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A THEORETICAL METHOD FOR THE ANALYSIS AND DESIGN OF AXISYMMETRIC BODIES

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Prepared by MCDONNELL DOUGLAS AIRCRAFT CORPORATION Long Beach, Calif. 90801 for Langley Research Center



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SUMMARY

A theoretical method is presented for the computation of the flow field about an axisymmetric body operating in a viscous incompressible fluid. This approach combines a smoothing routine, a potential flow method based on a surface source distribution, and a finite-difference boundary-layer method to accomplish the analysis. An empirical method used for modeling separated flow is shown to work reasonably well for cases of extreme flow separation. Results obtained by this method are presented which show very good agreement with experimental data. Suggestions are made for extending this method both to include a better model for separated flow and to calculate the "viscous" flow about axisymmetric bodies at angle of attack. A detailed instruction manual for inputing data to the computer program is given in Appendix A. Appendix B contains the necessary information to place this program on to a computer. This appendix also contains a complete description of output parameters from the computer program, as well as basic flow charts of some of the major subroutines. Appendix C contains a complete listing of the computer program for operation on either a CDC or an IEM computer.

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A THEORETICAL METHOD FOR THE ANALYSIS AND DESIGN OF AXISYMMETRIC BODIES

by T. D. Beatty McDonnell Douglas Aircraft Corporation

One of the ultimate goals in aerodynamics is the achievement of the ability to obtain the real fluid flow field about an arbitrary threedimensional configuration by theoretical calculation rather than by resorting to expensive and time consuming wind tunnel tests. The exact treatment of this problem requires the solution of the full Navier-Stokes equations, which is currently not practical. However, a good approximation to this real flow can be obtained by displacing the surface boundaries of the original body to account for viscosity as shown by Thwaites in Reference (1).

This technique of displacing the boundary surface to obtain a viscous solution has been used in two-dimensional flows quite successfully, as shown in References 2, 3, and 4. The extension of this approach to three-dimensional flow requires that appropriate computational routines be available to calculate the potential and viscous flow parameters. A potential flow routine which can calculate the flow about arbitrary three-dimensional bodies is available (Reference 5), although the comparable three-dimensional boundary layer method is not currently in the state of the art. At the present time, the general three-dimensional problem cannot be solved. However, both an axisymmetric potential flow method and an axisymmetric boundary layer method which can calculate the inviscid and viscous flow field about a body of revolution at zero degrees angle of attack are currently available.

Because of its simple nature and its common appearance in fluid dynamics, it was decided that a body of revolution would be a good starting point for the development of a three-dimensional method for calculating inviscid and viscous flow fields.

The axisymmetric potential flow routine (References 6 & 7), used in the present method was developed at the Douglas Aircraft Company under the guidance of A. M. O. Smith and has proven over the years to be an extremely versatile and accurate method, as well as the only purely axisymmetric potential flow method, generally available in industry today. This method has been well disseminated throughout industry; only a brief discussion will, therefore, be presented in a following section.

The boundary layer method presented in this report (Reference 8) is a finite difference technique which uses an eddy-viscosity concept to replace the Reynolds shear stress term. Since this method is relatively new and has been modified extensively since Reference 8 was reported, a detailed description will be presented.

The capability of the present method to determine the viscous flow about axisymmetric bodies is shown by correlations between the calculated results and experimental data.

Recommendations are presented for extending the present method to the calculation of the flow field about axisymmetric bodies at angle of attack.

DEFINITION OF SYMBOLS

A	Damping length or frontal area, wherever applicable
A+	Damping constants
C _F	Total skin friction coefficient
c_p	Pressure coefficient
с	Chord
^c f	Local skin friction coefficient $\tau_w/(\frac{1}{2})\rho u_e^2$
D	Maximum diameter
f	Dimensionless stream function
G	Spot formation parameter
н	Shape factor, θ/δ
к ₁	Mixing-length constant
k	Power to determine 2-D or axisymmetric flow
L	Reference body length
l	Mixing length
P+	Pressure gradient parameter
^R c	Chord Reynolds number, $u_{\infty}c/v$
R D	Diameter Reynolds number, $u_{\infty}D/v$
R _x	Local Reynolds number. u _e x/v
R ₀	Momentum thickness keynolds number, $U_e \theta / v$
r	Radial distance from axis of revolution
ro	Local radius of body of revolution
T	Absolute temperature, °K or °R.
ť	Transverse curvature term
U	Free stream velocity
υ _τ	Friction velocity, $\sqrt{\tau_w}/\rho$
u	x component of velocity

ue Velocity at edge of boundary layer

v y~coi	nponent	of v	velocity
---------	---------	------	----------

- x Distance along surface measured from leading edge or from stagnation point
- y Distance normal to the surface of the body

 α Angle between normal to the surface y and the radius r

- Constant in outer eddy viscosity equation
- β Dimensionless velocity gradient term, $\beta = (2\xi/u_p)(du_p/d\xi)$
- Y_{Tr} Transitional parameter
- δ Boundary layer thickness
- δ* Boundary layer displacement thickness
- ε Eddy viscosity
- ϵ^+ Ratio of eddy viscosity to kinematic viscosity, ϵ/ν
- η Transformed y-coordinate
- θ Momentum Thickness
- μ Dynamic viscosity
- v Kinematic viscosity
- ξ Transformed x-coordinate
- ρ Density
- τ Shear stress

SUBSCRIPTS

c Switching point between the inner and outer eddy viscosity formulas
 e Outer edge of boundary layer
 i Inner region
 Laminar

0	Outer Region	
t	Turbulent	
Tr	Transition	
w	Wall	
¢.	Free-stream conditions	

Primes denote differentiation with respect to n. No 200 (1999) and the action of a second of the sec

TECHNICAL DISCUSSION Geometry Definition

The geometry input to the Douglas Neumann Potential Flow Program must satisfy two primary requirements: the coordinates must be distributed properly and the surface curvature must be smooth. These requirements are easily achieved on an analytical body shape, since the input coordinates may be calculated exactly for any prescribed distribution. However, some method of determining accurate input coordinates for an arbitrary axisymmetric body is necessary, since the body may not always be amenable to exact analytical definition. The approach adopted in the following method is to assume that the coordinates are input in the proper distribution about the body, but that they are not necessarily smooth. These two requirements will be discussed in some detail in the following sections.

<u>Point distribution</u>. - In order to obtain a high degree of accuracy in defining a pressure distribution when using the Douglas Neumann Potential Flow program, surface coordinates should be concentrated in regions of high surface curvature where rapid changes in the surface pressures would be expected. Since the total number of points per body is fixed, the distribution of these points about the body contour becomes extremely important. The Neumann program uses the input coordinates to create linear segments between points, thus approximating the body by a series of Frustums of Cones. The basis distribution required is then quite simple: more points and thus smaller segment sizes in regions of high curvature and less points and thus larger segment sizes in the other areas of the body. The basic guidelines to follow to insure proper point distribution are simply that the surface lengths of adjacent elements should not change by more than twenty to thirty percent and the maximum length of any segment should not exceed either five percent of the body chord or fifty percent of the local body thickness.

<u>Smoothness of input coordinates</u>. - The Douglas Neumann program, or any similar potential flow method, is sensitive to the derivative of the surface slopes, or the curvature of the surface. The surface defined by the input coordinates must therefore have smooth first and second derivatives. The approach used in the

present method to smooth these coordinates, is a five point smoothing routine, which assumes that the input coordinates are smooth and continuous to graphical accuracy, i.e., points are chosen from a small graph (approximately a 10 inch chord). The output points from this routine will be moved very slightly to smooth the derivatives, but this movement will be negligible as far as the body shape is concerned. The equations used to accomplish this smoothing are is follows:

$$\overline{x}_{j} = \frac{1}{16} \left\{ -x_{j-2} + 4x_{j-1} + 10x_{j} + 4x_{j+1} - x_{j+2} \right\}$$
(1a)

$$\overline{y}_{j} = \frac{1}{16} \left\{ -y_{j-2} + 4y_{j-1} + 10y_{j} + 4y_{j+1} - y_{j+2} \right\}$$

where x and y are the unsmoothed input coordinates

and \overline{x}_{i} and \overline{y}_{i} are the smoothed coordinates.

Potential Flow Method

The Douglas Neumann method, (References 6 and 7) is very general in that it can calculate the potential flow about virtually any body. There is no restriction, for example, to slender bodies; in fact, the "body" in question need not be a single body but may be an ensemble of bodies. In principle, the calculated solution may be made as accurate as desired by suitably refining the numerical procedure; accordingly, the so-called Neumann method is designated an exact method in this sense.

The Neumann method is based on the use of a distribution of source density over the body surface. Applying the condition of zero normal velocity on the body surface yields an integral equation for the source distribution. Specifically, the equation is a Fredholm integral equation of the second kind over the body surface. Once this has been solved for the source distribution, all flow quantities of interest, i.e., velocity, pressure, etc., can be calculated by rapid straightforward procedures. To implement this method on a computer, the body surface is approximated by a large number of small surface segments, over each of which the source density is assumed constant. The

7

(1b)

integral equation is replaced by a set of linear algebraic equations for the values of the source density on the segments. Input to the computer program consists of the coordinates of a set of points defining the body surface; these points are then used to determine the surface segments for approximating the body. There is no assumption made that the body can be analytically represented.

