=YC*SPAN+YL(K1)
      IF (ABS(SPAN).LE.0.001) GO TO 140
      ZC=ZN(NPANEL,1)+(ZN(NPANEL,1)-ZN(NPANEL,2))*(YCP(NPANEL)-YN(NPANEL
     1,1))/(YN(NPANEL,1)-YN(NPANEL,2))
      XC=XN(NPANEL,1)+SLOPE(J)*(YCP(NPANEL)-YN(NPANEL,1))
      GO TO 150
140   ZC=0.5*(ZN(NPANEL,1)+ZN(NPANEL,2))
      XC=0.5*(XN(NPANEL,1)+XN(NPANEL,2))
```

```
150   ZCP(NPANEL)=ZC                                                    RES1000
      XV(NPANEL)=XC                                                     RES1010
160   CONTINUE                                                          RES1020
      IPANEL=NPANEL+1                                                   RES1030
      LAST=NPANEL                                                       RES1040
      JC=KK                                                             RES1050
170   CONTINUE                                                          RES1060
      RETURN                                                            RES1070
      END                                                               RES1080-
      SUBROUTINE PANEL (XXL,YL,XXT,CPCWL,CPSWL,NSW,IPANEL,LPANEL,KK,LR,SPAN   10
     1WP)                                                               PAN   20
C     TO DEFINE THE LOCATIONS OF VORTEX AND CONTROL POINTS ON THE WING  PAN   30
      DIMENSION XXL(1), YL(1), XXT(1), CPCWL(1), CPSWL(1)               PAN   40
      DIMENSION SWP(8,15)                                               PAN   50
      COMMON /SCHEME/ C(2),X(10,41),Y(10,41),SLOPE(15),XL(2,15),XTT(41),PAN   60
     1XLL(41)                                                           PAN   70
      COMMON /GEOM/ HALFSW,XCP(200),YCP(200),ZCP(200),XLE(50),YLE(50),XTPAN   80
     1E(50),PSI(20),CH(95),XV(200),YV(100),SN(8,8),XN(200,2),YN(200,2),ZPAN   90
     2N(200,2),WIDTH(8),YCON(25),SWEEP(50),HALFB,SJ(21,8),EX(95,2),TX(95PAN  100
     3,2),SC(160,5),SI(160,5),LC(3)                                     PAN  110
      COMMON /CONST/ NCS,NCW,M1(8),NSJ,NCJ(5),LAST,MJW1(3,5),MJW2(3,5),JPAN  120
     1PANEL,MJJ(5),NW(3),NNJ,NJP                                        PAN  130
      PI=3.14159265                                                     PAN  140
      NSW1=NSW-1                                                        PAN  150
      DO 10 I=1,2                                                       PAN  160
      C(I)=XXT(I)-XXL(I)                                                PAN  170
      DO 10 J=1,NCW                                                     PAN  180
10    XL(I,J)=XXL(I)+CPCWL(J)*C(I)/100.                                 PAN  190
      SPAN=YL(2)-YL(1)                                                  PAN  200
      DO 20 J=1,NCW                                                     PAN  210
      PSI(J)=0.5*(1.-COS(FLOAT(J)*PI/FLOAT(NCW)))                       PAN  220
      SLOPE(J)=(XL(2,J)-XL(1,J))/SPAN                                   PAN  230
20    SWP(J,LR)=ATAN(SLOPE(J))                                          PAN  240
      DO 30 K=1,NSW                                                     PAN  250
      YK=CPSWL(K)*SPAN/100.                                             PAN  260
      DO 30 J=1,NCW                                                     PAN  270
      Y(J,K)=YK+YL(1)                                                   PAN  280
      X(J,K)=XL(1,J)+SLOPE(J)*(Y(J,K)-YL(1))                            PAN  290
30    CONTINUE                                                          PAN  300
      XLL(1)=XXL(1)                                                     PAN  310
      XTT(1)=XXT(1)                                                     PAN  320
      DO 40 I=2,NSW                                                     PAN  330
      XLL(I)=XLL(I-1)+(XXL(2)-XXL(1))*(Y(1,I)-Y(1,I-1))/SPAN            PAN  340
40    XTT(I)=XTT(I-1)+(XXT(2)-XXT(1))*(Y(1,I)-Y(1,I-1))/SPAN            PAN  350
      DO 60 K=1,NSW1                                                    PAN  360
      KK=NCS+K                                                          PAN  370
      YLE(KK)=YCON(K)*SPAN+YL(1)                                        PAN  380
      XLE(KK)=XLL(K)+(XLL(K+1)-XLL(K))*(YLE(KK)-Y(1,K))/(Y(1,K+1)-Y(1,K)PAN  390
     1)                                                                 PAN  400
```

```
      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)
      EX(KK,1)=XXL(1)+(XXL(2)-XXL(1))*CPSWL(K)/100.
      EX(KK,2)=XXL(1)+(XXL(2)-XXL(1))*CPSWL(K+1)/100.
      TX(KK,1)=XXT(1)+(XXT(2)-XXT(1))*CPSWL(K)/100.
      TX(KK,2)=XXT(1)+(XXT(2)-XXT(1))*CPSWL(K+1)/100.
      TANG=(XXL(2)-XXL(1))/SPAN
      SWEEP(KK)=ATAN(TANG)
      DO 60 J=1,NCW
      NPANEL=(K-1)*NCW+J-1+IPANEL
      DO 50 I=1,2
      KI1=K+I-1
      XN(NPANEL,I)=X(J,KI1)
      YN(NPANEL,I)=Y(J,KI1)
      ZN(NPANEL,I)=0.
50    CONTINUE
      XCP(NPANEL)=XLE(KK)+PSI(J)*CH(KK)
      YCP(NPANEL)=YLE(KK)
      ZCP(NPANEL)=0.
      XV(NPANEL)=XLE(KK)+CPCWL(J)*CH(KK)/100.
      YV(NPANEL)=YLE(KK)
60    CONTINUE
      LPANEL=NPANEL
      RETURN
      END
      SUBROUTINE ENTRN (U,AMJ,T,XM,CMU,RT,XEL,XET,Z,KCODE,XJC)
C     TO COMPUTE THE JET ENTRAINMENT FUNCTION
      DIMENSION CSJ(70), SSJ(70)
      DIMENSION PU1(31), PU2(31), FU1(31), FU2(31), FU3(31), RR2(31)
      COMMON /JET/ PK1,XC,X(31),A(31),B(31)
      WRITE (6,260)
      WRITE (6,270)
      PI=3.14159265
      IK=1
      REJ=T
      PK1=0.0185+0.011*U
      KCODE=0
      XMID=0.5*(XEL+XET)
      XM=XMID
      X0=0.
      R0=1.
      F=2.*PK1*SQRT((1.-U)*REJ)
      XC=0.35/F
      XJC=XC
      P1=1.-U
      UA=(1.+2.*U/(1.-U))/(1.+U/(1.-U))
      X(1)=XC
      DXX=(3.*XET-XEL)/30.
```

```
      IDX=DXX
      DXX=IDX
      IF (DXX.GT.3.) GO TO 10
      IF (DXX.GE.1..AND.DXX.LE.3.) DXX=2.5
      IF (DXX.LT.1.) DXX=1.5
   10 CONTINUE
      X(2)=X(1)+DXX/2.
      DO 20 I=2,30
   20 X(I+1)=X(I)+DXX
      DO 30 I=1,70
      FI=I
      CSJ(I)=COS((2.*FI-1.)*PI/140.)
   30 SSJ(I)=SIN((2.*FI-1.)*PI/140.)
      DO 160 I=1,31
      IF (U.LE.0.01) GO TO 80
      IF (I.EQ.1.AND.ABS(T-1.).LE.0.01) GO TO 100
      IF (I.EQ.1) S=(2.*PK1*SQRT(REJ*(1.-U))*XC/0.72-0.35)*SQRT((1.-U)/U
     1*ALOG(UA))
      IF (I.EQ.2) S=DSX*(X(2)-XC)
      IF (I.GT.2) S=SH+DSX*DXX
      M=1
      IF (I.EQ.1) M=2
   40 CONTINUE
      SUM=0.
      DO 50 J=1,70
      SB=0.5*S*(1.-CSJ(J))
      AP1=(1.-U)*(1.-EXP(-1./(2.*SB)))
      AG=ALOG((1.+2.*U/AP1)/(1.+U/AP1))
   50 SUM=SUM+(1./SQRT(AP1*AG)-SQRT(2.*SB/((1.-U)*0.69314718)))*SSJ(J)
      RES=SUM*PI/70.*0.5*S*SQRT(U)+SQRT(2.*U/(1.-U))*S**1.5/1.0397208
      X1=RES+0.35
      IF (M.NE.1) GO TO 70
      XT=X1/(2.*PK1*SQRT((1.-U)*REJ))
      P1=(1.-U)*(1.-EXP(-1./(2.*S)))
      G1=ALOG((1.+2.*U/P1)/(1.+U/P1))
      DSX=2.*PK1*SQRT(REJ*(1.-U)*P1*G1/U)
      SH=S
      IF (ABS(X(I)-XT).LE.0.01) GO TO 60
      DX=X(I)-XT
      S=S+DX*DSX
      SH=S
      GO TO 40
   60 P1=(1.-U)*(1.-EXP(-1./(2.*SH)))
   70 IF (ABS(T-1.).LE.0.01) GO TO 100
      XH=X1*0.72/(2.*PK1*SQRT((1.-U)*REJ))
      IF (ABS(X(I)-XH).LE.0.01) GO TO 90
      AK2=(1.-U)*(1.-EXP(-1./(2.*S)))
      AG2=ALOG((1.+2.*U/AK2)/(1.+U/AK2))
      DSX1=2.*PK1/0.72*SQRT(REJ*(1.-U)*AK2*AG2/U)
```

```
      DX=X(I)-XH
      S=S+DX*DSX1
      M=M+1
      GO TO 40
80    IF (I.NE.1) SH=2.*PK1*SQRT(REJ)*X(I)-0.35
      IF (I.NE.1) P1=(1.-U)*(1.-EXP(-1./(2.*SH)))
      DSX=2.*PK1*SQRT(REJ)
      IF (ABS(T-1.).LE.0.01) GO TO 100
      S=2.*PK1/0.72*SQRT(REJ)*X(I)-0.35
90    IF (I.EQ.1.AND.U.GT.0.01) DSX=2.*PK1*SQRT(REJ*ALOG(UA)/U)*(1.-U)
      P1P=-2.*P1*P1/(1.-U)
      HO=1.-EXP(-1./(2.*S))
      HOP=-2.*HO**2/0.72
      P2=(T-1.+0.2*(1.-U*U)*AMJ*AMJ*T)*HO-0.2*P1*AMJ*AMJ*T*(P1+2.*U)
      P2P=(T-1.+0.2*(1.-U*U)*AMJ*AMJ*T)*HOP-0.2*P1P*AMJ*AMJ*T*(P1+2.*U)-
     10.2*P1*AMJ*AMJ*T*P1P
      F1P=-P2P*0.8907*(0.08901-0.04005*P2+0.01792*P2**2-0.00646*P2**3)/(
     11.+1.05001*P2)
      F2P=-P2P*0.79335*(0.0527-0.02886*P2+0.01478*P2**2-0.00589*P2**3)/(
     11.+1.08869*P2)
      F3P=-P2P*(0.12857-0.04653*P2+0.01820*P2**2-0.00599*P2**3)/(1.+1.02
     1272*P2)
      GO TO 110
100   P2=0.
      P2P=0.
      F1P=0.
      F2P=0.
      F3P=0.
      IF (I.EQ.1.AND.U.GT.0.01) DSX=2.*PK1*SQRT(REJ*ALOG(UA)/U)*(1.-U)
110   P1P=-2.*P1*P1/(1.-U)
      F1=0.8907*(0.12857+0.01617*P2-0.00607*P2**2+0.00192*P2**3)/(1.+0.8
     11817*P2)
      F2=0.79335*(0.06676+0.00453*P2-0.00204*P2**2+0.00075*P2**3)/(1.+0.
     185716*P2)
      F3=(0.21429+0.04061*P2-0.01249*P2**2+0.00351*P2**3)/(1.+0.78948*P2
     1)
      FU=U*P1*F1+P1*P1*F2
      DMC1=(P1P*F1+P1*F1P-U*P2P*F3-U*P2*F3P)/FU
      DMC2=(P1*F1-U*P2*F3)*(U*P1P*F1+U*P1*F1P+2.*P1*P1P*F2+P1*P1*F2P)/(F
     1U*FU)
      DMX=2.*(1.-U)*(DMC1-DMC2)*DSX/SQRT(REJ)
      RJ2=0.5*(1.-U)/FU
      RJ1=SQRT(RJ2)
      WRITE (6,250) X(I),RJ1,DMX
      IF (IK.GT.1) GO TO 140
      IF (X(I).GE.XEL) GO TO 120
      GO TO 140
120   IF (RJ1.LT.Z) GO TO 140
      XMJ=X0+(Z-R0)*(X(I)-X0)/(RJ1-R0)
```

```
      IF (XEL.LT.0) GO TO 130                                           ENT1220
      IF (XMJ.LT.XET) KCODE=1                                           ENT1230
      IK=IK+1                                                           ENT1240
      GO TO 140                                                         ENT1250
  130 XM=0.5*XET                                                        ENT1260
      IF (XMJ.LE.XM) KCODE=1                                            ENT1270
      IK=IK+1                                                           ENT1280
  140 CONTINUE                                                          ENT1290
      R0=RJ1                                                            ENT1300
      X0=X(I)                                                           ENT1310
      PU1(I)=P1                                                         ENT1320
      PU2(I)=P2                                                         ENT1330
      FU1(I)=F1                                                         ENT1340
      FU2(I)=F2                                                         ENT1350
      FU3(I)=F3                                                         ENT1360
      RR2(I)=RJ2                                                        ENT1370
      IF (I.EQ.1) GO TO 150                                             ENT1380
      B(I)=(DMX-DMXO)/(X(I+1)-X(I))                                     ENT1390
      A(I)=DMXO-B(I)*X(I)                                               ENT1400
      GO TO 160                                                         ENT1410
  150 A(I)=0.145*DMX/0.32                                               ENT1420
      B(I)=(DMX-A(I))/XC                                                ENT1430
  160 DMXO=DMX                                                          ENT1440
      K=1                                                               ENT1450
  170 IF (K.GT.30) GO TO 240                                            ENT1460
      IF (XM.GE.0..AND.XM.LT.XC) GO TO 180                              ENT1470
      IF (XM.GE.X(K).AND.XM.LT.X(K+1)) GO TO 180                        ENT1480
      K=K+1                                                             ENT1490
      GO TO 170                                                         ENT1500
  180 F11=RR2(K)*(PU1(K)*U*FU1(K)+PU1(K)**2*FU2(K))/(U*U)               ENT1510
      F12=RR2(K+1)*(PU1(K+1)*U*FU1(K+1)+PU1(K+1)**2*FU2(K+1))/(U*U)     ENT1520
      F21=RR2(K)*(PU1(K)*FU1(K)-U*PU2(K)*FU3(K))/U                      ENT1530
      F22=RR2(K+1)*(PU1(K+1)*FU1(K+1)-U*PU2(K+1)*FU3(K+1))/U            ENT1540
      IF (ABS(T-1.).LE.0.001) GO TO 190                                 ENT1550
      F31=RR2(K)*(9.*PU1(K)/70.-PU1(K)*FU1(K)+U*PU2(K)*FU3(K))/U        ENT1560
      F32=RR2(K+1)*(9.*PU1(K+1)/70.-PU1(K+1)*FU1(K+1)+U*PU2(K+1)*FU3(K+1ENT1570
     1))/U                                                              ENT1580
      X11=F11/(F21+F31)                                                 ENT1590
      X12=F12/(F22+F32)                                                 ENT1600
      GO TO 200                                                         ENT1610
  190 F31=0.                                                            ENT1620
      F32=0.                                                            ENT1630
  200 CONTINUE                                                          ENT1640
      X1=X(K)                                                           ENT1650
      X2=X(K+1)                                                         ENT1660
      X21=F11/(F21+F31)+F31*(F11/(F21+F31)-1.)/F21                      ENT1670
      X22=F12/(F22+F32)+F32*(F12/(F22+F32)-1.)/F22                      ENT1680
      X31=2.*F21*(F21+F31)/(F11-F21-F31)                                ENT1690
```