The usefulness of potential flow with its neglect of viscosity and compressibility is due to the fact that it is a good approximation to real flow under a wide variety of circumstances. With regard to viscosity, the program obtains useful results except in regions of catastrophic separation. To verify the usefulness of potential flow as a predictor of real flow, results calculated by the Neumann program have been compared with experimental data. Several collections of comparisons have been made. Reference 9 was a very complete collection but is now rather old. Reference 10 is a more recent collection that shows a smaller number of comparisons. In the calculation of the viscous flow about axisymmetric bodies it is necessary to add the boundary layer displacement thickness to the body as will be shown in a subsequent section. This results in an "open" trailing edge body. This "open" body can be evaluated by the Neumann program without any difficulty even though the boundary surface does not close. Reference 11 presents an explanation of this phenomenon which proceeds as follows: for a closed body the integral of the source density over the body is zero; for an "open trailing edge body, this integral is not zero, and a streamtube leaves the trailing edge of the open body which proceeds downstream and approaches infinity parallel to $\vec{u}_{...}$ as a constant cross section streamtube. Thus, the flow that is calculated may be thought of as that about a semi-infinite body consisting of the open body and an extension defined by this streamtube. The shape of the extension is unknown but is presumably unique, having both zero normal velocity and zero source density.

The potential flow program has many useful options available which do not pertain directly to the present development. The details of these options are described in References 12 through 17.

Boundary Layer Method

Basic boundary layer equations. - The calculation of the viscous flow over an axisymmetric body involves the solution of the laminar and turbulent flow equations. For laminar flows, the problem is strictly mathematical because the governing differential equations can be written exactly. For turbulent flows on the other hand, an exact solution of the governing equations is not possible. Consequently, in order to proceed at all, one must rely on a certain degree of empiricism. In the past, most of the work in this area has concentrated on so-called momentum and/or energy integral methods as a means of evaluating the viscous flow parameters. Thus, the exact mathematical solution to the problems of the turbulent flow was bypassed, leading to fast and simple methods with varying degrees of accuracy. These methods usually rely quite heavily on empirical correlations and generally are restricted to a limited range of flow conditions.

The Douglas Boundary-Layer Method (Reference 8), eliminates many of the disadvantages of the integral methods by proceeding to solve the full partial-differential equations governing the flow, thereby, being classified as a differential method. For two-dimensional and axisymmetric incompressible flows, turbulent boundary-layer equations contain terms involving time means of fluctuating velocity components known as Reynolds stress terms. At present the exact relationship between these terms and the mean velocity distribution in the boundary layer still remains unknown. In the present method, a relation based on the eddy-viscosity concept is used giving highly satisfactory results for a variety of flow conditions.

If the normal-stress terms are neglected, the incompressible turbulent boundary-layer equations for two-dimensional and axisymmetric flows can be written as in Reference 8:

Continuity

$$\frac{\partial}{\partial \mathbf{x}} \left[\mathbf{r}^{k} \mathbf{u} \right] + \frac{\partial}{\partial \mathbf{y}} \left[\mathbf{r}^{k} \mathbf{v} \right] = 0$$
⁽²⁾

Momentum

$$u \frac{\partial u}{\partial x} + v \frac{\partial u}{\partial y} = u_e \frac{du_e}{dx} + \frac{1}{\rho_{\infty}} \frac{1}{r^k} \frac{\partial}{\partial y} \left(r^k \tau \right)$$

where

 $\tau = \tau_{\ell} + \tau_{t}$ with $\tau_{\ell} = \mu_{\infty} \frac{\partial u}{\partial y} \qquad (For \ laminar \ flow \ only) \qquad (4)$ $\tau_{t} = -\rho_{\infty} \overline{u'v'} \qquad (Additional \ term \ due \ to \ turbulent \ flow)$ and $\overline{u'v'} = Reynolds \ shear \ stress \ term$ $k = 0 \quad for \ two-dimensional \ flow$

k = 1 for axisymmetric flow

The basic notation and coordinate scheme are shown in Figure 1, where U_{∞} is a reference velocity and $u_e(x)$ is the velocity just outside the boundary layer. The coordinate system is a curvilinear one in which x is the distance along the surface measured from the stagnation point or leading edge, and y is measured normal to the surface. Within the boundary layer, the velocity components in the x- and y-directions are u and v, respectively. The body radius is r_o .

The boundary conditions for equation (3) are

$$u(x,0) = 0$$
 (5a)

(3)

$$v(x_0) = 0$$
 (5b)

$$Lim u(x,y) = u_{x}(x)$$
 (5c)

Before equations (2) and (3) can be solved, they must be transformed to a coordinate system which removes the singularity at x = 0 and stretches the coordinate normal to the flow direction. First, these equations are placed in an almost two-dimensional form by the Probatein-Elliott transformation (Reference 18):

V->00

$$d\overline{\mathbf{x}} = \left[\frac{\mathbf{r}_{0}(\mathbf{x})}{L}\right]^{2k} d\mathbf{x}$$
(6)

$$d\overline{y} = \left[\frac{r(x,y)}{L}\right]^{K} dy$$
(7)

where $r_0(x)$ is the body radius and r(x,y) is a radius which accounts for the transverse curvature effect which will be subsequently discussed. A stream function Ψ is defined that satisfies the continuity equation (2):

$$\frac{\partial \Psi}{\partial y} = r^{k}u \qquad \frac{\partial \Psi}{\partial x} = -r^{k}v \quad , \quad \overline{\Psi} = \frac{\Psi}{L}$$
 (8)

The resulting equations are transformed by the Levy-Lees transformation (Reference 19) in order to remove the singularity at $\overline{x} = 0$ and stretch the coordinates in the \overline{x} and \overline{y} directions. The Levy-Lees transformations are:

$$d\xi = \rho_{\infty} \mu_{\infty} u_{e} d\overline{x}$$
 (9a)

$$d\eta = \frac{\rho_{\infty} u_{\infty}}{(2E)^2} d\overline{y}$$
(9b)

A dimensionless stream function, f, is introduced which is related to Ψ as follows:

$$\Psi = (2\xi)^{\frac{1}{2}} f(\xi,\eta)$$
 (10)

Combining the Levy-Lees and the Probstein-Elliott transformations given above we have $\Gamma_r (x) \gamma^{2k}$

$$d\xi = \rho_{\omega} \mu_{\omega} u_{e} \left[\frac{r_{o}(x)}{L} \right]^{L} dx \qquad (11a)$$

$$d\eta = \frac{\rho_{\infty} u_e}{(2\xi)^2} \left[\frac{r(x,y)}{L} \right]^k dy$$
(11b)

Introducing an eddy viscosity term to account for the Reynolds shear stress terms,

$$\varepsilon \equiv -\frac{\overline{u'v'}}{\frac{\partial u}{\partial y}}, \quad \varepsilon^+ \equiv \frac{\varepsilon}{U}$$
 (12)

and a transverse curvature term t along with a pressure parameter term

$$\beta = \frac{2\xi}{u_e} \frac{du_e}{d\xi}$$
(13)

The momentum equation (3) then becomes, with $f' = u/u_{e}$,

$$\left[1+t\right]^{2k} (1+\epsilon^{+}) f'' + ff'' + \beta \left[1-(f')\right]^{2} = 2\xi \left[f' \frac{\partial f}{\partial \xi}' - f'' \frac{\partial f}{\partial \xi}\right]$$
(14)

The boundary conditions given by equation (5) become

$$f(\xi_0) = f_w = 0$$
 (15a)

$$f'(\xi_0) = 0$$
 (15b)

$$\lim_{n \to \infty} f'(\xi, \eta) = 1 \tag{15c}$$

The momentum equation is then solved by a very efficient numerical scheme developed by Keller, (Reference 20) and applied to boundary layer calculations by Cebeci and Keller, (References 21 and 22).

Eddy viscosity equations. - The eddy viscosity concept is used to relate the time-mean fluctuating velocities to a mean velocity distribution as given in equation (12)

$$\varepsilon \equiv -\frac{\overline{u'v'}}{\frac{\partial u}{\partial y}}$$
(12)

A two-layer model of the eddy viscosity within the boundary layer will be used as shown in figure 2.

In the inner region of the boundary layer an eddy viscosity model, based on Prandtl's mixing-length theory, is used:

$$\epsilon_{i} = \ell^{2} \left| \frac{\partial u}{\partial y} \right|$$
(16)

where *l*, the mixing length is given by

$$\ell = K_1 Y \tag{17}$$

A modified expression for *l* has been developed by Van Driest (Reference 23) to account for the viscous sublayer close to the wall. This modification is

$$\ell = K_1 Y \left[1 - e^{-(Y/A)} \right]$$
(18)

where A is given by

$$A = A^{+} \frac{v_{\infty}}{N} \left[\frac{\tau_{w}}{\rho_{\infty}} \right]^{-\frac{1}{2}}$$
(19)

and

$$A^+ = 26.0$$
 (20)

$$N = \left[1 - 11.8 P^{+}\right]^{-\frac{1}{2}}$$
(21)

$$P^{+} = \frac{v_{\omega} u_{e}}{u_{\tau}^{3}} \frac{d u_{e}}{d \xi} \rho_{\omega} \mu_{\omega} u_{e} \left(\frac{r_{o}}{L}\right)^{2k}$$
(22)

 $u_{\tau} = \left(\frac{\tau_{W}}{\rho_{\infty}}\right)$ (23)

Now for axisymmetric flows the value of ℓ is replaced by

$$\ell = .4r_0 \ln\left(\frac{r}{r_0}\right) \left[1 - e^{-\frac{r_0}{A} \ln\left(\frac{r}{r_0}\right)}\right]$$
(24)

~

which is developed in reference 24. If transverse curvature effects are desired then

$$\frac{r}{r_0} = \frac{r_0 + Y \cos \alpha}{r_0} = 1 + \frac{Y}{r_0} \cos \alpha$$
$$= 1 + t \qquad (25)$$

where
$$t = \frac{Y}{r_o} \cos \alpha$$

then *l* becomes

$$\ell = .4r_0 \ln (1+t) \left[1 - e \right]$$
 (26)

The eddy viscosity in the outer region of the boundary layer is given by

$$\varepsilon_{o} = \alpha u_{e} \delta_{k}^{*}$$
 (27)

where δ_k^* is the boundary layer displacement thickness defined by

$$\delta^* = \int_{0}^{n_{\infty}} \left[1 - \left(\frac{u}{u_e} \right) \right] dn$$
 (28)

which in the transformed plane becomes

$$\delta_{k}^{*} = \left[\frac{L}{r_{0}}\right]^{k} \frac{(2\xi)^{\frac{1}{2}}}{\rho_{0}u_{e}} \int_{0}^{\infty} (1-f^{*})(1+t)^{-k} dn \qquad (29)$$

where

$$l+t = \left[1 + \frac{2L \cos \alpha}{r_0^2} + \frac{(2\xi)^{\frac{1}{2}}}{\rho_{\infty} u_e} \int_{0}^{n_{\infty}} dn\right]^{\frac{1}{2}}.$$
 (30)

This relationship for ε_0 is the same for two-dimensional or axisymmetric flows as shown in Reference 24.

Low Reynolds number effects. - The calculation of turbulent boundary layers about two-dimensional and axisymmetric bodies must often be done at low Reynolds number, i.e., momentum thickness Reynolds number, R_{θ} , less than 6000. Most of the boundary layer methods including the one presented above are based on empirical data which were obtained at high Reynolds numbers. A correction term to account for low Reynolds numbers which was developed by Cebeci (Reference 25) based on prior work by Coles (Reference 26) is, therefore, applied to the outer eddy viscosity by varying the α in equation (27) with R_{α} in the following manner.

if
$$R_{\theta} < 425$$
 then $\alpha = (.0168)(1.55)$ (31a)

if
$$R_{\theta} > 6000$$
 then $\alpha = .0168$ (31b)
if $425 < R_{\theta} < 6000$ then $\alpha = .0168 \left[\frac{1.55}{1+\Pi}\right]$ where

$$\Pi = .55 \begin{bmatrix} 1 - e \end{bmatrix} \text{ and } \gamma = (r_{\theta}/425) -1$$
(31c)

<u>Transverse curvature</u>. - In developing the axisymmetric boundary layer equations a radius term is introduced as shown in equations (2) and (3). If the assumption is made that the body radius is very large compared to the boundary layer thickness then the radii in equations (2) and (3) reduce to the local body radius r_0 and the effect of the transverse (i.e., circumferential) curvature in the momentum equation is neglected. If, however, the body radius is small compared to the boundary layer thickness then the effect of the transverse curvature cannot be ignored and r must be a function of the distance into the boundary layer, y. The relationship between y, r_o , and r is given by:

$$\mathbf{r} = \mathbf{r} + \mathbf{y} \cos \alpha \tag{32}$$

As observed in figure 3, α is simply the surface slope in the longitudinal direction. i.e.,

$$\tan \alpha = \frac{\mathrm{d}r}{\mathrm{d}x} \tag{33}$$

For slender cylinders where $\alpha = 0^{\circ}$, denote the denote the structure restriction of the structure of th

$$\mathbf{r} = \mathbf{r}_{0} + \mathbf{Y} \tag{34}$$

The inclusion of the transverse curvature terms in the boundary layer equations is shown in References 24 and 27 to substantially improve the accuracy of the calculation of the local skin friction as well as the other viscous parameters.

Transition region effect. - The boundary layer method has the capability of calculating transition from laminar flow to turbulent flow in two different ways. The first approach is to use the transition point as a switching point between laminar and turbulent boundary layer calculations. At the transition point the turbulent boundary layer calculations are started by activating the eddy viscosity coefficient. In general, especially at low Reynolds numbers this approach can lead to errors as shown by Cebeci in Reference 28. The second approach which is available uses the intermittancy factor given by Chen and Thyson (Reference 29) to modify the eddy viscosity equations to account for a region of transition. This modification was developed from the point of view of intermittent production of turbulent spots and is a further extension of Emmons' spot theory (Reference 30). The modification to be used is to multiply the inner and outer eddy viscosities equations (16) and (27) by the following parameter:

$$-Gr_{o}\left(x_{Tr}\right)\left[\int_{x_{Tr}}^{x} \frac{dx}{r_{o}}\right]\left[\int_{x_{Tr}}^{x} \frac{dx}{u_{e}}\right]$$
$$\gamma_{Tr} = 1 - e$$
$$G = \left(\frac{3}{3600}\right)\left(\frac{u_{e}^{3}}{v_{\infty}^{2}}\right)R_{e_{Tr}} - 1.34$$
where
$$R_{e_{Tr}} = \frac{u_{e}x_{Tr}}{v_{\infty}}$$

(35)

The effect of this transition region correction can be seen in figure 4 which compares experimental data to theoretical calculations for local skin friction with and without the above correction on a two-dimensional ellipse. This transitional effect will be assumed to be the same for axisymmetric bodies.

Boundary layer transition location. - The location of boundary layer transition from laminar to turbulent flow can be either input to the boundary layer method or calculated internally within the program. The approach used to calculate the transition location is one developed for two-dimensional flow by Michel (Reference 31) and later verified by Smith (Reference 32). This method correlates the local momentum thickness Reynolds number, R_{θ} and the local distance Reynolds number, R_{χ} , as shown in figure 5 which comes from Reference 32. The procedure used is to calculate the values of R_{χ} and R_{θ} at each station and to compare them to the curve in figure 5. If the value of R_{θ} is less than the value of $R_{\theta TR}$ than transition has not been reached but if the value of R_{θ} is greater than $R_{\theta TR}$ then transition has occurred.

The above method was extended to axisymmetric flow by the use of Mangler's transformation. The parameters R_{θ} and R_{x} are calculated by the axisymmetric boundary layer routine and they are then transformed to two-dimensional values by the following relationships:

$$\theta_{2-D} = \left(\frac{r_{o}}{L}\right) \theta_{AXISYMMETRIC}$$
(36a)
$$X_{2-D} = \int_{0}^{x_{LOCAL}} \left(\frac{r_{o}}{L}\right)^{2} (dX)_{AXISYMMETRIC}$$
(36b)

These values of θ_{2-D} and X_{2-D} are used to determine values of R_{θ} and R_{y} which can be used in conjunction with figure 5.

A study of transition location calculation for axisymmetric bodies was recently completed by Kaups (Reference 33). In this study empirical methods due to Granville, Hall and Gibbons, and the method of Michel presented above were compared to the stability analysis technique of Smith (Reference 32). It was determined that for flows where transition occurred in an adverse pressure gradient all of the above techniques predicted transition fairly accurately. For flows where transition occurred in favorable pressure gradients, only the method of Smith (Reference 32) gave satisfactory results as chown in figure 6 which is taken from Reference 33. The method of Smith, however, requires extremely lengthy computer calculation times which makes it undesirable for the iterative type of calculation presented in this report. Therefore, based on the results of Reference 33, the method of predicting transition in the present program should not be used for flows with very large Reynolds numbers where the transition point should be input to the program.

Calculation Procedure

The viscous flow field about an axisymmetric body is simulated by calculating the inviscid flow about an equivalent "viscous" body which is formed by adding the boundary layer displacement thickness to the original body surface. This technique of defining the inviscid body has been used quite successfully for two-dimensional flows as shown in Reference 2 and has also been used for axisymmetric flows as presented in Reference 34. This equivalent body is formed by combining the previously discussed geometry routine, potential flow method, and boundary layer method under control of the axisymmetric design and analysis method computer program known as ADAM.

Given the desired axisymmetric configuration and flow conditions, the ADAM program utilizes these sections, as shown in figure 7, in the following iterative manner:

1. Precise geometry definition for input into the potential flow program.

- 2. Calculation of the exact nonlinear potential flow for specified geometry and flow conditions.
- 3. Calculation of the viscous flow characteristics based on the results of the potential flow program.
- 4. Addition of boundary-layer displacement thickness to the basic geometry for each element.
- 5. Recalculation of the pressure distribution utilizing the potential flow program, based on the redefined geometry.
- 6. Recalculation of viscous flow field based on recalculated pressure distribution from redefined geometry, if desired.
- 7. Possible iteration of the above scheme; the degree to which this is required is presented in the subsequent discussion on correlations with experimental data.