```
      X31=SQRT(X31)
      X32=2.*F22*(F22+F32)/(F12-F22-F32)
      X32=SQRT(X32)
      IF (XM.GE.0..AND.XM.LT.XC) GO TO 210
      GO TO 220
210   X1=0.
      X2=XC
      X22=X21
      X32=X31
      X21=1./U
      X31=1.
      IF (ABS(T-1.).LE.0.001) GO TO 220
      X12=X11
      X11=1./(T*U)
220   CMU=X21+(XM-X1)*(X22-X21)/(X2-X1)
      RT=X31+(XM-X1)*(X32-X31)/(X2-X1)
      CMU=1./CMU
      IF (ABS(T-1.).LE.0.001) GO TO 230
      RU=X11+(XM-X1)*(X12-X11)/(X2-X1)
      T=1./(CMU*RU)
230   CONTINUE
240   CONTINUE
      RETURN
C
250   FORMAT (8F10.5)
260   FORMAT (/5X,43HTHE COMPUTED JET ENTRAINMENT ARE AS FOLLOWS)
270   FORMAT (/5X,4HXJET,8X,4HRJET,5X,5HDM/DX)
      END
      SUBROUTINE RECTJ (ISYM,NSJ,Y)
C     TO DEFINE THE UNIT NORMAL VECTORS TO THE SURFACE OF RECTANGULAR
C     JETS
      DIMENSION Y(10,41)
      IF (ISYM.EQ.0) GO TO 10
      NSJ1=NSJ+1
      NJH=(NSJ-1)/2+2
      GO TO 20
10    NSJ1=NSJ-1
      NJH=NSJ/2
20    DO 50 I=1,NSJ1
      IF (I.EQ.1.AND.ISYM.NE.0) GO TO 30
      IF (I.EQ.NJH) GO TO 40
      Y(3,I)=1.
      Y(4,I)=0.
      GO TO 50
30    Y(3,I)=0.
      Y(4,I)=-1.
      GO TO 50
40    Y(3,I)=0.
      Y(4,I)=1.
```