The above technique must be modified when the boundary layer separates or when the local body radius approaches zero at the trailing edge of the body. When the dimension of the local body radius approaches zero at the trailing edge, the boundary layer equations become invalid since the 1/r term in equation (3) approaches infinity. When this occurs, the boundary layer results are ignored from this point downstream to the trailing edge. The assumption is then made that the boundary layer displacement area at the point where

$$\delta^* \cos \alpha = r_0$$
 , is the set of decree dimension of the (37).

is defined by

DAREA =
$$\pi \left\{ \left(r_{o_p} + \delta^* \cos \alpha_p \right)^2 - r_{o_p}^2 \right\}$$
 (38)

where p refers to the point where equation (37) is first satisfied. This displacement area is then considered to remain constant from the point p to the trailing edge. The new "viscous" body coordinates in this region are then defined by

$$y_{new} = \left\{ \frac{\pi r_o^2 + DAREA}{\pi} \right\}^{\frac{1}{2}}$$
(39)

The second problem area occurs when the boundary layer separates from

the body creating a separation bubble. This bubble must be accounted for in the creation of a "viscous" body if the flow about this configuration is to be predicted accurately. The simplest technique of modeling this separation bubble is to assume that the flow leaves the surface parallel to the freestream direction, producing a cylindrical wake shape as shown in figure 8. This approach, however, gives decelerations in the flow at the junction of the body with the cylinder as shown in figure 9, which do not exist in the real flow field. To minimize this problem, a circular arc is used to fair the body into the separated cylinder.

This circular arc is defined by passing a circle through the last three "viscous" body coordinates defined prior to the separation point. The radius of this circle is then used to create a circular arc which is tangent to the "viscous" body at the point of separation. The center of this arc is then defined according to whether the surface slope of the body at separation is positive or negative.

If the surface slope is positive then the center is taken as the center of the circle passed through the three points as defined above. This center is defined by

x a gant x = x = t	x + R sin	$\tan^{-1} \left \frac{\mathrm{d}y}{\mathrm{d}x} \right $	e e la Carada de	(40a)
y c =	y _{sep} - R cos	$\tan^{-1} \left \frac{\mathrm{dy}}{\mathrm{dx}} \right $	a an an an ga mala ta Taon an	(40b)
where	R = Radius of t	the circle	n en la companya de l La companya de la comp	
	$\frac{dy}{dx}$ = Surface s	Lope at sep	aration	

This arc is then used from the point of separation to either the end of the body or to the maximum point on the arc, where dy/dx = 0, as shown in figure 10a. If the maximum point of the arc occurs before the trailing edge of the body is reached then a cylinder is defined which extends from the maximum point of the arc to the trailing edge.

If the surface slope is negative then the circular arc is defined such that the center is located above the body. The center is then defined by

$$x_{c} = x_{sep} + R \left[\sin \tan^{-1} \left| \frac{\partial y}{\partial x} \right| \right]$$
(41a)
$$y_{c} = y_{sep} + R \left[\cos \tan^{-1} \left| \frac{\partial y}{\partial x} \right| \right]$$
(41b)

This arc is then used from the point of separation to either the end of the body or to the minimum point on the arc, where dy/dx = 0, as shown in figure 10b. If the minimum point of the arc occurs before the trailing edge of the body then a cylinder is defined which extends from the minimum point of the arc to the trailing edge of the body.

The above separated wake model has been derived from intuitive considerations rather than from first principals. It does, however, provide reasonable results, as will be shown in the subsequent discussion.

The base drag coefficient for blunt axisymmetric bodies is calculated using the method of Hoerner, reference 35. This approach is based on the assumption that the flow field behind a blunt base is basically a jet pump, in that, air flowing around the body leaves the trailing edge forming a cylindrical jet which attempts to pump away the stagnated air in the base region. However, since there is no air to replace this stagnated air, the pumping mechanism can only reduce the static pressure acting on the base. The effectiveness of this jet pump mechanism is controlled by the boundary layer thickness at the base since this region of lower momentum flow acts as a buffer between the stagnated air behind the base and the flow in the jet. Since the boundary layer thickness is directly related to the skin friction on the body, C_f , Hoerner used C_f to correlate with the base drag to develop an empirical approach to determine base drag. Figure 11 shows the correlation obtained by Hoerner for bodies whose base area is the same as the maximum area. This curve is represented by

$$C_{D_{BASE}} = .029 / \sqrt{C_{f_{Forebody}}}$$
 (42)

where the coefficients are based on the base area. Thus, once the skin friction on the forebody has been calculated in the boundary layer programs, then the base drag can be determined by equation 42. This equation must be modified for boat-tailed bodies, that is, bodies whose base area is less than their maximum area. The mechanics of the base drag for these configurations do not change, but the calculation must take into account the reduced base area. This effect is taken into account by the following relationship:

and

so

(BOAT TAIL)

 $C_{D_{BASE}} \cdot \left(\frac{d_{BASE}}{D_{MAX}}\right)^{2}$ (42a) = $C_{f_{B}} \cdot \left(\frac{D_{MAX}}{d_{BASE}}\right)^{2}$ (43b)

(43c)

$$C_{D_{BASE}} = \frac{.029}{\sqrt{C_{f_B}}} \cdot \left(\frac{d_{BASE}}{D_{MAX}}\right)^3$$

BOAT TAIL

A comparison of results calculated by the above method in ADAM with experimental force data from reference 35 is presented in figure 12. One of these cases is for a boat-tailed body and the other for a body whose base area is also the maximum area.

The experimental data used for this comparison as well as the configuration used for the analytical calculations are both subject to some discussion. The experimental base drag, taken from Figure 4 of Reference 35, originally came from an old German report which is not readily available. These base drag values were obtained from both force measurements and pressure measurements which unfortunately do not agree. Therefore, since it was felt that the force measurements were the more accurate, they were used in the comparison shown in Figure 12. In addition, no good definition of the configuration tested was available, therefore, the geometry used in the ADAM analysis was taken from the schematics shown in Reference 35. In light of these uncertainties the comparison presented in Figure 12 is fairly good in that even though the levels are different, the trends are the same. It should be noted that this comparison was used only because there is a singular lack of experimental data for blunt based axisymmetric bodies at low subsonic Mach numbers.

EXPERIMENTAL CORRELATIONS

Experimental results from three different configurations were selected to establish the extent of validity of the method presented in this report. These geometries consisted of a high fineness ratio body of revolution, and a sphere in both subcritical and supercritical flow regimes. These correlations, while limited to some extent by the scope of the present effort, do represent a wide range of axisymmetric flow conditions.

The body of revolution chosen was tested in the low speed wind tunnel at the Douglas Aircraft Company, (Reference 36), and is shown in figure 13. This model was composed of three sections; an elliptical nose section, a cylindrical control section, and a parabolic afterbody. The calculation done for this configuration used the wind tunnel flow properties, namely, $U_m = 71.628$ M/Sec (235 Ft/Sec), $T_{\infty} = 288.3^{\circ}$ K (519.0°R) and $R_{T} = 10.05 \times 10^{6}$. Boundary layer transition was fixed on the model and in the calculation at .03048 meters (1.2 inches) from the nose. This model was relatively large for the wind tunnel in which it was tested; wall effects, not accounted for in the original data reduction, were present. To correct for this, the model was run in the potential flow program in the presence of the wind tunnel walls as shown in figure 14. The effect of including the walls in the calculation is shown in the inviscid pressure distributions of figure 15. The final results for this configuration are shown in figure 16 where the calculated "viscous" results are compared to experimental data. The inviscid distribution is also shown for reference. In this particular case no separation occurred and so only one iteration, that is, two potential flow solutions and two boundary layer solutions, was necessary. The calculated "viscous" results agree very well with the experimental values except in the region of the nose. This discrepancy is not due to the calculation method, but rather is due to the model being too long for the wind tunnel test section resulting in the nose being in a different static pressure field than the rest of the body. The overall effect of viscosity on this configuration is seen to be small except in the region of the trailing edge. The body is so slender in this region that the boundary layer equations are no longer valid so the technique described in the calculation procedure was used to modify the viscous body. The results show a pressure osciliation

in this modified region which is due to an unsmooth curvature distribution. However, the level of these pressures agree quite well with the experimental values.

The second case considered was that of a sphere in the supercritical flow regime, i.e., $R_{\rm D} = 1 \times 10^6$. Since the boundary layer transition was forced to occur at an X/D = .65, there were regions of both laminar and turbulent flow present. The experimental data for this case were taken from references 37 and 38. The freestream velocity assumed for this case was 47.85 M/Sec (157 Ft/Sec). Figure 17 shows the sphere with the "viscous" body superimposed and figure 18 presents a comparison between the calculated "viscous" solution and experimental data. Note that while the calculated pressure distribution is in reasonably good agreement with the experimental values, the calculated separation point is .07 diameters further downstream than the experimentally measured value. The inviscid and "viscous" solutions for the local skin friction coefficient, C_{f} , are presented in figure 19. The "viscious" solution shown is the fourth iteration, i.e., the fifth potential flow solution, and appears to be the best solution possible for this configuration with the technique being used in the present method to simulate flow separation.

The last correlation to be presented is for the flow about a sphere in the subcritical regime, i.e., $R_D = 1 \times 10^5$, which is a purely laminar case. The experimental data is again taken from Reference 37. The freesteam velocity for this case was assumed to be 4.785 M/Sec (15.7 Ft/Sec). The calculated "viscous" body is shown in figure 20 while a comparison of the "viscous" pressure distribution to experimental data is shown in figure 21. The calculated "viscous" pressures are in close agreement with the experimental values with some slight over-prediction in the separated region. The calculated separation point is only .03 diameters further downstream than the experimental value which is excellent considering the large effect that viscosity has on this configuration. Figure 22 presents the inviscid and "viscous" solutions for the local skin friction coefficient for this case.

A method has been presented for the computation of the viscous flow field about axisymmetric bodies at zero angle of attack in incompressible flow. This computing program requires only the specified body geometry and desired flow conditions as input. The appropriate theory has been discussed and correlations between theoretical and experimental results presented.