```
50    CONTINUE                                                          REC 220
      RETURN                                                            REC 230
      END                                                               REC 240-
      SUBROUTINE CIRCJ (ISYM,NSJ,Y)                                     CIR  10
C     TO DEFINE THE UNIT NORMAL VECTORS TO THE SURFACE OF CIRCULAR JETS CIR  20
      DIMENSION Y(10,41)                                                CIR  30
      PI=3.14159265                                                     CIR  40
      IF (ISYM.EQ.0) GO TO 10                                           CIR  50
      NSJ1=NSJ+1                                                        CIR  60
      NN=(NSJ-1)/2+1                                                    CIR  70
      FN2=NN                                                            CIR  80
      NJH=NN+1                                                          CIR  90
      Y(1,1)=-SIN(PI/(2.*FN2))                                          CIR 100
      Y(2,1)=-COS(PI/(2.*FN2))                                          CIR 110
      GO TO 20                                                          CIR 120
10    Y(1,1)=1.                                                         CIR 130
      Y(2,1)=0.                                                         CIR 140
      NSJ1=NSJ-1                                                        CIR 150
      FN2=NSJ/2                                                         CIR 160
      NJH=NSJ/2                                                         CIR 170
20    CONTINUE                                                          CIR 180
      DO 50 I=1,NSJ1                                                    CIR 190
      K=I                                                               CIR 200
      KI=I                                                              CIR 210
      IF (I.GT.NJH.AND.ISYM.NE.0) K=I-NJH+1                             CIR 220
      IF (I.GT.NJH.AND.ISYM.EQ.0) K=I-NJH                               CIR 230
      FI=K                                                              CIR 240
      IF (ISYM.NE.0) ANG2=(FI-1.)*PI/FN2                                CIR 250
      IF (ISYM.EQ.0) ANG2=FI*PI/FN2                                     CIR 260
      YP=0.5*(1.-COS(ANG2))                                             CIR 270
      IF (ISYM.EQ.0) ANG2=PI-ATAN(SQRT(1.-YP*YP)/YP)                    CIR 280
      II=I+1                                                            CIR 290
      KK=I                                                              CIR 300
      KII=II                                                            CIR 310
      IF (I.GT.NJH) KK=II-NJH                                           CIR 320
      FII=KK                                                            CIR 330
      IF (I.LE.NJH.AND.ISYM.EQ.0) FII=KK+1                              CIR 340
      ANG1=(2.*FII-1.)*PI/(2.*FN2)                                      CIR 350
      YP=0.5*(1.-COS(ANG1))                                             CIR 360
      IF (ANG1.GT.PI) YP=-YP                                            CIR 370
      IF (ISYM.EQ.0) ANG1=PI-ATAN(SQRT(1.-YP*YP)/YP)                    CIR 380
      IF (I.GT.NJH) GO TO 30                                            CIR 390
      GO TO 40                                                          CIR 400
30    ANG1=-ANG1                                                        CIR 410
      ANG2=-ANG2                                                        CIR 420
40    CONTINUE                                                          CIR 430
      Y(1,KII)=SIN(ANG1)                                                CIR 440
      Y(2,KII)=-COS(ANG1)                                               CIR 450
      Y(3,KI)=SIN(ANG2)                                                 CIR 460
```

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      Y(4,KI)=-COS(ANG2)
50    CONTINUE
      RETURN
      END
      SUBROUTINE JSHAPE (XXL,XXT,YL,YJ,ZJ,RJ,CPCWL,IPANEL,NJ,JC,ISYM)
C     TO DEFINE THE LOCATIONS OF VORTEX AND CONTROL POINTS ON CIRCULAR
C     JETS
      DIMENSION CPCWL(1), XXL(1), XXT(1), YL(1)
      COMMON /SCHEME/ C(2),X(10,41),Y(10,41),SLOPE(15),XL(2,15),XTT(41),
     1XLL(41)
      COMMON /GEOM/ HALFSW,XCP(200),YCP(200),ZCP(200),XLE(50),YLE(50),XT
     1F(50),PSI(20),CH(95),XV(200),YV(100),SN(8,8),XN(200,2),YN(200,2),Z
     2N(200,2),WIDTH(8),YCON(25),SWEEP(50),HALFB,SJ(21,8),EX(95,2),TX(95
     3,2),SC(160,5),SI(160,5),LC(3)
      COMMON /CONST/ NCS,NCW,MI(8),NSJ,NCJ(5),LAST,MJW1(3,5),MJW2(3,5),J
     1PANEL,MJJ(5),NW(3),NNJ,NJP
      PI=3.14159265
      N1=NSJ+1
      IF (ISYM.EQ.0) N1=NSJ-1
      N2=N1+1
      IF (ISYM.EQ.0) N2=NSJ
      N12=N1/2+2
      IF (ISYM.EQ.0) N12=NSJ/2+1
      DO 10 I=1,2
      C(I)=XXT(I)-XXL(I)
      DO 10 J=1,NJ
10    XL(I,J)=XXL(I)+CPCWL(J)*C(I)
      DO 20 J=1,NJ
      FJ=J
      FNCJ=NJ
      PSI(J)=0.5*(1.-COS(FJ*PI/FNCJ))
20    SLOPE(J)=(XL(2,J)-XL(1,J))/(2.*RJ)
      DO 30 K=1,N2
      YY=Y(2,K)
      IF (ISYM.NE.0.AND.K.EQ.1) YY=-1.
      IF (ISYM.NE.0.AND.K.EQ.2) YY=-1.
      IF (K.EQ.(N12-1).OR.K.EQ.N12) YY=1.
      IF (K.EQ.N2) YY=1.
      XTT(K)=YJ+RJ*YY
      DO 30 J=1,NJ
30    X(J,K)=XL(1,J)+SLOPE(J)*(XTT(K)-YL(1))
      DO 120 K=1,N1
      KK=JC+K
      L=K
      IF (K.EQ.N12) L=1
      EX(KK,1)=XXL(1)+(XXL(2)-XXL(1))*(XTT(L)-YL(1))/(2.*RJ)
      EX(KK,2)=XXL(1)+(XXL(2)-XXL(1))*(XTT(K+1)-YL(1))/(2.*RJ)
      TX(KK,1)=XXT(1)+(XXT(2)-XXT(1))*(XTT(L)-YL(1))/(2.*RJ)
      TX(KK,2)=XXT(1)+(XXT(2)-XXT(1))*(XTT(K+1)-YL(1))/(2.*RJ)
      CH(KK)=C(1)-(C(1)-C(2))*0.5*(1.+Y(4,K))
```

```
      DO 120 J=1,NJ
      NPANEL=(K-1)*NJ+J-1+IPANEL
      DO 90 I=1,2
      KI1=K+I-1
      SIGN=1.
      IF (K.EQ.N12.AND.I.EQ.1) KI1=1
      IF (ISYM.EQ.0) GO TO 40
      IF (KI1.EQ.1.OR.KI1.EQ.2) GO TO 60
      GO TO 50
 40   IF (K.EQ.N12.AND.KI1.EQ.1) SIGN=-1.
 50   CONTINUE
      IF (KI1.EQ.(N12-1).OR.KI1.EQ.N12) GO TO 70
      IF (KI1.EQ.N2) GO TO 70
      YY=Y(2,KI1)
      ZZ=Y(1,KI1)*SIGN
      GO TO 80
 60   YY=-1.
      ZZ=-Y(1,KI1)/Y(2,KI1)
      GO TO 80
 70   YY=1.
      ZZ=Y(1,KI1)/Y(2,KI1)
 80   CONTINUE
      XN(NPANEL,I)=X(J,KI1)
      YN(NPANEL,I)=YJ+RJ*YY
 90   ZN(NPANEL,I)=ZJ+RJ*ZZ
      YK=0.5*(1.+Y(4,K))
      IF (ISYM.EQ.0) YK=2.*YK-1.
      XCP(NPANEL)=XXL(1)+(XXL(2)-XXL(1))*YK+PSI(J)*CH(KK)
      IF (ABS(YN(NPANEL,2)-YN(NPANEL,1)).LE.0.0001) GO TO 100
      YCP(NPANEL)=YL(1)+YK*(YL(2)-YL(1))
      ZCP(NPANEL)=ZN(NPANEL,1)+(ZN(NPANEL,2)-ZN(NPANEL,1))*(YCP(NPANEL)-
     1YN(NPANEL,1))/(YN(NPANEL,2)-YN(NPANEL,1))
      GO TO 110
 100  ZCP(NPANEL)=ZJ
      YCP(NPANEL)=YN(NPANEL,1)
 110  CONTINUE
      XV(NPANEL)=XXL(1)+(XXL(2)-XXL(1))*YK+CPCWL(J)*CH(KK)
 120  CONTINUE
      JC=JC+N1
      LAST=NPANEL
      RETURN
      END
      OVERLAY(USBOWB,2,0)
      PROGRAM JETOFF
C     TO SET UP THE JETOFF INFLUENCE COEFFICIENT MATRIX AND COMPUTE THE
C     CAMBER TERMS
      DIMENSION AW(101)
      COMMON /GEOM/ HALFSW,XCP(200),YCP(200),ZCP(200),XLE(50),YLE(50),XT
     1E(50),PSI(20),CH(95),XV(200),YV(100),SN(8,8),XN(200,2),YN(200,2),Z
     2N(200,2),WIDTH(8),YCON(25),SWEEP(50),HALFB,SJ(21,8),EX(95,2),TX(95
```

```
     3,2),SC(160,5),SI(160,5),LC(3)
      COMMON /AERO/ AM1,AM2,B1,B2,CL(30),CT(30),CD(30),GAM(2,100)
      COMMON /CONST/ NCS,NCW,M1(8),NSJ,NCJ(5),LAST,MJW1(3,5),MJW2(3,5),J
     1PANEL,MJJ(5),NW(3),NNJ,NJP
      COMMON /ADD/ CP(100),CM(30),BREAK(8),SWP(8,15),GAL(30),ISYM,VMU,VU
     1,TEMP,FCR,CAMLER,CAMLET,CAMTER,CAMTET,XJ,YJ,ZJ,RJ,ALP,CREF,TWISTR
      COMMON /PARAM/ ALPT,ALPC,ALPS,CDF,SDF,TH,TDF
      COMMON /COST/ LTOTAL,LPAN1,NJW(5),LPANEL,IENTN,LPAN2,EXIT,PTIAL,TW
     1IST,DF(5),NFP
      REWIND 01
      J1=LPANEL+1
      B=B1
      IC=1
      MG=NW(1)
      NG=NW(1)
      NC=IENTN
      IG=1
10    CONTINUE
      LL=1
      IF (NW(2).EQ.0) GO TO 30
      II=1+NCS
      IF (NW(3).NE.0) GO TO 20
      CHORD=CH(1)+CH(II)
      GO TO 40
20    III=II+NCS
      CHORD=CH(1)+CH(II)+CH(III)
      GO TO 40
30    CHORD=CH(1)
40    CONTINUE
      CALL WING (AW,LPANEL,1,B,LPAN1,LPAN2)
      XC=(XCP(1)-XLE(IG))/CHORD
      CAM=ZCR(XC)-(ZCR(XC)-ZCT(XC))*YCP(1)/HALFB
      AW(J1)=-CAM
      WRITE (01) (AW(K),K=1,J1)
      IJ=2
      NJ=LPANEL-1
50    CALL WING (AW,LPANEL,IJ,B,LPAN1,LPAN2)
      IF (NW(2).EQ.0) GO TO 70
      II=IG+NCS
      IF (NW(3).NE.0) GO TO 60
      CHORD=CH(IG)+CH(II)
      CHFL=CH(IG)
      GO TO 80
60    III=II+NCS
      CHORD=CH(IG)+CH(II)+CH(III)
      CHFL=CH(IG)+CH(II)
      GO TO 80
70    CHORD=CH(IG)
      CHFL=CH(IG)
```

```
80    CONTINUE
      FCR=CHFL/CHORD
      XC=(XCP(IJ)-XLE(IG))/CHORD
      COM=ABS(XC-FCR)
      FCR1=FCR-0.01
      FCR2=FCR+0.01
      CZ=0.
      IF (ABS(1.-XC).LE.0.01) GO TO 90
      ZC1=ZCR(XC)
      ZC2=ZCT(XC)
      CZ=ZC1-(ZC1-ZC2)*YCP(IJ)/HALFB
90    CONTINUE
      IF (XC.LT.FCR1) CAM=CZ
      IF (COM.LT.0.001) CAM=CZ-0.5*DF(LL)
      IF (XC.GT.FCR2.AND.ABS(1.-XC).GT.0.01) CAM=-DF(LL)+CZ
      IF (ABS(1.-XC).LE.0.01) CAM=-DF(LL)+CAMTER-(CAMTER-CAMTET)*YCP(IJ)
     1/HALFB
      IF (PTIAL.LE.0.01.AND.XC.GT.FCR1) GO TO 140
      IF (PTIAL.GT.0.01) GO TO 110
100   IF (IJ.NE.MG) GO TO 140
      IF (ABS(XC-1.).LE.0.01) GO TO 120
      JK=1
      IF (NW(3).NE.0.AND.IJ.GT.LPAN1) JK=2
      NCM=IJ+(NCS-IG)*NW(JK)+(IG-1)*NW(JK+1)+1
      XC1=(XCP(NCM)-XLE(IG))/CHORD
      CAM1=ZCR(XC1)-(ZCR(XC1)-ZCT(XC1))*YCP(IJ)/HALFB
      CAM=(CAM+CAM1)/2.
      GO TO 140
110   IF (IJ.GE.MJW1(1,LL).AND.IJ.LE.MJW2(1,LL)) GO TO 130
      IF (IJ.GE.MJW1(2,LL).AND.IJ.LE.MJW2(2,LL)) GO TO 140
      IF (IJ.GE.MJW1(3,LL).AND.IJ.LE.MJW2(3,LL)) GO TO 140
      CAM=CZ
      GO TO 100
120   CAM=CAMTER-(CAMTER-CAMTET)*YCP(IJ)/HALFB
      GO TO 140
130   IF (XC.GT.FCR1) GO TO 140
      GO TO 100
140   CONTINUE
      AW(J1)=-CAM
      WRITE (01) (AW(K),K=1,J1)
      IF (IJ.GE.LPAN1.AND.IJ.LT.LPAN2) NG=NW(2)
      IF (IJ.GE.LPAN2.AND.IJ.LT.LPANEL) NG=NW(3)
      IF (IJ.EQ.MJW2(1,LL).OR.IJ.EQ.MJW2(2,LL)) LL=LL+1
      IF (IJ.EQ.MJW2(3,LL)) LL=LL+1
      IF (LL.GT.NFP) LL=1
      IF (IJ.LT.MG) GO TO 150
      IG=IG+1
      MG=MG+NG
150   IF (IJ.EQ.LPAN1.OR.IJ.EQ.LPAN2) IG=1
```

```
      IF (IJ.EQ.LPAN1.OR.IJ.EQ.LPAN2) LL=1
      IJ=IJ+1
      NJ=NJ-1
      IF (IJ.LE.LPANEL) GO TO 50
      IC=IC+1
      B=B2
      IS=1
      NS=NW(1)
      MS=NW(1)
      IF (ABS(B1-B2).LE.0.001) GO TO 160
      IF (IC.LE.2) GO TO 10
  160 CONTINUE
      RETURN
C
      END
      SUBROUTINE WING (AW,LPANEL,I,BB,LPAN1,LPAN2)
C     TO COMPUTE THE JET-OFF INFLUENCE COEFFICIENT MATRIX
      DIMENSION AW(1)
      DIMENSION W(2)
      COMMON /GEOM/ HALFSW,XCP(200),YCP(200),ZCP(200),XLE(50),YLE(50),XT
     1E(50),PSI(20),CH(95),XV(200),YV(100),SN(8,8),XN(200,2),YN(200,2),Z
     2N(200,2),WIDTH(8),YCON(25),SWEEP(50),HALFB,SJ(21,8),EX(95,2),TX(95
     3,2),SC(160,5),SI(160,5),LC(3)
      COMMON /AERO/ AM1,AM2,B1,B2,CL(30),CT(30),CD(30),GAM(2,100)
      COMMON /CONST/ NCS,NCW,M1(8),NSJ,NCJ(5),LAST,MJW1(3,5),MJW2(3,5),J
     1PANEL,MJJ(5),NW(3),NNJ,NJP
      IZ=1
      IFF=1
      ISN=1
      NL=NW(1)
      NN=NW(1)
      DO 60 J=1,LPANEL
      MI=J-IFF+1
      FN=NL
      IF (J.GT.LPAN1.AND.J.LE.LPAN2) ISN=2
      IF (J.GT.LPAN2.AND.J.LE.LPANEL) ISN=3
      IF (J.GE.LPAN1.AND.J.LT.LPANEL) GO TO 10
      GO TO 20
   10 NL=NW(2)
      IF (J.GE.LPAN2.AND.J.LT.LPANEL) NL=NW(3)
   20 CONTINUE
      X1=XN(J,1)-XCP(I)
      X2=XN(J,2)-XCP(I)
      X12=XN(J,2)-XN(J,1)
      Y12=YN(J,2)-YN(J,1)
      DO 50 II=1,2
      IF (II.EQ.1) GO TO 30
      N=1
      GO TO 40
```

```
30    N=2
40    CONTINUE
      YC=(-1.)**N*YCP(I)
      Y1=YN(J,1)-YC
      Y2=YN(J,2)-YC
      XYK=X1*Y12-Y1*X12
      R1=SQRT(X1*X1+BB*Y1*Y1)
      R2=SQRT(X2*X2+BB*Y2*Y2)
      U1=(X12*X2+BB*Y12*Y2)/R2-(X12*X1+BB*Y12*Y1)/R1
      U1=U1/XYK
      U2=(1.-X1/R1)/Y1
      U3=(1.-X2/R2)/Y2
50    W(II)=(U1+U2-U3)*CH(IZ)*SN(MI,ISN)/(8.*FN)
      AW(J)=W(1)+W(2)
      IF (J .LT. NN .OR. J .EQ. LPANEL)  GO TO 60
      IZ=IZ+1
      IFF=NN+1
      NN=NN+NL
60    CONTINUE
      RETURN
C
      END
      OVERLAY(USBOWB,3,0)
      PROGRAM JETON
C     TO SET UP THE JETON INFLUENCE COEFFICIENT MATRICES
      DIMENSION AW(300)
      COMMON /CODE/ KCODE
      COMMON /GEOM/ HALFSW,XCP(200),YCP(200),ZCP(200),XLE(50),YLE(50),XT
     1E(50),PSI(20),CH(95),XV(200),YV(100),SN(8,8),XN(200,2),YN(200,2),Z
     2N(200,2),WIDTH(8),YCON(25),SWEEP(50),HALFB,SJ(21,8),EX(95,2),TX(95
     3,2),SC(160,5),SI(160,5),LC(3)
      COMMON /AERO/ AM1,AM2,B1,B2,CL(30),CT(30),CD(30),GAM(2,100)
      COMMON /CONST/ NCS,NCW,MI(8),NSJ,NCJ(5),LAST,MJW1(3,5),MJW2(3,5),J
     1PANEL,MJJ(5),NW(3),NNJ,NJP
      COMMON /PARAM/ ALPT,ALPC,ALPS,CDF,SDF,TH,TDF
      COMMON /ADD/ CP(100),CM(30),BRFAK(8),SWP(8,15),GAL(30),ISYM,VMU,VU
     1,TEMP,FCR,CAMLER,CAMLET,CAMTER,CAMTET,XJ,YJ,ZJ,RJ,ALP,CREF,TWISTR
      COMMON /COST/ LTOTAL,LPAN1,NJW(5),LPANEL,IENTN,LPAN2,EXIT,PTIAL,TW
     1IST,DF(5),NFP
      REWIND 02
      LP1=LTOTAL+1
      MJ=LPANEL+NCJ(1)
      MCON=LAST+NCJ(1)
      IPHI=1
      JL=LAST+1
      INN=1
      LN=1
      LN1=1
      JNN=1
      VMUC=VMU*ALPC
```

```
      MK=1
      I=LAST+1
      I1=I-JPANEL
      CALL MATRIX (AW,LTOTAL,LPANEL,VMUC,I,MCON,MJ,IPHI,INN,LN,LN1,TEMP,
     1LPAN1,ISYM,KCODE,EXIT,LPAN2)
      WRITE (01) (AW(K),K=1,LTOTAL)
      KI=2
      NI=LTOTAL-1
      LI=LAST+2
      VMP=VMUC
   10 KJ=LI
      IF (LI.GT.LAST) KJ=LI-JPANEL
      CALL MATRIX (AW,LTOTAL,LPANEL,VMP,LI,MCON,MJ,IPHI,INN,LN,LN1,TEMP,
     1LPAN1,ISYM,KCODE,EXIT,LPAN2)
      WRITE (01) (AW(K),K=1,LTOTAL)
      IF (KJ.LT.MJ.OR.KJ.EQ.LAST) GO TO 20
      IPHI=IPHI+1
      MJ=MJ+NCJ(INN)
   20 CONTINUE
      MJI=MJJ(INN)-1
      IF (KJ.EQ.MJI) GO TO 30
      GO TO 40
   30 JNN=INN
      INN=INN+1
   40 IF (KJ.EQ.MJJ(JNN)) IPHI=1
      IF (LI.EQ.LTOTAL) GO TO 50
      GO TO 60
   50 CONTINUE
      IPHI=1
      MJ=LPANEL+NCJ(1)
      JNN=1
      INN=1
   60 CONTINUE
      KI=KI+1
      NI=NI-1
      IF (LI.EQ.LTOTAL) GO TO 70
      IF (LI.EQ.LAST) GO TO 80
      LI=LI+1
      GO TO 90
   70 LI=LPANEL+1
      GO TO 90
   80 LI=1
   90 CONTINUE
      JP=LI-LAST+LPANEL
      JP1=JP-1
      IF (JP.EQ.MJJ(LN1)) LN1=LN1+1
      IF (JP1.EQ.MJJ(LN)) LN=LN+1
      IF (KI.LE.LTOTAL) GO TO 10
      RETURN
      END
```

```
      SUBROUTINE MATRIX (AW,LTOTAL,LPANEL,VMU,I,MCON,MJ,IPHI,INN,LN,LN1,
     1TEMP,LPAN1,ISYM,KCODE,EXIT,LPAN2)
C     TO COMPUTE THE JETON INFLUENCE  COEFFICIENT MATRICES
      DIMENSION AW(1)
      DIMENSION W(4)
      DIMENSION SV(300)
      COMMON /GEOM/ HALFSW,XCP(200),YCP(200),ZCP(200),XLE(50),YLE(50),XT
     1E(50),PSI(20),CH(95),XV(200),YV(100),SN(8,8),XN(200,2),YN(200,2),Z
     2N(200,2),WIDTH(8),YCON(25),SWEEP(50),HALFB,SJ(21,8),EX(95,2),TX(95
     3,2),SC(160,5),SI(160,5),LC(3)
      COMMON /SCHEME/ C(2),X(10,41),Y(10,41),SLOPE(15),XL(2,15),XTT(41),
     1XLL(41)
      COMMON /AERO/ AM1,AM2,B1,B2,CL(30),CT(30),CD(30),GAM(2,100)
      COMMON /CONST/ NCS,NCW,M1(8),NSJ,NCJ(5),LAST,MJW1(3,5),MJW2(3,5),J
     1PANEL,MJJ(5),NW(3),NNJ,NJP
      COMMON /PARAM/ ALPT,ALPC,ALPS,CDF,SDF,TH,TDF
      EQUIVALENCE (X(1,1),SV(1))
      PI=3.14159265
      ZJET=YCON(25)
      IUSB=YCON(24)
      DFJ=CDF
      VJT=VMU
      TEM=TEMP
      NN2=NNJ-1
      N1=NNJ-1
      N2=NNJ-2
      N3=NNJ-3
      NJH=(NSJ+1)/2+1
      IF (ISYM.EQ.0) NJH=NSJ/2
      IF (ISYM.EQ.0) NP=NSJ-1
      IF (ISYM.NE.0) NP=NSJ+1
      NJT=NJH-1
      IZ=1
      IFF=1
      MM=NW(1)
      NN=NW(1)
      IND=1
      ISN=1
      L1=LPANEL+1
      LAST1=LAST-1
      IF (I.GT.LAST) GO TO 10
      IJ=I
      GO TO 20
10    IJ=I-JPANEL
20    CONTINUE
      DO 240 J=1,LAST
      MI=J-IFF+1
      FN=NN
      IF (J.GT.LPAN1.AND.J.LE.LPAN2) ISN=2
```

```
      IF (J.GT.LPAN2.AND.J.LE.LPANEL) ISN=3
      IF (J.GE.LPAN1.AND.J.LT.LPANEL) GO TO 30
      GO TO 40
30    NN=NW(2)
      IF (J.GE.LPAN2.AND.J.LT.LPANEL) NN=NW(3)
40    CONTINUE
      IF (J.GE.LPANEL.AND.J.LT.MJJ(IND)) NN=NCJ(IND)
      CHORD=CH(IZ)
      IF (J.EQ.L1) GO TO 50
      GO TO 60
50    ISN=ISN+1
      L1=MJJ(IND)+1
60    NL=MJJ(IND)-1
      IF (NL.EQ.LAST1) GO TO 70
      IF (J.EQ.NL) IND=IND+1
70    CONTINUE
      X1=XN(J,1)-XCP(IJ)
      X2=XN(J,2)-XCP(IJ)
      X12=XN(J,2)-XN(J,1)
      Y12=YN(J,2)-YN(J,1)
      Z12=ZN(J,2)-ZN(J,1)
      Z1=ZN(J,1)-ZCP(IJ)
      Z2=ZN(J,2)-ZCP(IJ)
      XZJ=X1*Z12-Z1*X12
      DO 220 II=1,2
      IF (II.EQ.1) GO TO 80
      N=1
      GO TO 90
80    N=2
90    CONTINUE
      YC=(-1.)**N*YCP(IJ)
      Y1=YN(J,1)-YC
      Y2=YN(J,2)-YC
      XYK=X1*Y12-Y1*X12
      YZI=Y1*Z12-Z1*Y12
      ALB1=XYK*XYK+XZJ*XZJ+B1*YZI*YZI
      R1B1=SQRT(X1*X1+B1*Y1*Y1+B1*Z1*Z1)
      R2B1=SQRT(X2*X2+B1*Y2*Y2+B1*Z2*Z2)
      UUB1=(X2*X12+B1*Y2*Y12+B1*Z2*Z12)/R2B1-(X1*X12+B1*Y1*Y12+B1*Z1*Z12
     1)/R1B1
      G1B1=(1.-X1/R1B1)/(Y1*Y1+Z1*Z1)
      G2B1=(1.-X2/R2B1)/(Y2*Y2+Z2*Z2)
      IF (I.GT.LPANEL) GO TO 110
      F1=UUB1*XYK/ALB1
      F2=-Y2*G2B1+Y1*G1B1
      IF (J.GT.LPANEL) GO TO 100
      GO TO 200
100   F3=0.
      F4=0.
```

```
      F1=2.*F1
      F2=2.*F2
      GO TO 200
110   CONTINUE
      IF (J.LE.LPANEL) GO TO 130
      IF (ABS(B1-B2).LE.0.001) GO TO 120
      ALB2=XYK*XYK+XZJ*XZJ+B2*YZI*YZI
      R1B2=SQRT(X1*X1+B2*Y1*Y1+B2*Z1*Z1)
      R2B2=SQRT(X2*X2+B2*Y2*Y2+B2*Z2*Z2)
      UUB2=(X2*X12+B2*Y2*Y12+B2*Z2*Z12)/R2B2-(X1*X12+B2*Y1*Y12+B2*Z1*Z12
     1)/R1B2
      G1B2=(1.-X1/R1B2)/(Y1*Y1+Z1*Z1)
      G2B2=(1.-X2/R2B2)/(Y2*Y2+Z2*Z2)
      GO TO 130
120   ALB2=ALB1
      UUB2=UUB1
      G2B2=G2B1
      G1B2=G1B1
130   CONTINUE
      IF (I.GT.LAST) GO TO 160
      F13=UUB1*XZJ/ALB1
      F12=UUB1*XYK/ALB1
      G13=Z2*G2B1-Z1*G1B1
      G12=-Y2*G2B1+Y1*G1B1
      IF (J.LE.LPANEL) GO TO 140
      F23=UUB2*XZJ/ALB2
      F22=UUB2*XYK/ALB2
      G23=Z2*G2B2-Z1*G1B2
      G22=-Y2*G2B2+Y1*G1B2
      GO TO 150
140   F22=0.
      G22=0.
      F23=0.
      G23=0.
150   F1=-F13*Y(4,IPHI)*(-1.)**N+F12*Y(3,IPHI)
      F2=G13*Y(4,IPHI)*(-1.)**N+G12*Y(3,IPHI)
      F3=-F23*Y(4,IPHI)*(-1.)**N+F22*Y(3,IPHI)
      F4=G23*Y(4,IPHI)*(-1.)**N+G22*Y(3,IPHI)
      IF (J.LE.LPANEL) GO TO 190
      F1=F1*2.
      F2=2.*F2
      F3=2.*F3
      F4=2.*F4
      GO TO 190
160   F1=UUB1*YZI/ALB1
      IF (EXIT.LE.0.001) GO TO 170
      IF (NNJ.EQ.1) GO TO 170
      IF (IJ.GT.LPANEL.AND.IJ.LE.MJJ(1)) VMU=1.
      IF (IJ.GT.LPANEL.AND.IJ.LE.MJJ(1)) TEMP=1.
170   CONTINUE
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      F2=0.                                                             MTX1490
      IF (J.LE.LPANEL) GO TO 180                                        MTX1500
      F3=UUB2*YZI/ALB2                                                  MTX1510
      F4=0.                                                             MTX1520
      F1=-F1*VMU*VMU*2.*TEMP                                            MTX1530
      F3=-F3*2.                                                         MTX1540
      GO TO 190                                                         MTX1550
180   F1=-F1*VMU*VMU*TEMP                                               MTX1560
190   CONTINUE                                                          MTX1570
200   W(II)=(F1+F2)*CHORD*SN(MI,ISN)/(8.*FN)                            MTX1580
      IF (J.LE.LPANEL) GO TO 210                                        MTX1590
      IF (II.EQ.2) GO TO 210                                            MTX1600
      K2=II+2                                                           MTX1610
      W(K2)=(F3+F4)*CHORD*SN(MI,ISN)/(8.*FN)                            MTX1620
210   CONTINUE                                                          MTX1630
220   CONTINUE                                                          MTX1640
      IF (J.LT.MM) GO TO 230                                            MTX1650
      IZ=IZ+1                                                           MTX1660
      IFF=MM+1                                                          MTX1670
      MM=MM+NN                                                          MTX1680
230   CONTINUE                                                          MTX1690
      IF (J.LE.LPANEL) JA=J+2*JPANEL                                    MTX1700
      IF (J.GT.LPANEL) JA=J-LPANEL+JPANEL                               MTX1710
      AW(JA)=W(1)+W(2)                                                  MTX1720
      SV(JA)=W(1)                                                       MTX1730
      IF (J.LE.LPANEL) GO TO 240                                        MTX1740
      J1=J-LPANEL                                                       MTX1750
      AW(J1)=W(3)                                                       MTX1760
      VMU=VUT                                                           MTX1770
      TEMP=TEM                                                          MTX1780
240   CONTINUE                                                          MTX1790
      IF (KCODE.EQ.0) GO TO 360                                         MTX1800
      IF (IUSB.EQ.1.AND.ZJET.GT.0.01) GO TO 340                         MTX1810
      IF (DFJ.LE.0.0001) GO TO 340                                      MTX1820
      IF (NNJ.EQ.1.AND.I.LE.LPANEL) GO TO 340                           MTX1830
      IF (NNJ.EQ.1.AND.I.GT.LPANEL) GO TO 250                           MTX1840
      IF (I.LE.MJJ(N1).OR.I.GT.LAST) GO TO 340                          MTX1850
250   CONTINUE                                                          MTX1860
      IF (I.GT.LAST) GO TO 340                                          MTX1870
      IF (IPHI.EQ.NJH) GO TO 340                                        MTX1880
      IF (ISYM.NE.0.AND.IPHI.EQ.1) GO TO 340                            MTX1890
      IF (IPHI.LT.NJH) IL=IPHI-ISYM                                     MTX1900
      IF (IPHI.GT.NJH) IL=IPHI-NJH                                      MTX1910
      REWIND 2                                                          MTX1920
      MF=IJ-MJJ(N1)-(IPHI-1)*NCJ(NNJ)                                   MTX1930
      FNNJ=NNJ                                                          MTX1940
      DISTJ=SDF                                                         MTX1950
      DLX=DISTJ*0.5*PI/FNNJ                                             MTX1960
      SZX=-(1.-VMU)                                                     MTX1970
      IQ=(IL-1)*NCJ(NNJ)                                                MTX1980
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      CALL SKIP (IQ,JPANEL)                                             MTX1990
      DO 290 JJ=1,MF                                                    MTX2000
      READ (02) (SV(K),K=1,JPANEL)                                      MTX2010
      IF (JJ.EQ.MF) GO TO 260                                           MTX2020
      DXTH=DLX*PSI(JJ)/TH                                               MTX2030
      GO TO 270                                                         MTX2040
  260 DXTH=DLX*PSI(JJ)*0.5/TH                                           MTX2050
  270 CONTINUE                                                          MTX2060
      PROD=SZX*DXTH                                                     MTX2070
      DO 280 K1=1,JPANEL                                                MTX2080
      KK=K1+JPANEL                                                      MTX2090
  280 AW(KK)=AW(KK)+PROD*SV(K1)                                         MTX2100
  290 CONTINUE                                                          MTX2110
      IQ=NCJ(NNJ)-MF+((NP-1-ISYM)/2-1)*NCJ(NNJ)                         MTX2120
      CALL SKIP (IQ,JPANEL)                                             MTX2130
      DO 330 JJ=1,MF                                                    MTX2140
      READ (02) (SV(K),K=1,JPANEL)                                      MTX2150
      IF (JJ.EQ.MF) GO TO 300                                           MTX2160
      DXTH=DLX*PSI(JJ)/TH                                               MTX2170
      GO TO 310                                                         MTX2180
  300 DXTH=DLX*PSI(JJ)*0.5/TH                                           MTX2190
  310 PROD=SZX*DXTH                                                     MTX2200
      DO 320 K1=1,JPANEL                                                MTX2210
      KK=K1+JPANEL                                                      MTX2220
  320 AW(KK)=AW(KK)-PROD*SV(K1)                                         MTX2230
  330 CONTINUE                                                          MTX2240
  340 CONTINUE                                                          MTX2250
      IF (EXIT.LE.0.001) GO TO 350                                      MTX2260
      IF (NNJ.EQ.1) GO TO 350                                           MTX2270
      IF (IJ.GT.LPANEL.AND.IJ.LE.MJJ(1)) VMU=1.                         MTX2280
      IF (IJ.GT.LPANEL.AND.IJ.LE.MJJ(1)) TEMP=1.                        MTX2290
  350 CONTINUE                                                          MTX2300
  360 IF (I.LE.LAST) GO TO 710                                          MTX2310
      IF (IPHI.EQ.NJH) GO TO 570                                        MTX2320
      IF (ISYM.NE.0.AND.IPHI.EQ.1) GO TO 570                            MTX2330
      IF (NNJ.EQ.1) GO TO 430                                           MTX2340
      IF (IJ.GT.MJJ(N1)) GO TO 430                                      MTX2350
      IF (IPHI.GT.NJH.AND.ZJET.LE.0.01) GO TO 430                       MTX2360
      IF (IPHI.GT.NJH) L1=NJH                                           MTX2370
      IF (ISYM.EQ.0.AND.IPHI.GT.NJH) L1=NJH+1                           MTX2380
      IF (IPHI.LE.NJH) L1=1                                             MTX2390
      NZ=1                                                              MTX2400
      IF (NW(2).NE.0.AND.NW(3).EQ.0) NZ=2                               MTX2410
      IF (NW(3).NE.0) NZ=3                                              MTX2420
      IF (NNJ.LE.3.AND.NW(2).NE.0) IR=N2                                MTX2430
      IF (NNJ.LE.3.AND.NW(2).EQ.0) IR=N1                                MTX2440
      IF (NNJ.GE.4.AND.NW(3).NE.0) IR=N3                                MTX2450
      IF (NNJ.EQ.4.AND.NW(3).EQ.0) IR=N2                                MTX2460
      DO 420 NR=1,NZ                                                    MTX2470
      K1=MJW1(NR,NJP)+(IPHI-L1-ISYM)*NW(NR)-1                           MTX2480
```

```
      K2=LC(NR)+IPHI-L1-ISYM
      KNW=NW(NR)
      K1=K1-KNW
      K2=K2-1
      MR=3
      IF (K1.GE.0) GO TO 370
      K1=K1+KNW
      K2=K2+1
      MR=2
370   DO 410 NQ=1,MR
      SUM=0.
      DO 380 KK=1,KNW
      KL=K1+KK
      JA=KL+2*JPANEL
380   SUM=SUM+SV(JA)
      CALL INTEG (RES,KNW,K1,K2,IJ,B1,IR)
      DO 400 KK=1,KNW
      KL=K1+KK
      JA=KL+2*JPANEL
      AA=1.
      DO 390 L=1,KNW
      LL=K1+L
      IF (L.EQ.KK) GO TO 390
      AA=AA*(XCP(IJ)-XV(LL))/(XV(KL)-XV(LL))
390   CONTINUE
      AW(JA)=AW(JA)-SUM*AA-RES*AA*VMU*VMU*TEMP
400   CONTINUE
      K1=K1+KNW
      K2=K2+1
410   CONTINUE
      IR=IR+1
420   CONTINUE
430   CONTINUE
      IF (KCODE.EQ.0) GO TO 570
      IF (NW(2).EQ.0) NSTRIP=NCS
      IF (NW(2).NE.0.AND.NW(3).EQ.0) NSTRIP=NCS*2
      IF (NW(3).NE.0) NSTRIP=NCS*3
      IF (IPHI.LT.NJH) IP=NJH+1
      IF (IPHI.GT.NJH) IP=ISYM+1
      IF (NNJ.EQ.1) GO TO 480
      IF (IJ.GT.MJJ(N1)) GO TO 480
      IF (NNJ.EQ.2) GO TO 490
      IF (IJ.GT.MJJ(N2)) GO TO 490
      IF (NNJ.EQ.3) GO TO 470
      IF (IJ.GT.MJJ(N3)) GO TO 460
      IF (NNJ.EQ.4) GO TO 450
      IF (NNJ.EQ.5.AND.IJ.GT.MJJ(NNJ-4)) GO TO 440
      LI=NNJ-4
      IZ=NSTRIP
      GO TO 500
```

```
440   L1=N3                                                        MTX2990
      IZ=NSTRIP+NP                                                 MTX3000
      GO TO 500                                                    MTX3010
450   L1=N3                                                        MTX3020
      IZ=NSTRIP                                                    MTX3030
      GO TO 500                                                    MTX3040
460   L1=N2                                                        MTX3050
      IZ=NSTRIP+(NNJ-3)*NP                                         MTX3060
      GO TO 500                                                    MTX3070
470   CONTINUE                                                     MTX3080
      L1=N2                                                        MTX3090
      IZ=NSTRIP                                                    MTX3100
      GO TO 500                                                    MTX3110
480   L1=NNJ                                                       MTX3120
      IZ=NSTRIP+(NNJ-1)*NP                                         MTX3130
      GO TO 500                                                    MTX3140
490   L1=N1                                                        MTX3150
      IZ=NSTRIP+(NNJ-2)*NP                                         MTX3160
500   CONTINUE                                                     MTX3170
      IZ=IZ+IP                                                     MTX3180
      NT=NJT                                                       MTX3190
      IF (ISYM.NE.0) NT=NJT-1                                      MTX3200
      KNW=NCJ(L1)                                                  MTX3210
      DO 560 KP=1,NT                                               MTX3220
      SUM1=0.                                                      MTX3230
      SUM2=0.                                                      MTX3240
      K1=MJJ(L1)-NP*NCJ(L1)+(KP-1)*NCJ(L1)+(IP-1)*NCJ(L1)          MTX3250
      DO 510 KK=1,KNW                                              MTX3260
      KL=K1+KK                                                     MTX3270
      KJ=KL+JPANEL                                                 MTX3280
      IA=KL-LPANEL+JPANEL                                          MTX3290
      IB=KJ-LAST                                                   MTX3300
      SUM1=SUM1+SV(IA)                                             MTX3310
510   SUM2=SUM2+AW(IB)                                             MTX3320
      CALL INTEG (RES,KNW,K1,IZ,IJ,B1,L1)                          MTX3330
      IF (ABS(B1-B2).LE.0.001) GO TO 520                           MTX3340
      CALL INTEG (REF,KNW,K1,IZ,IJ,B2,L1)                          MTX3350
      GO TO 530                                                    MTX3360
520   REF=RES                                                      MTX3370
530   DO 550 KK=1,KNW                                              MTX3380
      KL=K1+KK                                                     MTX3390
      KJ=KL+JPANEL                                                 MTX3400
      IA=KL-LPANEL+JPANEL                                          MTX3410
      IB=KJ-LAST                                                   MTX3420
      AA=1.                                                        MTX3430
      DO 540 L=1,KNW                                               MTX3440
      LL=K1+L                                                      MTX3450
      IF (L.EQ.KK) GO TO 540                                       MTX3460
      AA=AA*(XCP(IJ)-XV(LL))/(XV(KL)-XV(LL))                       MTX3470
```

```
540   CONTINUE                                                          MTX3480
      AW(IA)=AW(IA)-SUM1*AA-RES*AA*VMU*VMU*TEMP*2.                      MTX3490
      AW(IB)=AW(IB)-SUM2*AA-REF*AA*2.                                   MTX3500
550   CONTINUE                                                          MTX3510
      IZ=IZ+1                                                           MTX3520
560   CONTINUE                                                          MTX3530
570   CONTINUE                                                          MTX3540
      SK=1.                                                             MTX3550
      IF (IPHI.GT.NJH) SK=-1.                                           MTX3560
      JI=I-LAST+LPANEL                                                  MTX3570
      K=MCON-LAST-NCJ(LN)+LPANEL                                        MTX3580
      JNJ=NCJ(LN)                                                       MTX3590
      DO 590 KK=1,JNJ                                                   MTX3600
      KL=K+KK                                                           MTX3610
      KJ=KL+JPANEL                                                      MTX3620
      IA=KL-LPANEL+JPANEL                                               MTX3630
      IB=KJ-LAST                                                        MTX3640
      AA=1.                                                             MTX3650
      DO 580 L=1,JNJ                                                    MTX3660
      LL=K+L                                                            MTX3670
      IF (L.EQ.KK) GO TO 580                                            MTX3680
      AA=AA*(XCP(JI)-XV(LL))/(XV(KL)-XV(LL))                            MTX3690
580   CONTINUE                                                          MTX3700
      AW(IB)=AW(IB)+AA*SK                                               MTX3710
590   AW(IA)=AW(IA)-AA*VMU*VMU*TEMP*SK                                  MTX3720
      IF (I.EQ.MCON.AND.I.LT.LTOTAL) MCON=MCON+NCJ(LN1)                 MTX3730
      IF (KCODE.EQ.0) GO TO 680                                         MTX3740
      IF (IUSB.EQ.1.AND.ZJET.GT.0.01) GO TO 680                         MTX3750
      IF (NNJ.EQ.1) GO TO 680                                           MTX3760
      IF (IJ.GT.MJJ(N1)) GO TO 680                                      MTX3770
      IF (IPHI.LE.NJH) GO TO 680                                        MTX3780
      L1=NJH                                                            MTX3790
      IF (ISYM.EQ.0) L1=NJH+1                                           MTX3800
      IF (NW(2).EQ.0) GO TO 610                                         MTX3810
      IF (NW(3).EQ.0) GO TO 600                                         MTX3820
      IF (IJ.GT.MJJ(N2)) GO TO 640                                      MTX3830
      IF (IJ.GT.MJJ(N3)) GO TO 630                                      MTX3840
      IF (NNJ.EQ.4) GO TO 620                                           MTX3850
      IF (NNJ.EQ.5.AND.IJ.GT.MJJ(NNJ-4)) GO TO 620                      MTX3860
      GO TO 680                                                         MTX3870
600   IF (IJ.GT.MJJ(N2)) GO TO 630                                      MTX3880
      IF (NNJ.EQ.3) GO TO 620                                           MTX3890
      IF (NNJ.EQ.4.AND.IJ.GT.MJJ(N3)) GO TO 620                         MTX3900
      GO TO 680                                                         MTX3910
610   IF (NNJ.EQ.2) GO TO 620                                           MTX3920
      IF (NNJ.EQ.3.AND.IJ.GT.MJJ(N2)) GO TO 620                         MTX3930
      GO TO 680                                                         MTX3940
620   K1=MJW1(1,NJP)+(IPHI-L1-ISYM)*NW(1)-1                             MTX3950
      KNW=NW(1)                                                         MTX3960
      GO TO 650                                                         MTX3970
```

```
630   K1=MJW1(2,NJP)+(IPHI-L1-ISYM)*NW(2)-1
      KNW=NW(2)
      GO TO 650
640   K1=MJW1(3,NJP)+(IPHI-L1-ISYM)*NW(3)-1
      KNW=NW(3)
650   DO 670 KK=1,KNW
      KL=K1+KK
      JA=KL+2*JPANEL
      AA=1.
      DO 660 L=1,KNW
      LL=K1+L
      IF (L.EQ.KK) GO TO 660
      AA=AA*(XCP(IJ)-XV(LL))/(XV(KL)-XV(LL))
660   CONTINUE
670   AW(JA)=AW(JA)-AA*VMU*VMU*TEMP*0.5
680   CONTINUE
      IF (KCODE.EQ.0) GO TO 710
      IF (ZJET.GT.0.01) GO TO 710
      IF (DFJ.LE.0.0001) GO TO 710
      IF (NNJ.EQ.1) GO TO 690
      IF (IJ.LE.MJJ(N1)) GO TO 710
690   CONTINUE
      IF (IPHI.EQ.NJH) GO TO 710
      IF (ISYM.NE.0.AND.IPHI.EQ.1) GO TO 710
      DO 700 J=1,JPANEL
      JJ=J+JPANEL
700   SV(J)=-AW(JJ)
      WRITE (02) (SV(J),J=1,JPANEL)
710   CONTINUE
      VMU=VUT
      TEMP=TEM
      RETURN
C
      END
      SUBROUTINE SKIP (I,JPANEL)
      DIMENSION DUMMY(200)
      IF (I.EQ.0) GO TO 20
      DO 10 J=1,I
      READ (02) (DUMMY(K),K=1,JPANEL)
10    CONTINUE
20    RETURN
      END
      OVERLAY(USBOWB,4,0)
      PROGRAM SOLUTN
C     TO SOLVE THE JET ON AND JET OFF EQUATIONS
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 AW(300), CA(300), GAMMA(20170)
```

```
      DIMENSION GAMVR(300)
      COMMON /CODE/ KCODE
      COMMON /SCHEME/ C(2),X(10,41),Y(10,41),SLOPE(15),XL(2,15),XTT(41),
     1XLL(41)
      COMMON /GEOM/ HALFSW,XCP(200),YCP(200),ZCP(200),XLE(50),YLE(50),XT
     1E(50),PSI(20),CH(95),XV(200),YV(100),SN(8,8),XN(200,2),YN(200,2),Z
     2N(200,2),WIDTH(8),YCON(25),SWEEP(50),HALFB,SJ(21,8),EX(95,2),TX(95
     3,2),SC(160,5),SI(160,5),LC(3)
      COMMON /PARAM/ ALPT,ALPC,ALPS,CDF,SDF,TH,TDF
      COMMON /AERO/ AM1,AM2,B1,B2,CL(30),CT(30),CD(30),GAM(2,100)
      COMMON /ADD/ CP(100),CM(30),BREAK(8),SWP(8,15),GAL(30),ISYM,VMU,VU
     1,TEMP,FCR,CAMLER,CAMLET,CAMTER,CAMTET,XJ,YJ,ZJ,RJ,ALP,CREF,TWISTR
      COMMON /CONST/ NCS,NCW,M1(8),NSJ,NCJ(5),LAST,MJW1(3,5),MJW2(3,5),J
     1PANEL,MJJ(5),NW(3),NNJ,NJP
      COMMON /COST/ LTOTAL,LPAN1,NJW(5),LPANEL,IENTN,LPAN2,EXIT,PTIAL,TW
     1IST,DF(5),NFP
      REWIND 01
      IUSB=YCON(24)
      NC=IENTN
      ZZ=YCON(25)
      ITN=YCON(23)
      IC=1
      J1=LPANEL+1
      LP1=LTOTAL+1
      BB=B1
      DFJ=CDF
      NA=3
      IF (NW(2).EQ.0) NA=1
      IF (NW(2).NE.0.AND.NW(3).EQ.0) NA=2
   10 CONTINUE
      IG=1
      MG=NW(1)
      NG=NW(1)
      READ (01) (AW(I),I=1,J1)
      XB=XCP(1)
      YB=YCP(1)
      PHPV=0.
      IF (IUSB.EQ.1.AND.ITN.EQ.0) GO TO 20
      CALL INDVEL (XB,YB,XJ,YJ,ZJ,RJ,BB,PHRV,PHX,TEMP,VU,PHY,ISYM)
   20 CONTINUE
      AW(J1)=AW(J1)+XTT(IG)+PHPV/(ALPC*VU)
      DO 30 I=1,LPANEL
   30 GAMMA(I)=-AW(I+1)/AW(1)
      NJ=LPANEL-1
      DO 60 IJ=2,LPANEL
      READ (01) (AW(K),K=1,J1)
      XB=XCP(IJ)
      YB=YCP(IJ)
      IF (IUSB.EQ.1.AND.ITN.EQ.0) GO TO 40
```

```
      CALL INDVEL (XB,YB,XJ,YJ,ZJ,RJ,BB,PHRV,PHX,TEMP,VU,PHY,ISYM)
40    CONTINUE
      AW(J1)=AW(J1)+XTT(IG)*PHRV/(ALPC*VU)
      IK=IJ
      CALL VMSEQN (NJ,IK,AW,GAMMA,CA)
      NJ=NJ-1
      IF (IJ.GE.LPAN1.AND.IJ.LT.LPAN2) NG=NW(2)
      IF (IJ.GE.LPAN2.AND.IJ.LT.LPANEL) NG=NW(3)
      IF (IJ.LT.MG) GO TO 50
      IG=IG+1
      MG=MG+NG
50    IF (IJ.EQ.LPAN1.OR.IJ.EQ.LPAN2) IG=1
60    CONTINUE
      DO 70 I=1,LPANEL
70    GAM(IC,I)=GAMMA(I)
      IF (ABS(B1-B2).LE.0.001) GO TO 80
      IC=IC+1
      BB=B2
      IF (IC.GT.2) GO TO 80
      GO TO 10
80    CONTINUE
      VMUC=VMU*ALPC
      IPHI=1
      MJ=LPANEL+NCJ(1)
      INN=1
      JNN=1
      I=LAST+1
      READ (01) (AW(K),K=1,LTOTAL)
      CALL STREAM (ALPHA,VMUC,I,IPHI,LPANEL,TEMP,LPAN1,LPAN2,ISYM,KCODE,
     1EXIT,MJ)
      AW(LP1)=ALPHA
      DO 90 I=1,LTOTAL
90    GAMMA(I)=-AW(I+1)/AW(1)
      KI=2
      NI=LTOTAL-1
      LT=LAST+2
      IH=NW(NA)+MJW1(NA,NJP)-1
100   KJ=LI
      IF (LI.GT.LAST) KJ=LI-JPANEL
      READ (01) (AW(K),K=1,LTOTAL)
      CALL STREAM (ALPHA,VMUC,LI,IPHI,LPANEL,TEMP,LPAN1,LPAN2,ISYM,KCODE
     1,EXIT,MJ)
      IF (KCODE.EQ.0) GO TO 120
      IF (ZZ.GE.0.01) GO TO 120
C     ADDITIONAL EXTERNAL FLOW DEFLECTION IS ALLOWED IF THE JET ANGLE IS
C     GREATER THAN THE FLAP ANGLE BECAUSE OF THE EFFECT OF FINITE TRAI-
C     LING-EDGE ANGLES. FOR THIN AIRFOILS, THIS CAN BE ELIMINATED BY
C     INSERTING THE STATEMENT, IF (KCODE.EQ.1) GO TO 63
      IF (LI.GE.MJW1(NA,NJP).AND.LI.LE.MJW2(NA,NJP)) GO TO 110
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      GO TO 120                                                         SOL1060
110   IF (LI.NE.IH) GO TO 120                                           SOL1070
      IF ((DFJ-TDF).LT.0.) GO TO 120                                    SOL1080
      CZT=CAMTER-(CAMTER-CAMTET)*YCP(LI)/HALFB                          SOL1090
      APA=0.5*(DFJ-TDF+CZT)                                             SOL1100
      IF (VMU.GT.0.85) APA=APA*(1.-VMU)/0.15                            SOL1110
      IF (APA.LT.0.) APA=0.                                             SOL1120
      ALPHA=ALPHA+APA                                                   SOL1130
      IH=IH+NW(NA)                                                      SOL1140
120   CONTINUE                                                          SOL1150
      AW(LP1)=ALPHA                                                     SOL1160
      CALL VMSEQN (NI,KI,AW,GAMMA,CA)                                   SOL1170
      IF (KJ.LT.MJ.OR.KJ.EQ.LAST) GO TO 130                             SOL1180
      IPHI=IPHI+1                                                       SOL1190
      MJ=MJ+NCJ(INN)                                                    SOL1200
130   CONTINUE                                                          SOL1210
      MJI=MJJ(INN)-1                                                    SOL1220
      IF (KJ.EQ.MJI) GO TO 140                                          SOL1230
      GO TO 150                                                         SOL1240
140   JNN=INN                                                           SOL1250
      INN=INN+1                                                         SOL1260
150   IF (KJ.EQ.MJJ(JNN)) IPHI=1                                        SOL1270
      IF (LI.EQ.LTOTAL) GO TO 160                                       SOL1280
      GO TO 170                                                         SOL1290
160   CONTINUE                                                          SOL1300
      IPHI=1                                                            SOL1310
      MJ=LPANEL+NCJ(1)                                                  SOL1320
      JNN=1                                                             SOL1330
      INN=1                                                             SOL1340
170   CONTINUE                                                          SOL1350
      KI=KI+1                                                           SOL1360
      NI=NI-1                                                           SOL1370
      IF (LI.EQ.LTOTAL) GO TO 180                                       SOL1380
      IF (LI.EQ.LAST) GO TO 190                                         SOL1390
      LI=LI+1                                                           SOL1400
      GO TO 200                                                         SOL1410
180   LI=LPANEL+1                                                       SOL1420
      GO TO 200                                                         SOL1430
190   LI=1                                                              SOL1440
200   CONTINUE                                                          SOL1450
      IF (KI.LE.LTOTAL) GO TO 100                                       SOL1460
      IA=2*JPANEL                                                       SOL1470
      JPAN1=JPANEL+1                                                    SOL1480
      DO 210 I=1,LTOTAL                                                 SOL1490
210   GAMVR(I)=GAMMA(I)                                                 SOL1500
      IF (IUSB.EQ.1.AND.ITN.EQ.0) GO TO 260                             SOL1510
      IG=1                                                              SOL1520
      MG=NW(1)                                                          SOL1530
      NG=NW(1)                                                          SOL1540
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```
      REWIND 01
      READ (01) (AW(I),I=1,J1)
      AW(J1)=AW(J1)+XTT(IG)
      DO 220 I=1,LPANEL
  220 GAMMA(I)=-AW(I+1)/AW(1)
      NJ=LPANEL-1
      DO 240 IJ=2,LPANEL
      READ (01) (AW(K),K=1,J1)
      AW(J1)=AW(J1)+XTT(IG)
      IK=IJ
      CALL VMSEQN (NJ,IK,AW,GAMMA,CA)
      NJ=NJ-1
      IF (IJ.GE.LPAN1.AND.IJ.LT.LPAN2) NG=NW(2)
      IF (IJ.GE.LPAN2.AND.IJ.LT.LPANEL) NG=NW(3)
      IF (IJ.LT.MG) GO TO 230
      IG=IG+1
      MG=MG+NG
  230 IF (IJ.EQ.LPAN1.OR.IJ.EQ.LPAN2) IG=1
  240 CONTINUE
      DO 250 I=1,LPANEL
  250 GAM(2,I)=GAMMA(I)
      GO TO 280
  260 DO 270 I=1,LPANEL
  270 GAM(2,I)=GAM(1,I)
  280 CONTINUE
      CAM=CAMLER
      CAMT=CAMLET
      CALL THRUST (LTOTAL,LPANEL,GAMVR,CAM,LPAN1,VU,XJ,YJ,ZJ,RJ,TEMP,GAL
     1,ISYM,LPAN2,CAMT)
      DO 290 I=1,LPANEL
      IB=I+IA
      IC=1
  290 GAMVR(I)=GAMVR(IB)+GAM(IC,I)
      DO 300 I=1,LPANEL
  300 CP(I)=GAMVR(I)*2.*ALPC
      RETURN
C
      END
      SUBROUTINE INDVEL (XD,Y,XJ,YJ,ZJ,RJ,B2,PHRV,PHX,T,U,PHY,ISYM)
C     TO COMPUTE THE INDUCED VELOCITIES DUE TO JET ENTRAINMENT
      DIMENSION VZ(2), VX(2), VY(2)
      COMMON /JET/ PK1,XC,X(31),A(31),B(31)
      REJ=T
      VZ(2)=0.
      VX(2)=0.
      VY(2)=0.
      SRJ=SQRT(REJ)
      XB=(XD-XJ)/RJ
      NCOT=ISYM+1
```

```
      DO 40 K=1,NCOT
      IF (K.EQ.1) FC=1.
      IF (K.EQ.2) FC=-1.
      RB=SQRT(ZJ*ZJ+(Y*FC-YJ)**2)/RJ
      F1=SQRT((XB-XC)**2+B2*RB*RB)
      F2=SQRT(XB**2+B2*RB*RB)
      G10=(XB-XC)/F1-XB/F2
      G20=1./F1-1./F2
      SUMR=-(A(1)+B(1)*XB)*G10/RB-B2*RB*B(1)*G20
      SUMX=(A(1)+B(1)*XB)*G20-B(1)*G10+B(1)*ALOG((XB-XC+F1)/(XB+F2))
      IF (U.LE.0.01) GO TO 20
      J=2
10    SUM1=SUMR
      SUM2=SUMX
      F1=SQRT((XB-X(J))**2+B2*RB*RB)
      F2=SQRT((XB-X(J-1))**2+B2*RB*RB)
      G1=(XB-X(J))/F1-(XB-X(J-1))/F2
      G2=1./F1-1./F2
      SUMR=SUMR-(A(J)+B(J)*XB)*G1/RB-B2*RB*B(J)*G2
      SUMX=SUMX+(A(J)+B(J)*XB)*G2-B(J)*G1+B(J)*ALOG((XB-X(J)+F1)/(XB-X(J
     1-1)+F2))
      IF (J.GE.31) GO TO 30
      J=J+1
      GO TO 10
20    SUMR=SUMR+0.32*(1.+(XB-XC)/F1)/RB
      SUMX=SUMX-0.32/F1
30    PHRV=SRJ*0.25*SUMR*ZJ/(RB*RJ)
      PHY=-SRJ*0.25*SUMR*(Y-YJ*FC)/(RB*RJ)
      PHX=-SRJ*0.25*SUMX
      VX(K)=PHX/2.
      VY(K)=PHY/2.
40    VZ(K)=PHRV/2.
      PHRV=VZ(1)+VZ(2)
      PHX=VX(1)+VX(2)
      PHY=VY(1)+VY(2)
      RETURN
C
      END
      SUBROUTINE STREAM (ALPHA,VMU,I,IPHI,LPANEL,TEMP,LPAN1,LPAN2,ISYM,K
     1CODE,EXIT,MJ)
C     TO COMPUTE THE RIGHT HAND SIDE OF THE SIMULTANEOUS EQUATIONS
      DIMENSION PHIN(300)
      COMMON /SCHEME/ C(2),X(10,41),Y(10,41),SLOPE(15),XL(2,15),XTT(41),
     1XLL(41)
      COMMON /GEOM/ HALFSW,XCP(200),YCP(200),ZCP(200),XLE(50),YLE(50),XT
     1E(50),PSI(20),CH(95),XV(200),YV(100),SN(8,8),XN(200,2),YN(200,2),Z
     2N(200,2),WIDTH(8),YCON(25),SWEEP(50),HALFB,SJ(21,8),EX(95,2),TX(95
     3,2),SC(160,5),SI(160,5),LC(3)
      COMMON /AERO/ AM1,AM2,B1,B2,CL(30),CT(30),CD(30),GAM(2,100)
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```
      COMMON /CONST/ NCS,NCW,M1(8),NSJ,NCJ(5),LAST,MJW1(3,5),MJW2(3,5),JSTM 120
     1PANEL,MJJ(5),NW(3),NNJ,NJP                                        STM 130
      COMMON /PARAM/ ALPT,ALPC,ALPS,CDF,SDF,TH,TDF                      STM 140
      EQUIVALENCE (X(1,1),PHIN(1))                                      STM 150
      PI=3.14159265                                                     STM 160
      IUSB=YCON(24)                                                     STM 170
      ZJET=YCON(25)                                                     STM 180
      N1=NNJ-1                                                          STM 190
      N2=NNJ-2                                                          STM 200
      N3=NNJ-3                                                          STM 210
      NJH=(NSJ+1)/2+1                                                   STM 220
      IF (ISYM.EQ.0) NJH=NSJ/2                                          STM 230
      NP=NJH-1                                                          STM 240
      IF (ISYM.EQ.0) NP=NJH                                             STM 250
      ALPHA=0.                                                          STM 260
      IF (I.GT.LPANEL) GO TO 10                                         STM 270
      GO TO 220                                                         STM 280
   10 IF (I.GT.LAST) GO TO 100                                          STM 290
      IF (EXIT.LE.0.001) GO TO 20                                       STM 300
      IF (NNJ.EQ.1) GO TO 20                                            STM 310
      IF (I.LE.MJJ(1).AND.I.NE.MJ) GO TO 220                            STM 320
   20 CONTINUE                                                          STM 330
      ALPHA=ALPT*Y(3,IPHI)*(1.-VMU)                                     STM 340
      IF (TH.LE.0.001) GO TO 30                                         STM 350
      IF (IPHI.EQ.NJH) GO TO 30                                         STM 360
      IF (ISYM.NE.0.AND.IPHI.EQ.1) GO TO 30                             STM 370
      IF (I.GT.MJJ(N1)) ALPHA=ALPHA+CDF*(1.-VMU)                        STM 380
   30 CONTINUE                                                          STM 390
      IF (ABS(B1-B2).LE.0.001) GO TO 40                                 STM 400
      CALL NORSPD (I,ALPH,LPANEL,IPHI,LPAN1,LPAN2)                      STM 410
      ALPHA=ALPHA+ALPH                                                  STM 420
   40 IF (KCODE.EQ.0) GO TO 220                                         STM 430
      IF (EXIT.LE.0.001) GO TO 50                                       STM 440
      IF (I.LE.MJJ(1).AND.I.EQ.MJ) ALPHA=ALPHA/2.                       STM 450
   50 IF (IPHI.EQ.NJH) GO TO 220                                        STM 460
      IF (ISYM.NE.0.AND.IPHI.EQ.1) GO TO 220                            STM 470
      IF (IUSB.EQ.1.AND.ZJET.GT.0.01) GO TO 220                         STM 480
      IF (CDF.LT.0.0001) GO TO 220                                      STM 490
      IF (NNJ.EQ.1) GO TO 60                                            STM 500
      IF (I.LE.MJJ(N1)) GO TO 220                                       STM 510
   60 IF (IPHI.LT.NJH) IL=IPHI+ISYM                                     STM 520
      IF (IPHI.GT.NJH) IL=IPHI-NJH+ISYM                                 STM 530
      MF=I-MJJ(N1)-(IPHI-1)*NCJ(NNJ)                                    STM 540
      FNNJ=NNJ                                                          STM 550
      DISTJ=SDF                                                         STM 560
      DLX=DISTJ*0.5*PI/FNNJ                                             STM 570
      SZX=-(1.-VMU)                                                     STM 580
      IQ=(IL-1)*NCJ(NNJ)                                                STM 590
```