The flow field about axisymmetric bodies at zero angle of attack with no flow separation is well defined and can be computed accurately by the present method. When flow separation occurs, the flow field is no longer amenable to analytical treatment. Currently, methods do not exist to calculate the flow field within a separated region; it is therefore necessary to resort to empirical methods to account for flow separation. Since there is almost a complete lack of experimental data concerning the behavior of separated regions, any empirical methods must necessarily be somewhat crude. The most sophisticated model for separation currently available is due to Jacob (References 39 and 40) and is strictly for two-dimensional airfoils. An unsuccessful attempt was made in Reference 41 to adapt Jacob's approach to axisymmetric configurations. The conclusions of Reference 41 indicated that the assumed boundary conditions needed to be modified if this approach was to be used for axisymmetric flow. It is proposed that the Douglas-Neumann program be used to pursue this approach at modeling separation. This potential flow program is ideal for attempting to use Jacob's technique since it already has the ability to specify a non-uniform flow distribution over all or part of a configuration; therefore, only suitable boundary conditions would have to be added to the program. It is felt that this approach can be successful in modeling separation if care is taken in developing the distribution of non-uniform velocity as well as specifying the proper boundary considerations.

The further extension of this model to the calculation of flow about axisymmetric bodies at angle of attack is also possible. The potential flow routine contained in the present method has the capability of predicting the flow field about non-lifting bodies at angle of attack by combining the streamflow and the crossflow solutions. The boundary layer analysis would require the replacement of the routine in the present method by a three-dimensional technique, which is currently not available. However, it is felt that a good approximation to the boundary layer calculations can be made by the small crossflow program of Reference 42.

One area of primary concern in extending the method to include an angle of attack capability is the determination of the separation line about the The present method of predicting separation for two-dimensional bodies body. and for axisymmetric bodies at zero angle of attack is to find the location where the skin friction goes to zero. It has been shown in several studies, including those reported in References 43 and 44, that this condition does not apply in three-dimensional flows because the skin friction along a separation line is not necessarily zero. Therefore, some method of determining the separation line for axisymmetric bodies at angle of attack must be developed. It is proposed that the present method could be extended to calculate the "viscous" flow about axisymmetric bodies at angle of attack when no flow separation is present. This method could then be used to assist in the development of a procedure for determining the separation line location. Once the location of the separation line is known then a model could be developed for analyzing the viscous flow about the separated body. The development of such procedures is not a simple task and considerable effort would have to be expended; but the reward for accomplishing this task is an advance in the ability to calculate the real flow about arbitrary three-dimensional bodies which is our ultimate goal.

APPENDIX A

INPUT INFORMATION FOR ADAM COMPUTER PROGRAM

This part of the report contains the necessary information to input data to the ADAM computer program. The input data is broken into three sections: smoothing, potential flow, and viscous flow. These sections can be used together in the iterative fashion described in the main text, or the potential flow and viscous flow sections may be used independently. A detailed card-by-card description of all input quantities is given followed by a set of input forms which can be used to facilitate the loading of the input data into the program. The Adam program requires one system control card followed by the required sets of data cards for each program option to be executed. The sets of data furnished must be in the same order as the options are specified on the system control card. If an iteration is desired the system control card is repeated along with the necessary other data cards.

The general scheme used in describing the input data is shown below:

		Routine	
Column	Code	Format	Explanation

- Column Column indicates the starting position on the card for each data field.
- Code The "code" gives the FORTRAN name used in the read statement by the program.
- Routine "Routine" indicates the subroutine where the data is read.
- Format The parameter "FORMAT" which is given right under the routine name, indicates the FORTRAN format of the data read statement field. The parameter I5 would indicate that the parameter is an integer in a field that is 5 columns wide. Integers should be punched on the right side of the field (right justified). The parameter F10.0 would indicate a fixed point number punched with a decimal point (i.e., -12.354). The number may be punched anywhere in the field indicated irrespective of the decimal point location indicatied by the format. The parameter E12.6 would indicate a floating point number punched with a decimal point (i.e., 5.0 x 10⁶). The number must be punched to the right of the field in the manner 5.0E+06.

Explanation - The description of the input data is given under "explanation".

SUSTEM	CONTROL DATA CARD	(This card mu	st be the first card in the data deck)
Column	Code	Routine Format	Explanation
4	IGEOM	MAIN	Smoothing option flag
		11	
			=0 no smoothing is desired
			=1 smoothing is desired
8	INEUM	MAIN Il	Potential flow option flag
			=0 No potential flow solution is desired
			Potential flow solution is desired
12	IBOUND	MAIN	Boundary layer option flag
		11 (1997) 11	
			=0 No boundary layer solution is desired
			=1 Boundary layer solution is desired
16	ITER	MAIN	"Viscous" body formation flag
			=0 No "viscous" body is formed =1 "Viscous" body is formed
17-20	IFINSH	MAIN	Termination Flag
		I4	=0 Another case expected
	an an an Arrange ann an Arrange ann Arrange ann an Arrange ann an Arrange Arrange ann an Arrange		=9999 Program will stop after exer- cising all options specified above

SMOOTHING SECTION

These cards required if IGEOM = 1 on system control card. This section is used to smooth body geometry data before it is input to the potential flow program.

Smoothing	Control	Card
And in case of the local data and the local data an		Construction of the local division of the lo

Column	Code	Routine Format	Explanation
2	NPTS	SMOOTH I3	Number of input data points for this configuration. NPTS must be ≤ 100
8	ITAPE	Smooth 11	Data source flag =0 Data input on unit 5 (card input)
			#0 Data input on unit 1. This is used for a case where a "viscous" body generated by the iteration

procedure is being read.

Geometry Data Input Cards

These cards are input only if ITAPE = 0.

Column	Code	Routine Format	Explanation
x-coord	inate cards		
1-10 11-20 21-30	x(1) x(2) x(3) etc.	SMOOTH 6F10.0	x-coordinates starting at the leading edge and proceeding along the upper surface to the trailing edge. Input 6 x-values on each card. The numbers of x-values must be equal to NPTS.
y-coord	inate cards		
1-10 11-20 21-30	y(1) y(2) y(3) etc.	SMOOTH 6F10.0	y-coordinates to correspond to the above x-locations. y-values must be positive. Input 6 values per card.

POTENTIAL FLOW SECTION

These cards required if INEUM = 1 on system control card. The input geometry for this program may be obtained from the geometry storage unit (10) as generated by the smoothing section, or it may be input directly on unit 5. Thus, this program may be operated as a separate entry if so desired. The program saves the geometry data element midpoints with the corresponding pressure coefficients on unit 3 for input to the boundary layer routine and it saves the basic non-dimentional input Neumann coordinates on unit 1 for use if a "visous' body is desired.

Title Card

<u>Column</u>	Code	Routine Format	Explanation
1	HEDR	PART1 10A6	Title of case. May be any characters input in the first 60 columns of card:
63	CASE	PART1 16	Case number with the second of the second
77	PSF	PART1 16	Additional identifier for this case.

Flag Card

Card columns 1-30 when punched with any non-zero integer, activate

flags that	indicate the following:	
Column	Code Routin Format	Explanation
1	NB PARTI Il	The number of bodies input. Normally set equal to 1. $1 \le NB \le 5$
2	NNU PARTI	The number of non-uniform onset flows. Normally set equal to 0.
3	FLG03 PART1	Axisymmetric flow flag.
	11	=0 No axisymmetric stream-flow solution calculated.
		• • • • • • • • • • • •

=1 Axisymmetric streamflow solution is calculated

Normally set equal to 1

Flag Card	(Continue	d)		
Column	Code	Routine Format		Explanation
4	FLG04	PART1	Cros	ss flow flag.
		11 14 19 - 19 - 19 - 19 - 19 - 19 - 19 - 1	=0	No cross flow solution is calculated
			=1	Cross flow solution is calculated
			Nort	mally set equal to 0
5	FLG05	PART1	Off-	-body point flag
		1. a	=0	No off body points input
			a]	Off body points are input
			Thi poi	This flag allows the velocity at points off the body surface to be determined.
			det	
6	FLG06	PARTI	Bas	sic data formation flag
		II Ang ang ang ang ang ang ang ang ang ang a	=0	A full case will be done
			The basic data, i.e., midpoints, normals, etc. will be formed and printed. No velocities will be	
				calculated.
7	FLG07	PART1	E11:	ipse generator option
		I1	=0	Body coordinates will be input
			=]	An ellipse is generated using data input later. No body coordinates are input
8	FLG08	a do a serie da la PARTI andre serie da la II da la filo na dase da la contra da serie	Mat	rix print flag
			=0	Coefficient matrices are not printed.
			=]	Coefficient matrices will be printed.
			Nori	mally set equal to O
11	FLG11	PART1	Per	turbation velocity flag
		11 	=0	Normal case
			=1	No onset flow used. Only per- turbation velocities are calculated
12	FLG12	PART1	Pot	tential matrix solution *
		11	=0	Normal case
			=1	A potential matrix is solved
Flag Card	(Continued)			
-----------	---	-------------------	--	
Column	Code	Routine Format	Explanation	
13	FLG13	PART1 11	Matrix solution flag =0 No matrix solution done	
			<pre>>> Matrix solution performed</pre>	
.,		+ B	Normally set equal to 1.	
14	FLG14	PARTL Il	Prescribed tangential velocity flag " =0 Normal case	
			=1 Tangential velocities are specified	
15	FLG15	PART1	Strip ring vorticity flag *	
		I1	=0 Normal case	
			=1 A vorticity distribution is formulated.	
16	FLG16	PART1	Axisymmetric uniform flow flag	
		11 (b)	=0 Normal case	
	a ka shekara na shekara A ka shekara na shekara Shekara		=1 Axisymmetric uniform flow solution is omitted	
			Normally set equal to 0.	
17	FLG17	PART1 I1	Crossflow uniform flow flag	
			=0 Normal case	
			=1 Crossflow uniform flow solution is omitted.	
			Since FLGO4 is normally = 0 then so is FLG17 normally set equal to 0.	
18	FLG18	PART1 Il	Surface vorticity flag *	
			=0 Normal case	
			=1 Surface vorticity is generated.	
19	FLG19	PART1 I1	Prescribed vorticity Flag *	
			=0 Normal case	
			=1 A prescribed vorticity is input	
20	FLG20	PART1 Il	Total vorticity flag *	
		_	=0 Normal case	

=1 Total vorticity calculated

Flag Card (C	ontinued)		
Column	Code	Routine Format	Explanation
21	FLG21	PART1	Extra crossflow flag *
			=0 Normal case
			=1 Extra crossflow option used
22	FLG22	PART1	Generated boundary condition flag *
		11	=0 Normal case
			=1 Boundary conditions generated
23	FLG23	PART1	Ring wing option flag *
			=0 Normal case
			=1 Ring wing option used
28-29	NIN ANA ANA ANA ANA ANA ANA ANA ANA ANA	PART1 12	Tape input flag
			=0, 10 Data input on unit 10 from smoothing program
			=5 Data input from unit 5 (card input)
30	ITER	PART1	Iteration tape flag
			=0 x/c, y/c transformed data saved on unit 15
			<pre>=1 x/c, y/c transformed data not saved.</pre>
			This flag is necessary because for a "viscous" body to be formed, the
			coordinates of the original unmodified body must be saved. Therefore, for
			subsequent iterations we do not want to use the modified bodies to form
	£		new bodies so set ITER = 1.

 These flags are for special options which are discussed in the main text. They are never used for a normal axisymmetric calculation. Therefore, set them equal to zero.

Chord Card

Column	Code	Routine Format	Explanation
1	CHORD	PART1 F10.0	Reference chord length used to non-dimensionalize x and y coordinates
11	MN	PART1 F10.0	Mach number (MN < 1.0) use to approximate effect of compressi- bility (Gothert's rule)
21	TCNST	PART1 F10.0	This is a constant which is used for the value of the tangential velocity if this option is desired.

Body Transformation Card

Column	Code	Routine Format	Explanation
8	NN	BASIC1 I3	The number of input points on this body. NN ≤ 100
11	MX	BASIC1 F10.0	A factor used to multiply all x-coordinates. MX is assumed equal to 1 if no value is input.
21	MY	BASIC1 F10.0	A factor used to multiply all y- coordinates. MY is assumed equal to l if no value is input.
31	THETA	BASIC1 F10.0	An angle (in degrees) through which all points of a body are to be rotated about the origin in the clockwise direction.
41	ADDX	BASIC1 F10.0	A constant to be added to all x-coordinates
51	ADDY	BASIC1 F10.0	A constant to be added to all y-coordinates

Body Control	Card		
Column	Code	Routine Format	Explanation
10	BDN	BASIC1 I1	Body sequence number. This program will handle up to 5 bodies.
20	SUBKS	BASIC1	Subcase Flag.
		I1	=0 Normal case
			=1 Use unmodified coordinates of the previous case.
30	NLF	BASICI	Non-lifting flag
		11	=0 Body is non-lifting (normal case)
			=1 Body is lifting (this is used in special option)
			in special option,
31	XE SANTAL	BASICI F10.0	Value of major semi-axis for use by ellipse generation option.
41	YE	BASIC1 F10.0	Value of minor semi-axis for use by ellipse generation option
			Note: if XE = YE a sphere will be formed.

Geometry Data Cards

The body geometry data cards are included only if the input parameters NIN = 5 and FLG07 = 0 on the flag card. If NIN = 0 or 10 then the data is read from unit 10. If NIN = 5 and BDN = 0, then the following cards contain the x-y coordinates of off-body points instead of x-y geometry data. The number of either geometry data point or off-body points must be equal to NN.

x-Coordinate cards	(six	values	per	card))
		a support of the second s	and the second s	the second s	

Column	Code	Routine Format	Explanation
1	TX1(1)	BASIC1 6F10.0	x-coordinates of body input from leading to trailing edge.
11	TX1(2)		
21	TX1(3)		

y-Coord	inate cards	(six values per card)) – status se
Column	Code	Routine Format	Explanation
1	TY1(1)	BASIC1 6F10.0	y-Coordinates of body which correspond to the x-values above. y values must be positive.
11	TY1(2)		
21	TY1(3)		
	etc.		

NOTE: Each body input, including the off body points, requires the body transformation card, the body control card, and may also require the geometry data cards depending on the input flags. This is the stopping place for a normal axisymmetric case. The following cards are input only if one of the special options is required.

Tangential Velocity Data (six values per card)

These cards are input only if FLG14 \neq 0 and TCNST = 0.0

Column	Code	Routine Format	Explanat	fon		
1	TG(1)	BASIC1 6F10.0	Specified tange element midpoin	ntial ts.	velocities	at
11	TG(2)					
21	TG(3)					
et	с.					

Non-uniform Flow Cards (six values per card)

These cards are input only if NNU $\neq 0$.

Column	Code	Routine Format	Explanation
6	NUM AND ADDRESS OF	BASIC2 15	Non-uniform flow identification number.

Non-unif	orm Flow Cards	(Continued)	
Column	Code	Routine Format	Explanation
19 Markau Markau	MSF	BASIC2 I2	If MSF = 0 the flow velocities N ₀ ,T ₀ will be used for the axisym- metric case only.
			If MSF = 1 the flow velocities N _o ,T _o will be used for the cross flow case only.
			If MSF > 1 the flow velocities will be used for both axisymmetric and cross flow cases.
21	TYPE	BASIC2 F10.0	Flag which specifies the type of input flow velocities at each mid-point. If TYPE > 0.0, the velocities are input as x & y components.
			If TYPE = 0.0 the velocities are input as normal & tangential components.
			If TYPE < 0.0 the automatic generation of the flow due to a rotating body is used.
31	FG	BASIC2 F10.0	Constant used by the flow generator. Type must be less than 0.0.

The following cards are input only if NNU $\neq 0$ and TYPE $\neq -1.0$.

Normal velocity cards (six values per card)

Column	Code	Routine Format	Explanation
1	NO(1)	BASIC2	This is either the x or normal velocity component depending on the value of type above. These values must be in sequence with the coordi- nate data. If the x component is input it is defined as positive to the right. If the normal velocity is input it is positive if it is to the interior of the body. NN-1 values are input.

Tangential Velocity Cards (six values per card)

Column	CodeRoutineFormat	Explanation
1	TO(1) BASIC2 6F10.0	This is either the y or tangential velocity component depending on the value of type above. These values

must correspon to the NO values above. If the y component is input it is

defined as positive if it is orientated upwards. If the tangential velocity is input it is positive if the flow field is to the left of the vector representing the tangential velocity.

These cards required if IBOUND = 1.

BOUNDARY LAYER PROGRAM

The geometry and pressure distribution data required by this program may be input directly on cards (Unit 5), or read from the data save unit (Unit 3) as generated by the Neumann program.

HEADER CARD

This card is supplied purely for description purposes.

Column	Code	Routine Format	Explanation
1-60	and a second part TITLE and the	INPT 15A4	Description of input
61	CASE	INPT A4	Case number

Flag Control Card

This card contains flags which control the type of flow to be considered and the form of the input.

Column	Code	Routine <u>Format</u>	Explanation
1	NXT (194 1971 - 1944 A	INPT I4	The number of the x-station where the flow goes turbulent measured from the stagnation point (i.e., the leading
			edge for axisymmetric bodies at zero angle of attack) if transition is to be calculated by the program set NXT
			to be one greater than the number of points input.
5	LG16	INPT	Transition flag
		11	=0 Boundary layer transition point is input

All Arrest and Arrest a

A. A set of the set

=1 Boundary layer transition point is computed. Set NXT to be greater than number of points input.