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      IF (NNJ.EQ.1) IP=LPANEL+IQ+1                                      STM 600
      IF (NNJ.NE.1) IP=MJJ(N1)+IQ+1                                     STM 610
      DO 90 JJ=1,MF                                                     STM 620
      IF (JJ.EQ.MF) GO TO 70                                            STM 630
      DXTH=DLX*PSI(JJ)*TEMP*VMU*VMU/TH                                  STM 640
      GO TO 80                                                          STM 650
70    DXTH=DLX*PSI(JJ)*TEMP*0.5*VMU*VMU/TH                              STM 660
80    JK1=IP+JJ                                                         STM 670
      JK2=JK1-1                                                         STM 680
      PROD=SZX*DXTH                                                     STM 690
      JK3=JK2+NP*NCJ(NNJ)                                               STM 700
      ALPHA=ALPHA+PROD*(PHIN(JK2)-PHIN(JK3))                            STM 710
90    CONTINUE                                                          STM 720
      GO TO 220                                                         STM 730
100   CONTINUE                                                          STM 740
      IJ=I-JPANEL                                                       STM 750
      IF (KCODE.EQ.0) GO TO 200                                         STM 760
      IF (EXIT.LE.0.01) GO TO 110                                       STM 770
      IF (NNJ.EQ.1) GO TO 110                                           STM 780
      IF (IJ.GT.LPANEL.AND.IJ.LE.MJJ(1)) GO TO 220                      STM 790
110   CONTINUE                                                          STM 800
      IF (IUSB.EQ.1.AND.ZJET.GT.0.01) GO TO 200                         STM 810
      IF (NNJ.EQ.1) GO TO 200                                           STM 820
      IF (IJ.GT.MJJ(N1)) GO TO 200                                      STM 830
      IF (IPHI.LE.NJH) GO TO 200                                        STM 840
      L1=NJH                                                            STM 850
      IF (ISYM.EQ.0) L1=NJH+1                                           STM 860
      IF (NW(2).EQ.0) GO TO 130                                         STM 870
      IF (NW(3).EQ.0) GO TO 120                                         STM 880
      IF (IJ.GT.MJJ(N2)) GO TO 160                                      STM 890
      IF (IJ.GT.MJJ(N3)) GO TO 150                                      STM 900
      IF (NNJ.EQ.4) GO TO 140                                           STM 910
      IF (NNJ.EQ.5.AND.IJ.GT.MJJ(NNJ-4)) GO TO 140                      STM 920
      GO TO 200                                                         STM 930
120   IF (IJ.GT.MJJ(N2)) GO TO 150                                      STM 940
      IF (NNJ.EQ.3) GO TO 140                                           STM 950
      IF (NNJ.EQ.4.AND.IJ.GT.MJJ(N3)) GO TO 140                         STM 960
      GO TO 200                                                         STM 970
130   IF (NNJ.EQ.2) GO TO 140                                           STM 980
      IF (NNJ.EQ.3.AND.IJ.GT.MJJ(N2)) GO TO 140                         STM 990
      GO TO 200                                                         STM1000
140   K1=MJW1(1,NJP)+(IPHI-L1-ISYM)*NW(1)-1                             STM1010
      K2=LC(1)+IPHI-L1-ISYM                                             STM1020
      KNW=NW(1)                                                         STM1030
      GO TO 170                                                         STM1040
150   K1=MJW1(2,NJP)+(IPHI-L1-ISYM)*NW(2)-1                             STM1050
      K2=LC(2)+IPHI-L1-ISYM                                             STM1060
      KNW=NW(2)                                                         STM1070
      GO TO 170                                                         STM1080
```

```
160   K1=MJW1(3,NJP)+(IPHI-L1-ISYM)*NW(3)-1                             STM1090
      K2=LC(3)+IPHI-L1-ISYM                                             STM1100
      KNW=NW(3)                                                         STM1110
170   CONTINUE                                                          STM1120
      ALPHA1=0.                                                         STM1130
      ALPHA2=0.                                                         STM1140
      DO 190 KK=1,KNW                                                   STM1150
      KL=K1+KK                                                          STM1160
      AA=1.                                                             STM1170
      DO 180 L=1,KNW                                                    STM1180
      LL=K1+L                                                           STM1190
      IF (L.EQ.KK) GO TO 180                                            STM1200
      AA=AA*(XCP(IJ)-XV(LL))/(XV(KL)-XV(LL))                            STM1210
180   CONTINUE                                                          STM1220
      ALPHA1=ALPHA1+AA*GAM(1,KL)                                        STM1230
      IF (ABS(B1-B2).LE.0.001) GO TO 190                                STM1240
      ALPHA2=ALPHA2+AA*GAM(2,KL)                                        STM1250
190   CONTINUE                                                          STM1260
      IF (ABS(B1-B2).LE.0.001) ALPHA2=ALPHA1                            STM1270
      ALPHA=(ALPHA2-TEMP*VMU*VMU*ALPHA1)*0.5                            STM1280
      GO TO 220                                                         STM1290
200   CONTINUE                                                          STM1300
      CALL SPEED (VMU,I,ALPHA,LPANEL,TEMP,LPAN1,LPAN2,PHIS,IPHI,ISYM)   STM1310
      IF (KCODE.EQ.0) GO TO 220                                         STM1320
      IF (CDF.LT.0.0001) GO TO 220                                      STM1330
      IF (NNJ.EQ.1) GO TO 210                                           STM1340
      IF (IJ.LE.MJJ(N1)) GO TO 220                                      STM1350
210   PHIN(IJ)=PHIS                                                     STM1360
220   CONTINUE                                                          STM1370
      RETURN                                                            STM1380
C                                                                       STM1390
      END                                                               STM1400-
      SUBROUTINE SPEED (VMU,I,ALPHA,LPANEL,TEMP,LPAN1,LPAN2,PHIS,IPHI,ISSPD  10
     1YM)                                                               SPD  20
C     TO COMPUTE THE INDUCED TANGENTIAL VELOCITIES DUE  TO WING ALONE   SPD  30
C     VORTICES                                                          SPD  40
      DIMENSION SU(100)                                                 SPD  50
      COMMON /SCHEME/ C(2),X(10,41),Y(10,41),SLOPE(15),XL(2,15),XTT(41),SPD  60
     1XLL(41)                                                           SPD  70
      COMMON /GEOM/ HALFSW,XCP(200),YCP(200),ZCP(200),XLE(50),YLE(50),XTSPD  80
     1E(50),PSI(20),CH(95),XV(200),YV(100),SN(8,8),XN(200,2),YN(200,2),ZSPD  90
     2N(200,2),WIDTH(8),YCON(25),SWEEP(50),HALFB,SJ(21,8),EX(95,2),TX(95SPD 100
     3,2),SC(160,5),SI(160,5),LC(3)                                     SPD 110
      COMMON /AERO/ AM1,AM2,B1,B2,CL(30),CT(30),CD(30),GAM(2,100)       SPD 120
      COMMON /CONST/ NCS,NCW,M1(8),NSJ,NCJ(5),LAST,MJW1(3,5),MJW2(3,5),JSPD 130
     1PANEL,MJJ(5),NW(3),NNJ,NJP                                        SPD 140
      N1=NNJ-1                                                          SPD 150
      N2=NNJ-2                                                          SPD 160
```