Flag Control Card (Continued)

Column	Code	Routine Format	Explanation
6	LG17	INPT Il	Transition control flag
			=0 Transition is instantaneous
			=1 Transition is gradual (transitional region used)
7	LG18	INPT	Transverse curvature flag
		11	=0 No transverse curvature correction used.
		1999 yang seriesi	=1 Transverse curvature corrections applied.
8	LG32	INPT	Print control flag
		e il See Ageneral of A	=0 Print using long format (with velocity profiles)
		trian	=1 Use short printout (no velocity profiles)
9	LG26	INPT	Velocity input control flag
	•	11	=2 Velocity ratio (U_e/U_{∞}) is input
			=3 Pressure coefficient (c) is input.
10	LG40	INPT I1	Unit input flag for geometry and velocity data.
			=0 Data read from unit 3 as generated by the potential flow program.
			≠0 Data read from cards (unit 5)
11	LG41	INPT	System of units FLAG
	engli in the state english angle an eise		=0 English system of units
			=1 Internation system of units
tent of a state			
Flow Conditi	on Card		
Column	<u>Code</u>	Routine Format	Explanation
1	TI	INPT	Reference static temperature used to

F10.0

Reference static temperature used to compute the reference fluid properties. If TI is input as zero then TI is set equal to either 288.33°K or 519°R depending on FLAG LG41

Flow Condition Card (Continued)

Column	Code	Routine Format	Explanation
11	RMI	INPT F10.0	Reference or free-stream Mach number.
			=0.0 UI is input next
			≠0.0 UI is computed from RMI.
21	na UI Na UI Na Angelana angelana	INPT F10.0	Reference or free-stream velocity
			=0.0 M_{∞} is input above
			≠0.0 M _∞ input as zero above.
31	FK	INPT F10.0	Flow index
			=0.0 2-D flow assumed
			=1.0 Axisymmetric flow assumed
41	RL	INPT F10.0	Chord or reference length
51	RI	INPT E12.0	Reynolds number/foot $R_{c}/\ell = \frac{U_{\infty}}{v}$

If CHORD = 1.0 then RI must be Reynolds number based on CHORD.

NOTE: The input of either Mach number or freestream velocity is for convenience only. This program is entirely incompressible.

Radius card

Column	Code	Routine Format	Explanation
1	ROMAX	INPT F10.0	Maximum radius of body. This is used to obtain frontal area for skin friction calculation.
11	DETA1	INPT F10.0	Initial step size of boundary layer velocity profile grid. For a case which contains turbulent flow set DETA1 = .005.

Radius card (continued)

Column	Code	Routine Format	Explanation
21	VGP	INPUT F10.0	VGP is the growth factor for the boundary layer velocity profile grid; for cases with turbulent flow set equal to 1.14.
			NOTE: For laminar cases the boundary layer velocity profile grid may be made constant if VGP = 1.0 is input. However, if this is done the minimum value of DETA1 that can be input is approxi- mately .10. This can be calcu- lated if the value of the transformed boundary layer thickness, ETAINF, in known. Then DETA1 becomes
			$DETA1 = \frac{ETAINF}{100}$

Geometry-Pressure Distribution Cards

These cards input only if $LG40 \neq 0$.

Point Number Card

Column	Code	Routine Format	Explanation
1	NXM	INPT I4	Number of data points to be input. Maximum of 100 points allowed.
x-Coordinate	Data Cards	i	
<u>Column</u>	Code	Routine Format	Explanation
1	XS(1)	INPT	x-coordinate points input from
11	XS(2)	6F10.0	leading to trailing edge input 6 points per card. Number of points
21	XS(3)		= NXM
etc.			
y-Coordinate	Data Cards		
<u>Column</u>	Code	Routine Format	Explanation
1	YS(1)	INPT 6F10.0	y-coordinate points corresponding to x-coordinates above input 6 points

per card.

y-Coordinate Data Cards (continued)

Column	Code	Routine Format
11	¥S(2)	
21	¥S(3)	
etc	•	

Pressure Distribution Cards

Column	Code	Routine Format	Explanation
1	UE(1)	INPT 6F10.0	Velocity-pressure-distribution points corresponding to x-points input above
11	UE(2)		input 6 points per card.
21	UE(3)		If LG26 = 2 u_e/U_{∞} input
etc	•		$LG20 = 5 C_p$ input

Explanation

				= 1 FIVE-POINT SMOOTHING	= 1 NEUMANN ROUTINE USED	 BOUNDARY LAYER SOLUTION WILL BE DONE 	<pre>= 1 A "VISCOUS" BODY WILL BE CREATED</pre>	ED = 9999 THIS IS THE LAST CASE	PHONE
				NO SMOOTHING REQUIRED	NO POTENTIAL FLOW	NO BOUNDARY LAYER SOLUTION DESIRED	NO "VISCOUS" SOLUTION IS DESIRED	ANOTHER CASE IS EXPECTE	ENGINEER
			ATA GARI	0	0	0	0	= 0000	
			CONTROL D	IGEOM	INEUM	IBOUND	ITER	IFINSH	suu
IFINSH	-	20	SYSTEM (cc 4	сс 8	cc 12	cc 16	cc 17	ypunch: ank colur
ITER		1.6							to Ke nch bl
LBOUND		12							ctions not pu
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AXISYMMETRIC DESIGN AND ANALYSIS METHOD

ပ္ပ

ADAM



SMOOTHING PROGRAM











ADAM



Instructions to Keypunch Do not punch blank columns

ENGINEER PHONE PHONE DATE · · · PAGE OF

COORDINATE DATA OR VELOCITY CARDS

L	X(I) V(I)	(I)X	X(I) X(I)	X(I) X	X(I)	X(I) X(I)
	CP(I)	r(L) CP(I)	CL (1)	r(1) CP(1)	r(1) CP (1)	$\operatorname{CP}(\mathrm{I})$
് റ	2 3 4 5 6 7 8 9 10	11/12/13/14/15/16/17/18/19/20	21222324252627282930	31 22 33 34 35 36 37 38 3940	<1/2 43 44 5 46 4 7 48 4 950	515253545555657585960
					111111111	
		111111	11111111	1111111		
		111111111	111111111	1111111111		
أسرمع						
		- - - -				

THE POTENTIAL FLOW PROGRAM, AND THE BOUNDARY LAYER ROUTINE. THIS FORM IS ALSO USED FOR VELOCITY DATA INPUT TO THE BOUNDARY LAYER PROGRAM AND FOR THE NON-UNIFORM VELOCITY DATA WHICH CAN BE INPUT TO THE POTENTIAL FLOW ROUTINE. THIS INPUT FORM IS THE SAME FOR GEOMETRY DATA INPUT TO THE SMOOTHING ROUTINE,

APPENDIX B

CONTROL INFORMATION FOR ADAM COMPUTER PROGRAM

This part of the report contains the necessary control information to operate this program on a computer system. This section contains the overlay structure as well as flow charts of the main subroutines including input flow information. Also, the various data sets used between main programs are described.











BASIC FLOW CHART FOR SUBROUTINE BASIC1

























The following is a description of the output symbols from the various sections of the ADAM computer program:

NEUMANN POTENTIAL FLOW SUBPROGRAM

SYMBOL	DESCRIPTION
ADDED MASS	Σ2π · Phi · V _n ·ds
AJK	Influence coefficients W_{jk} resolved parallel to the outward normal of the element. Output only if FLG08 = 1.
ADDX	Constant which is added to all X-coordinates of a particular body. Value printed out for each body.
ADDY	Constant which is added to all Y-coordinates of a particular body. Value printed out for each body.
BJK	Influence coefficient \mathbb{W}_{jk} resolved parallel to the tangent direction of the element.
BODIES	Number of bodies in system, same as NB input on flag card.
BODY NO.	Number of this particular body. This parameter input on body control card.
CHORD	The reference chord for the system.
COSA	The cosine of DALPHA
CP	The pressure coefficient on a body element.
DALPHA	The change in angle between consecutive elements of a body. (degrees)
DELTAS	The length of a body element.
MACH NO.	Mach number used in Gothert's transformation.
MX	The factor by which all X-coordinates are multiplied for one body. Input on body transformation card.
MY	'The factor by which all Y-coordinates are multiplied for one body. Input on body transformation card.
SYMBOL	DESCRIPTION
----------------	--
N	Velocity normal to a surface element, this is a measure of how well the boundary condition of zero normal velocity is satisfied.
NN	The number of geometry data points for a given body. This is input on the body transformation card.
NNU	The number of non-uniform onset flows to be considered.
PHI	Value of potential on each surface element.
PSF NO.	Identification for this case
SIGMA	Source density on each surface element.
SINA	Sin of DALPHA
SUM(T) DELTA(S	3) This is the summation of T multiplied by Deltas up to each element midpoint.
SUMDS	Summation of Deltas, surface distance around the body.
TCNST	Constant value of tangential velocity used in special option.
THETA	The angle through which a body is to be rotated about the origin in a clockwise direction.
TI	The velocity at each midpoint.
VOLUME	The volume of the body being analyzed. (calculated by Neumann)
X	The input X-coordinate defining the body surface, or off-body X-coordinates.
XE	The value of semi-major axis used in ellipse generation option.
Y	The input Y-coordinates defining the body surface, or off-body Y-coordinates.
YE	The value of semi-minor axis used in ellipse generation option.

OUTPUT DATA SYMBOLS

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Finite Difference Boundary Layer Subprogram

Output of this routine consists of CASE DATA and STATION DATA inputs as well as the computed STATION DATA. Body geometry data, flags and counters, and reference quantities are printed out under the heading of CASE DATA. Values of parameters at the outer edge of the boundary layer as well as the boundary condition inputs are printed out under the heading of STATION DATA. These are followed by iteration results, velocity profiles for each x-station (if FLG32 = 0), and a summary of the computed boundary-layer parameters as functions of streamwise or x-distance.

Error messages generated by the program are printed out at the end of the STATION DATA printout if they are generated by input errors. Other error messages are issued at different locations in the profile printout if errors are detected during the computations.