```
      N3=NNJ-3
      ZJET=YCON(25)
      II=I-JPANEL
      BB=B1
      IC=1
10    CONTINUE
      IZ=1
      MM=0
      ISN=1
      NL=NW(1)
      NM=NW(1)
      B=0.
      DO 70 J=1,LPANEL
      JJ=J-MM
      FN=NL
      IF (J.GT.LPAN1.AND.J.LE.LPAN2) ISN=2
      IF (J.GT.LPAN2.AND.J.LE.LPANEL) ISN=3
      IF (J.GE.LPAN1.AND.J.LT.LPANEL) GO TO 20
      GO TO 30
20    NL=NW(2)
      IF (J.GE.LPAN2.AND.J.LT.LPANEL) NL=NW(3)
30    CONTINUE
      X1=XN(J,1)-XCP(II)
      X2=XN(J,2)-XCP(II)
      X12=XN(J,2)-XN(J,1)
      Y12=YN(J,2)-YN(J,1)
      Z1=-ZCP(II)
      Z2=-ZCP(II)
      Z12=0.
      XZJ=-Z1*X12
      DO 60 K=1,2
      IF (K.EQ.1) GO TO 40
      N=1
      GO TO 50
40    N=2
50    CONTINUE
      YC=(-1.)**N*YCP(II)
      Y1=YN(J,1)-YC
      Y2=YN(J,2)-YC
      XYK=X1*Y12-Y1*X12
      YZI=-Z1*Y12
      ALB1=XYK*XYK+XZJ*XZJ+BB*YZI*YZI
      R1B1=SQRT(X1*X1+BB*Y1*Y1+BB*Z1*Z1)
      R2B1=SQRT(X2*X2+BB*Y2*Y2+BB*Z2*Z2)
      UUB1=(X2*X12+BB*Y2*Y12+BB*Z2*Z12)/R2B1-(X1*X12+BB*Y1*Y12+BB*Z1*Z12
     1)/R1B1
      F1=UUB1*YZI/ALB1
      SUM=F1*CH(IZ)*SN(JJ,ISN)*GAM(IC,J)/FN
      IF (K.EQ.1) SU(J)=F1*CH(IZ)*SN(JJ,ISN)/FN
```

```
60    B=B+SUM
      IF (J.LT.NM) GO TO 70
      IZ=IZ+1
      MM=NM
      NM=NM+NL
70    CONTINUE
      NJH=(NSJ+1)/2+1
      IF (ISYM.EQ.0) NJH=NSJ/2
      IF (IPHI.EQ.NJH) GO TO 140
      IF (ISYM.NE.0.AND.IPHI.EQ.1) GO TO 140
      IF (NNJ.EQ.1) GO TO 140
      IF (II.GT.MJJ(N1)) GO TO 140
      IF (IPHI.GT.NJH.AND.ZJET.LE.0.01) GO TO 140
      IF (IPHI.GT.NJH) L1=NJH
      IF (ISYM.EQ.0.AND.IPHI.GT.NJH) L1=NJH+1
      IF (IPHI.LE.NJH) L1=1
      NZ=1
      IF (NW(2).NE.0.AND.NW(3).EQ.0) NZ=2
      IF (NW(3).NE.0) NZ=3
      IF (NNJ.LE.3.AND.NW(2).NE.0) IR=N2
      IF (NNJ.LE.3.AND.NW(2).EQ.0) IR=N1
      IF (NNJ.GE.4.AND.NW(3).NE.0) IR=N3
      IF (NNJ.EQ.4.AND.NW(3).EQ.0) IR=N2
      DO 130 MP=1,NZ
      K1=MJW1(MP,NJP)+(IPHI-L1-ISYM)*NW(MP)-1
      K2=LC(MP)+IPHI-L1-ISYM
      KNW=NW(MP)
      K1=K1-KNW
      K2=K2-1
      MR=3
      IF (K1.GE.0) GO TO 80
      K1=K1+KNW
      K2=K2+1
      MR=2
80    DO 120 NR=1,MR
      SUM=0.
      DO 90 KK=1,KNW
      KL=K1+KK
90    SUM=SUM+SU(KL)
      CALL INTEG (RES,KNW,K1,K2,II,BB,IR)
      CORN=0.
      DO 110 KK=1,KNW
      KL=K1+KK
      AA=1.
      DO 100 L=1,KNW
      LL=K1+L
      IF (L.EQ.KK) GO TO 100
      AA=AA*(XCP(II)-XV(LL))/(XV(KL)-XV(LL))
100   CONTINUE
110   CORN=CORN+AA*GAM(IC,KL)
```

```
      B=B-CORN*SUM+CORN*RES*8.
      K1=K1+KNW
      K2=K2+1
  120 CONTINUE
      IR=IR+1
  130 CONTINUE
  140 CONTINUE
      IF (IC.EQ.2) GO TO 150
      ALPHA1=B/8.
      IC=IC+1
      BB=B2
      IF (ABS(B1-B2).LE.0.001) GO TO 160
      GO TO 10
  150 ALPHA2=B/8.
      GO TO 170
  160 ALPHA2=ALPHA1
  170 ALPHA=ALPHA2-TEMP*VMU*VMU*ALPHA1
      PHIS=ALPHA2
      RETURN
C
      END
      SUBROUTINE THRUST (LTOTAL,LPANEL,GAMMA,CAM,LPAN1,VMU,XJ,YJ,ZJ,RJ,T
     1,GAL,ISYM,LPAN2,CAMLET)
C     TO EVALUATE THE LEADING EDGE THRUST
      DIMENSION GAMMA(1), GAL(1)
      COMMON /SCHEME/ C(2),X(10,41),Y(10,41),SLOPE(15),XL(2,15),XTT(41),
     1XLL(41)
      COMMON /GEOM/ HALFSW,XCP(200),YCP(200),ZCP(200),XLE(50),YLE(50),XT
     1E(50),PSI(20),CH(95),XV(200),YV(100),SN(8,8),XN(200,2),YN(200,2),Z
     2N(200,2),WIDTH(8),YCON(25),SWEEP(50),HALFB,SJ(21,8),EX(95,2),TX(95
     3,2),SC(160,5),SI(160,5),LC(3)
      COMMON /AERO/ AM1,AM2,B1,B2,CL(30),CT(30),CD(30),GAM(2,100)
      COMMON /CONST/ NCS,NCW,M1(8),NSJ,NCJ(5),LAST,MJW1(3,5),MJW2(3,5),J
     1PANEL,MJJ(5),NW(3),NNJ,NJP
      COMMON /PARAM/ ALPT,ALPC,ALPS,CDF,SDF,TH,TDF
      PI=3.14159265
      CAMLER=CAM
      CN=NW(1)
      IUSB=YCON(24)
      ITN=YCON(23)
      DO 200 I=1,NCS
      FCOS=COS(SWEEP(I))
      FTAN=TAN(SWEEP(I))
      NK=I*NW(1)
      IF (NW(2).EQ.0) GO TO 20
      II=I+NCS
      IF (NW(3).NE.0) GO TO 10
      CHL=CH(I)+CH(II)
      GO TO 30
```

```
10    III=II+NCS
      CHL=CH(I)+CH(II)+CH(III)
      GO TO 30
20    CHL=CH(I)
30    CONTINUE
      SQT=SQRT(CH(I)/CHL)
      BB=B1
      IC=1
      IZ=1
      MM=0
      ISN=1
      NM=NW(1)
      NL=NW(1)
      BC=0.
      A=0.
      DO 90 NN=1,LPANEL
      J=NN-MM
      FN=NL
      IF (NN.GE.LPAN1.AND.NN.LT.LPANEL) GO TO 40
      GO TO 50
40    NL=NW(2)
      IF (NN.GE.LPAN2.AND.NN.LT.LPANEL) NL=NW(3)
      IF (NN.GT.LPAN1.AND.NN.LE.LPAN2) ISN=2
      IF (NN.GT.LPAN2.AND.NN.LE.LPANEL) ISN=3
50    CONTINUE
      X1=XN(NN,1)-XLE(I)
      X2=XN(NN,2)-XLE(I)
      X12=XN(NN,2)-XN(NN,1)
      Y12=YN(NN,2)-YN(NN,1)
      DO 80 K=1,2
      IF (K.EQ.1) GO TO 60
      N1=1
      GO TO 70
60    N1=2
70    CONTINUE
      YC=YLE(I)*(-1.)**N1
      Y1=YN(NN,1)-YC
      Y2=YN(NN,2)-YC
      XYK=X1*Y12-Y1*X12
      R1=SQRT(X1*X1+BB*Y1*Y1)
      R2=SQRT(X2*X2+BB*Y2*Y2)
      U1=(X12*X2+BB*Y12*Y2)/R2-(X12*X1+BB*Y12*Y1)/R1
      U1=U1/XYK
      U2=(1.-X1/R1)/Y1
      U3=(1.-X2/R2)/Y2
      BC=BC+(U1+U2-U3)*SN(J,ISN)*GAM(2,NN)*CH(IZ)/FN
80    A=A+(U1+U2-U3)*SN(J,ISN)*GAM(IC,NN)*CH(IZ)/FN
      IF (NN.LT.NM.OR.NN.EQ.LPANEL) GO TO 90
      IZ=IZ+1
```

```
      MM=NM
      NM=NM+NL
90    CONTINUE
      CAMLE=CAMLER-(CAMLER-CAMLET)*YLE(I)/HALFB
      A=A/8.+XTT(I)-CAMLE
      XB=XLE(I)
      YB=YLE(I)
      PHRV=0.
      IF (IUSB.EQ.1.AND.ITN.EQ.0) GO TO 100
      CALL INDVEL (XB,YB,XJ,YJ,ZJ,RJ,B1,PHRV,PHX,T,VMU,PHY,ISYM)
100   CONTINUE
      A=A+PHRV/(ALPC*VMU)
      A=A*SRT
      THRT1=A/(CN*SQRT(FTAN*FTAN+BB))
      XTE(I)=(PI/2.)*SQRT(1.-AM1*AM1*FCOS*FCOS)*THRT1*THRT1/FCOS
      BC=BC/8.+XTT(I)-CAMLE
      BC=BC*SRT
      THR=BC/(CN*SQRT(FTAN*FTAN+BB))
      X(5,I)=(PI/2.)*SQRT(1.-AM1*AM1*FCOS*FCOS)*THR*THR/FCOS
      NM=NW(1)
      IND=1
      ISN=1
      L1=LPANEL+1
      SK=1.
      IZ=1
      MM=0
      II=NW(1)
      A=0.
      FACTOR=1.
      AM=AM1
      BB=B1
      CONV=ALPC
      DO 190 NN=1,LAST
      IF (NN.GT.LPANEL) NA=NN-LPANEL+JPANEL
      IF (NN.LE.LPANEL) NA=NN+2*JPANEL
      FN=II
      IF (NN.GT.LPAN1.AND.NN.LE.LPAN2) ISN=2
      IF (NN.GT.LPAN2.AND.NN.LE.LPANEL) ISN=3
      IF (NN.GE.LPAN1.AND.NN.LT.LPANEL) GO TO 110
      GO TO 120
110   II=NW(2)
      IF (NN.GE.LPAN2.AND.NN.LT.LPANEL) II=NW(3)
120   CONTINUE
      IF (NN.GE.LPANEL.AND.NN.LT.MJJ(IND)) II=NCJ(IND)
      J=NN-MM
      CHORD=CH(IZ)
      IF (NN.EQ.L1) GO TO 130
      GO TO 140
130   ISN=ISN+1
```

```
      L1=MJJ(IND)+1
140   NL=MJJ(IND)-1
      IF (NN.EQ.NL) IND=IND+1
      IF (NN.GT.LPANEL) FACTOR=0.5
      X1=XN(NN,1)-XLE(I)
      X2=XN(NN,2)-XLE(I)
      X12=XN(NN,2)-XN(NN,1)
      Y12=YN(NN,2)-YN(NN,1)
      Z12=ZN(NN,2)-ZN(NN,1)
      XZJ=X1*Z12-ZN(NN,1)*X12
      DO 170 K=1,2
      IF (K.EQ.1) GO TO 150
      N1=1
      GO TO 160
150   N1=2
160   CONTINUE
      YC=YLE(I)*(-1.)**N1
      Y1=YN(NN,1)-YC
      Y2=YN(NN,2)-YC
      XYK=X1*Y12-Y1*X12
      YZI=Y1*Z12-ZN(NN,1)*Y12
      ALPRIM=XYK*XYK+XZJ*XZJ+BB*YZI*YZI
      RXYZ1=SQRT(X1*X1+BB*Y1*Y1+BB*ZN(NN,1)*ZN(NN,1))
      RXYZ2=SQRT(X2*X2+BB*Y2*Y2+BB*ZN(NN,2)*ZN(NN,2))
      UU=(X2*X12+BB*Y2*Y12+BB*ZN(NN,2)*Z12)/RXYZ2-(X1*X12+BB*Y1*Y12+BB*Z
     1N(NN,1)*Z12)/RXYZ1
      GN1=(1.-X1/RXYZ1)/(Y1*Y1+ZN(NN,1)*ZN(NN,1))
      GN2=(1.-X2/RXYZ2)/(Y2*Y2+ZN(NN,2)*ZN(NN,2))
      F1=UU*XYK/ALPRIM*SK
      F2=(GN1*Y1-GN2*Y2)*SK
170   A=A+(F1+F2)*SN(J,ISN)*CHORD*GAMMA(NA)/(8.*FN*FACTOR)
      IF (NN.LT.NM) GO TO 180
      IZ=IZ+1
      MM=NM
      NM=NM+II
180   CONTINUE
190   CONTINUE
      A=A*SRT
      THRT2=A/(CN*SQRT(FTAN*FTAN+BB))
      THRT=(THRT1+THRT2)*CONV
      GAL(I)=2.*THRT/(SRT*CONV)
      CT(I)=(PI/2.)*SQRT(1.-AM*AM*FCOS*FCOS)*THRT*THRT/FCOS
200   CONTINUE
      RETURN
      END
      SUBROUTINE NORSPD (I,ALPH,LPANEL,IPHI,LPAN1,LPAN2)
C     TO COMPUTE THE  INDUCED NORMAL VELOCITIES DUE TO WING ALONE
C     VORTICES
      COMMON /SCHEMF/ C(2),X(10,41),Y(10,41),SLOPE(15),XL(2,15),XTT(41),
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```
     1XLL(41)
      COMMON /GEOM/ HALFSW,XCP(200),YCP(200),ZCP(200),XLE(50),YLE(50),XT
     1E(50),PSI(20),CH(95),XV(200),YV(100),SN(8,8),XN(200,2),YN(200,2),Z
     2N(200,2),WIDTH(8),YCON(25),SWEEP(50),HALFB,SJ(21,8),EX(95,2),TX(95
     3,2),SC(160,5),SI(160,5),LC(3)
      COMMON /AERO/ AM1,AM2,B1,B2,CL(30),CT(30),CD(30),GAM(2,100)
      COMMON /CONST/ NCS,NCW,M1(8),NSJ,NCJ(5),LAST,MJW1(3,5),MJW2(3,5),J
     1PANEL,MJJ(5),NW(3),NNJ,NJP
      NJH=(NSJ-1)/2
      IZ=1
      MM=0
      NM=NW(1)
      ISN=1
      NL=NW(1)
      A1=0.
      A2=0.
      DO 60 J=1,LPANEL
      JJ=J-MM
      FN=NL
      IF (J.GT.LPAN1.AND.J.LE.LPAN2) ISN=2
      IF (J.GT.LPAN2.AND.J.LE.LPANEL) ISN=3
      IF (J.GE.LPAN1.AND.J.LT.LPANEL) GO TO 10
      GO TO 20
10    NL=NW(2)
      IF (J.GE.LPAN2.AND.J.LT.LPANEL) NL=NW(3)
20    CONTINUE
      X1=XN(J,1)-XCP(I)
      X2=XN(J,2)-XCP(I)
      X12=XN(J,2)-XN(J,1)
      Y12=YN(J,2)-YN(J,1)
      Z12=0.
      Z1=-ZCP(I)
      Z2=-ZCP(I)
      XZJ=X1*Z12-Z1*X12
      DO 50 K=1,2
      IF (K.EQ.1) GO TO 30
      N=1
      GO TO 40
30    N=2
40    CONTINUE
      YC=(-1.)**N*YCP(I)
      Y1=YN(J,1)-YC
      Y2=YN(J,2)-YC
      XYK=X1*Y12-Y1*X12
      YZI=Y1*Z12-Z1*Y12
      ALB1=XYK*XYK+XZJ*XZJ+B1*YZI*YZI
      R1B1=SQRT(X1*X1+B1*Y1*Y1+B1*Z1*Z1)
      R2B1=SQRT(X2*X2+B1*Y2*Y2+B1*Z2*Z2)
      UUB1=(X2*X12+B1*Y2*Y12+B1*Z2*Z12)/R2B1-(X1*X12+B1*Y1*Y12+B1*Z1*Z12
```

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     1)/R1B1
      GI=(1.-X1/R1B1)/(Y1*Y1+Z1*Z1)
      G2=(1.-X2/R2B1)/(Y2*Y2+Z2*Z2)
      ALB2=XYK*XYK+XZJ*XZJ+B2*YZI*YZI
      R1B2=SQRT(X1*X1+B2*Y1*Y1+B2*Z1*Z1)
      R2B2=SQRT(X2*X2+B2*Y2*Y2+B2*Z2*Z2)
      UUB2=(X2*X12+B2*Y2*Y12+B2*Z2*Z12)/R2B2-(X1*X12+B2*Y1*Y12+B2*Z1*Z12
     1)/R1B2
      G3=(1.-X1/R1B2)/(Y1*Y1+Z1*Z1)
      G4=(1.-X2/R2B2)/(Y2*Y2+Z2*Z2)
      F13=UUB1*XZJ/ALB1
      F12=UUB1*XYK/ALB1
      G13=Z2*G2-Z1*GI
      G12=-Y2*G2+Y1*G1
      F23=UUB2*XZJ/ALB2
      F22=UUB2*XYK/ALB2
      G23=Z2*G4-Z1*G3
      G22=-Y2*G4+Y1*G3
      F1=-F13*Y(4,IPHI)*(-1.)**N+F12*Y(3,IPHI)
      F2=G13*Y(4,IPHI)*(-1.)**N+G12*Y(3,IPHI)
      F3=-F23*Y(4,IPHI)*(-1.)**N+F22*Y(3,IPHI)
      F4=G23*Y(4,IPHI)*(-1.)**N+G22*Y(3,IPHI)
      A1=A1+(F1+F2)*CH(IZ)*SN(JJ,ISN)*GAM(1,J)/FN
   50 A2=A2+(F3+F4)*CH(IZ)*SN(JJ,ISN)*GAM(2,J)/FN
      IF (J.LT.NM) GO TO 60
      IZ=IZ+1
      MM=NM
      NM=NM+NL
   60 CONTINUE
      ALPH=(A1-A2)/8.
      RETURN
      END
      OVERLAY(USBOWB,5,0)
      PROGRAM LOAD
C     TO EVALUATE THE AERODYNAMIC CHARACTERISTICS
      DIMENSION CA(30), CPSWL(30), AW(30)
      COMMON /GEOM/ HALFSW,XCP(200),YCP(200),ZCP(200),XLE(50),YLE(50),XT
     1E(50),PSI(20),CH(95),XV(200),YV(100),SN(8,8),XN(200,2),YN(200,2),Z
     2N(200,2),WIDTH(8),YCON(25),SWEEP(50),HALFB,SJ(21,8),EX(95,2),TX(95
     3,2),SC(160,5),SI(160,5),LC(3)
      COMMON /AERO/ AM1,AM2,B1,B2,CL(30),CT(30),CD(30),GAM(2,100)
      COMMON /CONST/ NCS,NCW,MI(8),NSJ,NCJ(5),LAST,MJW1(3,5),MJW2(3,5),J
     1PANEL,MJJ(5),NW(3),NNJ,NJP
      COMMON /PARAM/ ALPT,ALPC,ALPS,CDF,SDF,TH,TDF
      COMMON /SCHEME/ C(2),X(10,41),Y(10,41),SLOPE(15),XL(2,15),XTT(41),
     1XLL(41)
      COMMON /ADD/ CP(100),CM(30),BREAK(8),SWP(8,15),GAL(30),ISYM,VMU,VU
     1,TEMP,FCR,CAMLER,CAMLET,CAMTER,CAMTET,XJ,YJ,ZJ,RJ,ALP,CREF,TWISTR
      COMMON /COST/ LTOTAL,LPAN1,NJW(5),LPANEL,IENTN,LPAN2,EXIT,PTIAL,TW
```

```
     1IST,DF(5),NFP
      PI=3.14159265
      ALPH=ALP*180./PI
      WRITE (6,330)
      WRITE (6,320) ALPH
      WRITE (6,330)
      ZJET=YCON(25)
      IUSB=YCON(24)
      NC=IENTN
      DFJ=CDF
      CMU=C(1)
      CLT=0.
      CMT=0.
      CDT=0.
      CLW=0.
      CMWT=0.
      CDW=0.
      CLWW=0.
      CMWWT=0.
      CDWW=0.
      KC=1
      NCOL=M1(1)
      KLL=0
      MM=0
      IU=1
      IF (NW(2).NE.0) IU=2
      IF (NW(3).NE.0) IU=3
      NW2=NW(1)+NW(2)
      NW3=NW(2)+NW(3)
      NCW1=NCW+1
      NL=1
      DO 140 I=1,NCS
      IF (NW(2).EQ.0) GO TO 20
      II=I+NCS
      IF (NW(3).NE.0) GO TO 10
      CHORD=CH(I)+CH(II)
      GO TO 30
10    III=II+NCS
      CHORD=CH(I)+CH(II)+CH(III)
      GO TO 30
20    CHORD=CH(I)
30    CONTINUE
      CML=0.
      CL(I)=0.
      CD(I)=0.
      CA(I)=0.
      CMW=0.
      CPSWL(I)=0.
      CMWW=0.
      X(4,I)=0.
```

```
      X(6,I)=0.
      X(7,I)=0.
      DO 120 J=1,NCW
      NN=J+MM
      IF (NW(2).EQ.0) GO TO 50
      IF (J.LE.NW(1)) GO TO 50
      IF (J.GT.NW2) GO TO 40
      LL=LPAN1+NW(2)*(I-1)+J-NW(1)
      IL=II
      JLL=J-NW(1)
      L=2
      FN=NW(2)
      GO TO 60
40    LL=LPAN2+NW(3)*(I-1)+J-NW2
      IL=III
      JLL=J-NW2
      L=3
      FN=NW(3)
      GO TO 60
50    LL=NN
      IL=I
      JLL=J
      L=1
      FN=NW(1)
60    CONTINUE
      XC=(XV(LL)-XLE(I))/CHORD
      X(1,J)=ZCR(XC)
      X(2,J)=ZCT(XC)
      GBS=CP(LL)*SN(JLL,L)*CH(IL)/(2.*FN)
      WBS=GAM(1,LL)*SN(JLL,L)*CH(IL)*ALPC/FN
      WAS=GAM(2,LL)*SN(JLL,L)*CH(IL)*ALPC/FN
      IF (DF(NL).LE.0.001) GO TO 70
      IF (PTIAL.LE.0.1) GO TO 80
      IF (NW(3).EQ.0) GO TO 100
      IF (LL.GE.MJW1(3,NL).AND.LL.LE.MJW2(3,NL)) GO TO 90
70    CAM=X(1,J)-(X(1,J)-X(2,J))*YV(LL)/HALFB
      EPHA=XLL(I)-ATAN(CAM)
      CS=COS(EPHA)
      SS=SIN(EPHA)
      GO TO 110
80    IF (NW(2).NE.0.AND.LL.LE.LPAN1) GO TO 70
      IF (NW(3).NE.0.AND.LL.LE.LPAN2) GO TO 70
90    EP=XLL(I)+DF(NL)
      CAM=X(1,J)-(X(1,J)-X(2,J))*YV(LL)/HALFB
      EP=EP-ATAN(CAM)
      CS=COS(EP)
      SS=SIN(EP)
      GO TO 110
100   IF (LL.GE.MJW1(2,NL).AND.LL.LE.MJW2(2,NL)) GO TO 90
      GO TO 70
110   CONTINUE
```

```
      CL(I)=CL(I)+GBS*CS                                                LOD1180
      CML=CML-GBS*XV(LL)*CS                                             LOD1190
      CD(I)=CD(I)+GBS*SS                                                LOD1200
      CA(I)=CA(I)+WBS*CS                                                LOD1210
      CMW=CMW-WBS*XV(LL)*CS                                             LOD1220
      CPSWL(I)=CPSWL(I)+WBS*SS                                          LOD1230
      X(4,I)=X(4,I)+WAS*CS                                              LOD1240
      CMWW=CMWW-WAS*XV(LL)*CS                                           LOD1250
      X(6,I)=X(6,I)+WAS*SS                                              LOD1260
  120 CONTINUE                                                          LOD1270
      CAMLE=CAMLER-(CAMLER-CAMLET)*YLE(I)/HALFB                         LOD1280
      EPHA=XLL(I)-ATAN(CAMLE)                                           LOD1290
      X(1,NCW1)=COS(EPHA)                                               LOD1300
      X(2,NCW1)=SIN(EPHA)                                               LOD1310
      CL(I)=CL(I)*PI/CHORD+CT(I)*X(2,NCW1)                              LOD1320
      CM(I)=CML*PI/(CREF*CHORD)                                         LOD1330
      CD(I)=CD(I)*PI/CHORD-CT(I)*X(1,NCW1)                              LOD1340
      CA(I)=CA(I)*PI/CHORD+XTE(I)*X(2,NCW1)                             LOD1350
      AW(I)=CMW*PI/(CREF*CHORD)                                         LOD1360
      CPSWL(I)=CPSWL(I)*PI/CHORD-XTE(I)*X(1,NCW1)                       LOD1370
      X(4,I)=X(4,I)*PI/CHORD+X(5,I)*X(2,NCW1)                           LOD1380
      X(7,I)=CMWW*PI/(CREF*CHORD)                                       LOD1390
      X(6,I)=X(6,I)*PI/CHORD-X(5,I)*X(1,NCW1)                           LOD1400
      IF (I.LT.NCOL) GO TO 130                                          LOD1410
      KLL=NCOL-1                                                        LOD1420
      KC=KC+1                                                           LOD1430
      NCOL=NCOL+M1(KC)-1                                                LOD1440
  130 KL=I-KLL                                                          LOD1450
      FM=M1(KC)                                                         LOD1460
      AA=CHORD*SJ(KL,KC)*WIDTH(KC)/FM                                   LOD1470
      CLT=CLT+CL(I)*AA                                                  LOD1480
      CMT=CMT+CM(I)*AA                                                  LOD1490
      CDT=CDT+CD(I)*AA                                                  LOD1500
      CLW=CLW+CA(I)*AA                                                  LOD1510
      CMWT=CMWT+AW(I)*AA                                                LOD1520
      CDW=CDW+CPSWL(I)*AA                                               LOD1530
      CLWW=CLWW+X(4,I)*AA                                               LOD1540
      CMWWT=CMWWT+X(7,I)*AA                                             LOD1550
      CDWW=CDWW+X(6,I)*AA                                               LOD1560
      MM=(NCW-NW3)*I                                                    LOD1570
      IF (LL.EQ.MJW2(IU,NL)) NL=NL+1                                    LOD1580
  140 CONTINUE                                                          LOD1590
      CLT=CLT*PI/(2.*HALFSW)                                            LOD1600
      CMT=CMT*PI/(2.*HALFSW)                                            LOD1610
      CDT=CDT*PI/(2.*HALFSW)                                            LOD1620
      CDCL2=CDT/(CLT*CLT)                                               LOD1630
      CLW=CLW*PI/(2.*HALFSW)                                            LOD1640
      CMWT=CMWT*PI/(2.*HALFSW)                                          LOD1650
      CDW=CDW*PI/(2.*HALFSW)                                            LOD1660
      CLWW=CLWW*PI/(2.*HALFSW)                                          LOD1670
      CMWWT=CMWWT*PI/(2.*HALFSW)                                        LOD1680
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```
      CDWW=CDWW*PI/(2.*HALFSW)
      IF (CLWW.LE.0.001) GO TO 150
      CDWL2=CDWW/(CLWW*CLWW)
      GO TO 160
150   CDWL2=0.
160   CONTINUE
      WRITE (6,340)
      K1=0
      JJ1=0
      DO 240 I=I,NCS
      IF (NW(2).EQ.0) GO TO 180
      II=I+NCS
      IF (NW(3).NE.0) GO TO 170
      CHORD=CH(I)+CH(II)
      GO TO 190
170   III=II+NCS
      CHORD=CH(I)+CH(II)+CH(III)
      GO TO 190
180   CHORD=CH(I)
190   CONTINUE
      DO 230 J=1,NCW
      JJ=JJ1+J
      KK=K1+J
      IF (NW(2).EQ.0) GO TO 210
      IF (J.LE.NW(1)) GO TO 210
      IF (J.GT.NW2) GO TO 200
      LL=LPAN1+NW(2)*(I-1)+J-NW(1)
      GO TO 220
200   LL=LPAN2+NW(3)*(I-1)+J-NW2
      GO TO 220
210   LL=JJ
220   CONTINUE
      XI=(XV(LL)-XLE(I))/CHORD
      ETA=YV(LL)/HALFB
      CPW=2.*GAM(2,LL)*ALPC
230   WRITE (6,350) KK,XI,ETA,CP(LL),CPW
      JJ1=(NCW-NW3)*I
      K1=K1+NCW
240   CONTINUE
      WRITE (6,360)
      DO 250 I=1,NCS
      YE=YLE(I)/HALFB
250   WRITE (6,370) YE,CL(I),CM(I),CT(I),CD(I),X(4,I),X(7,I),X(6,I)
      WRITE (6,380) CLT
      WRITE (6,390) CDT
      WRITE (6,400) CDCL2
      WRITE (6,410) CMT
      IF (IUSB.NE.1) GO TO 300
      IF (DFJ.LE.0.001) GO TO 300
      IF (ZJET.GT.0.01) GO TO 300
```

```
      SDFJ=SIN(DFJ)
      CDFJ=COS(DFJ)
      CLR=CMU*SIN(DFJ+ALP)
      CDR=CMU*(VMU-COS(DFJ+ALP))
      CF=COS(TDF)
      SF=SIN(TDF)
      IF (NNJ.EQ.1) CDR=-CMU*COS(DFJ+ALP)
      IJ=(NSJ+1)/2-1
      IF (ISYM.EQ.0) IJ=NSJ/2-1
      IF (NW(3).NE.0) GO TO 260
      IF (NW(2).EQ.0) GO TO 270
      IZ=NCS+(MJW1(2,NJP)-LPAN1-1)/NW(2)+1
      KJ=MJW1(2,NJP)
      NN=NW(2)
      GO TO 280
  260 IZ=NCS*2+(MJW1(3,NJP)-LPAN2-1)/NW(3)+1
      KJ=MJW1(3,NJP)
      NN=NW(3)
      GO TO 280
  270 IZ=LC(1)
      KJ=MJW1(1,NJP)
      NN=NW(1)
  280 CONTINUE
      CM1=0.
      DO 290 I=1,IJ
      YDIF=YN(KJ,2)-YN(KJ,1)
      CM1=CM1+YDIF/WIDTH(NJW(NJP))*((XLE(IZ)+CH(IZ)*CF)*SDFJ-CH(IZ)*SF*C
     1DFJ)
      KJ=KJ+NN
  290 IZ=IZ+1
      CMR=-CM1*CMU/CREF
      IF (NNJ.NE.1) WRITE (6,420) CLR
      IF (NNJ.EQ.1) WRITE (6,430) CLR
      IF (NNJ.NE.1) WRITE (6,440) CDR
      IF (NNJ.EQ.1) WRITE (6,450) CDR
      IF (NNJ.NE.1) WRITE (6,460) CMR
      IF (NNJ.EQ.1) WRITE (6,470) CMR
  300 CONTINUE
      IF (IUSB.EQ.1) GO TO 310
      WRITE (6,480) CLW
      WRITE (6,490) CDW
      WRITE (6,500) CMWT
  310 CONTINUE
      WRITE (6,510) CLWW
      WRITE (6,520) CDWW
      WRITE (6,530) CMWWT
      WRITE (6,540) CDWL2
      RETURN
C
```

```
  320 FORMAT (1H0,26X,7HALPHA =,F10.3,3X,7HDEGREES)
  330 FORMAT (1H0,20X,40HXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX)
  340 FORMAT (1H0,3X,6HVORTEX,14X,2HXV,17X,2HYV,19X,2HCP,19X,3HCPW)
  350 FORMAT (6X,I3,4(10X,F10.5))
  360 FORMAT (1H0,9X,4HY/SP,11X,2HCL,13X,2HCM,12X,2HCT,13X,3HCDI,12X,3HC
     1LW,12X,3HCMW,12X,3HCDW)
  370 FORMAT (8(5X,F10.5))
  380 FORMAT (1H0,22HTHE LIFT COEFFICIENT =,F10.5)
  390 FORMAT (1H0,32HTOTAL INDUCED DRAG COEFFICIENT =,F10.5)
  400 FORMAT (1H0,28HTHE INDUCED DRAG PARAMETER =,F10.5)
  410 FORMAT (1H0,35HTOTAL PITCHING MOMENT COEFFICIENT =,F10.5)
  420 FORMAT (1H0,34HTHE COANDA LIFT COEFFICIENT, CLR =,F10.5)
  430 FORMAT (1H0,47HTHE LIFT COEFFICIENT DUE TO JET REACTION, CLJ =,F10
     1.5)
  440 FORMAT (1H0,34HTHE COANDA DRAG COEFFICIENT, CDR =,F10.5)
  450 FORMAT (1H0,47HTHE DRAG COEFFICIENT DUE TO JET REACTION, CDJ =,F10
     1.5)
  460 FORMAT (1H0,36HTHE COANDA MOMENT COEFFICIENT, CMR =,F10.5)
  470 FORMAT (1H0,58HTHE PITCHING MOMENT COEFFICIENT DUE TO JET REACTION
     1, CMJ =,F10.5)
  480 FORMAT (1H0,2X,49HTHE LIFT COEFFICIENT WITH JET ENTRAINMENT ALONE 
     1=,F10.5)
  490 FORMAT (1H0,2X,57HTHE INDUCED DRAG COEFFICIENT WITH JET ENTRAINMEN
     1T ALONE =,F10.5)
  500 FORMAT (1H0,2X,60HTHE PITCHING MOMENT COEFFICIENT WITH JET ENTRAIN
     1MENT ALONE =,F10.5)
  510 FORMAT (1H0,40HTHE LIFT COEFFICIENT FOR THE WING ALONE=,F10.5)
  520 FORMAT (1H0,48HTHE INDUCED DRAG COEFFICIENT FOR THE WING ALONE=,F1
     10.5)
  530 FORMAT (1H0,51HTHE PITCHING MOMENT COEFFICIENT FOR THE WING ALONE=
     1,F10.5)
  540 FORMAT (1H0,46HTHE INDUCED DRAG PARAMETER FOR THE WING ALONE=,F10.
     15)
      END
```