SYMBOL

DESCRIPTION

ALPH1	Local body slope dy/dx.	
ALPH2	Not used in this program. The control of the contro	
BETA	$\beta = (2\xi/u_e)(du_e/d\xi) $	
с		
CDBASE	Base drag coefficient.	
CF	$c_f = \tau_w / (1/2 u_e^2)$, value of local skin friction coefficient.	•
CFA	Total integrated skin friction to each point.	
с _р	Pressure coefficient	
DELS	Boundary layer displacement thickness.	
DELVW	Delta $V(1,2)$ used in iteration for $V(1,2)$	
EPS	ε^+ , eddy viscosity parameter for outer region.	
EPS1	ϵ_1 , eddy viscosity parameter for inner region.	
ETA	n, non-dimensionalized boundary layer thickness to each	
	point in the boundary layer.	

SYMBOL	DESCRIPTION
ETAE	η_{ω} value of η which corresponds to δ .
ETAINF	Non-dimensional boundary layer thickness used as maximum. value in forming numerical solution grid.
F,FP,FPP	f,f',f", respectively.
FPPW	f" at the wall.
FPW	$f' = U/U_e$ at the wall.
FW	f_w , this is the transformed stream function at the wall.
	$f_{w} = -\frac{1}{(2\xi)^{1/2}} \int_{0}^{\xi} \frac{v_{w}}{\mu_{e} u_{e}} d\xi$
GW Second States and Second	Not used in this method.
GPW	Not used in this method.
н	Boundary layer form factor, $H = \delta^*/\theta$
HE	Enthalpy
H1	Initial step size, same as DETAl in input.
IMAX	Number of points taken through the boundary layer.
К	Initial step size of the variable grid system.
KK	Variable grid parameter chosen internally.
ME	Local Mach number.
MUE	Local dynamic viscosity, μ_e , at edge of boundary layer.
MREF	Free stream Mach number.
MUREF	Free stream dynamic viscosity, μ_{∞} .
PE	Pressure at edge of boundary layer, Pe.
PRO	Laminar Prandtl number.
QW	Not used in this program.
REY	Reynolds number based on reference conditions (see input)

SYMBOL	DESCRIPTION	
RHOREF	Freestream reference density.	
R _o /C	R ₀ /L axisymmetric radius.	
RR	Not used by this program.	
RTHETA	Momentum thickness Reynolds number, R ₀ .	
R _x	Reynolds number based on local conditions.	
	$R_x = \frac{u_e x}{v}$	
S	Surface distance.	
S/C	Nondimensionalized surface distance.	
SHORTP	Flag which tells program to print velocity profiles.	
	Same as FLG32 in input.	
SQUIG	Transformed x-coordinate, ξ $\xi = \int_{0}^{x} \rho_{e}^{\mu} e^{u} e^{\left(\frac{r_{o}}{L}\right)^{2k}} dx$	
ST	Not used in this program.	
SWEEP	Not used in this program.	
TE	Temperature through boundary layer. Not needed for this	
	program.	
THETA	Momentum thickness, θ.	
TREF	Reference temperature, T_{∞} .	
TRFLAG	Flag which determines transition (input).	
TRINT	Flag which determines instantaneous transition or use o transitional region option (input).	f
TW	Temperature at the wall. Not used in this program.	
TVC	Transverse curvature flag (input).	
UE	Velocity at edge of boundary layer.	
UPLUS	Non-dimensionlized velocity in the boundary layer.	

SYMBOL	DESCRIPTION	
X	X-coordinate	10 - 10 10 - 10
x/c	Non-dimensionalized x-coordinate	
XI	Transformed x-coordinate - same as SQUIG	- 23 23 2 2 2 2
Y	Y-coordinate	
Y/C	Non-dimensionalized y-coordinate	
YPLUS	Non-dimensionalized y-coordinate in boundary layer.	
VREF	Reference velocity (input)	

Iteration Subprogram

XNEW and YNEW These are the coordinates of the equivalent viscous body. The original coordinates modified by the addition of the boundary layer displacement thickness δ^* .

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DESCRIPTION OF STORAGE UNITS

The following is a description of all disk storage units used in ADAM:

TAPE	DESCRIPTION
TAPE1	This unit used in subroutine SOLVIT as a scratch unit and also used to transfer the "viscous" coordinates from subroutine iterat to subroutine smooth or sub- routine BASIC1.
TAPE2	This unit used in subroutine SOLVIT as a scratch unit and also used to transfer the boundary layer displace- ment thickness's from subroutine OTPT to subroutine ITERAT.
TAPE3	This unit used to store source densities in subroutine SOLVIT and used to transfer body geometry and pressures from subroutine AXIS to subroutine INPT.
TAPE4	sin α , cos α , TCNST, TG(I), cos \mathbb{R}^2 , 2 (sin α) (cos α) , N _o , T _o , V _N , T _T , A(J), B(J), etc. Used exclusively in Neumann subprogram to store and
TAPE5	transfer data. This tape used for card input.
TAPE6	This tape used for printed output.
TAPE8	This tape used to store extra cross flow matrices, EC , ECY, ECZ, in subroutine MATRIX.
таре9	This tape used to store axisymmetric flow matrices AS, AY, AZ, in subroutine MATRIX.
TAPE10	This tape used to store cross flow matrices CX, CY, CZ in subroutine matrix and also used to transfer smoothed

TAPE		DESCRIPTION	
TAPE10	(Continued)	coordinate data from subroutine smooth to subroutine BASIC1.	5
TAPE11		This tape used as a scratch unit in subroutine SOLVI	[T.
TAPE12		This tape used to store transformed parameters X1, X2, Y2, and ΔS_i .	Yl,
TAPE13		This tape used to store untransformed coordinates (TX1, TY1) for use in SUBCASE option.	
TAPE15		This tape used to store transformed coordinates, (X1, Y1) for use in subroutine ITERAT.	
		$(x_1, y_1) = (x_1, y_2) + (x_2, y_3) + (x_1, y_2) + (x_2, y_3) + (x_3, y_3) + (x_$	

APPENDIX C

PROGRAM LISTINGS

This part of the report contains the source card listings for the axisymmetric design and analysis method (ADAM) computer program. This program may be run either on a CDC or an IBM computer. The listing as presented here is for the CDC version of the program. This program has been run on the CDC 6600 computer. The program is written in FORTRAN for the CDC run compiler and has been run under the scope 3.1 and 3.4 operating systems. In this listing all cards that are peculiar to the CDC version of FORTRAN are identified by a C in card column 80. All cards that are peculiar to the IBM FOR-TRAN IV compiler are identified by an I in card column 80 and a C in card column 1. In other words, the code for both CDC and IBM machines is in the deck but the IBM cards are made inactive by converting them to comment statements (C in card column 1). Since all of the machine dependent cards are identified by an I or C in card column 80 it is a simple matter to convert the deck from one version to the other with a small conversion program. When converting from CDC to IBM code this conversion program reads and copies each card to a storage unit. If a card has a C in card column 80, then a C is written into card column 1 to make the CDC peculiar card inactive. If a card has an I in card bolumn 80, then the C is removed from card column 1 and the card image written to the storage unit as an active FORTRAN statement. The conversion from IBM back to CDC is made in a similar manner. The conversion program to convert the deck from CDC to IBM FORTRAN is listed below (for use on an IBM machine):

> DIMENSION DATA(22) DATA CB,CC,CI/1H, 1HC,1HI/ REWIND 19 DO 100 I=1,20000 READ (5,20,END=300) DATA 20 FORMAT (1A1,19A4,1A2,1A1) IF (DATA(22) .EQ. CJ) DATA(1) = CB IF (DATA(22) .EQ. CC) DATA(1) = CC WRITE (19,20) DATA 100 CONTINUE 300 STOP END

This program places the new deck with IEM cards made active, and CDC cards inactive, on to unit 19. The references to unit 19 above can be changed to unit 7 to punch the deck out.

OVERLAY (AXSY,0,0)	MAIN	0010
PRAGRAM MAIN(INPUT=201,OUTPUT, TAPES=INPUT,TAPE6=017PUT,	MAIN	0020
1 TAPE1=201, TAPE2=201, TAPE3=201, TAPE4=201, TAPE8=201,	MAIN	0030
2 TAPE9#201, TAPE10#201, TAPE11#201, TAPE12#201, TAPE13#201, TAPF15#201)	MAIN	0040
BBAC MAIN PRIGRAM	MATN	002
	MAIN	000
THIS IS THE AXISYMMETRIC DESIGN AND ANALYSIS METHOD , ADAM,	MAIN	007
COMPUTER PROGRAM, THIS COMPUTER PROGRAM WILL CALCULATE THE	MAIN	800
AERODYNAMIC FORCES ACTING DN AN AXISYMMETRIC BODY OPERATING	MAIN	000
IN A VISCOUS INCOMPRESSIBLE FLOW FIELD	MAIN	000
	MAIN	3 3 0 0 8 8
1 FORMAT(SI4)	MAIN	012
	MAIN	013
2 READ(5,1) IGEOM, INEUM, IBOUND, ITER, IFINSH	MAIN	010
	MAIN	015
THESE FOUR FLAGS DETERMINE WHICH ROUTINES WILL HE USED	MAIN	016
	N I V M	017
ICEOM CONTROLS THE GEOMETRY DEFINITION	MAIN	010
IF IGEOM # 0 NO SMOOTHING IS USED	MAIN	000
IF IGEOM # 1 SMOOTHING IS USED	MAIN	020
	MAIN	021
INEUM INDICATES WHETHER OR NOT A POTENTIAL FLOW SOLUTION WILL	MAIN	022
	NAIN	025
IF INEUM # 0 NO POTENTIAL FLOW SOLUTION IS USED	MAIN	024
IF INEUM # 1 A POTENTIAL FLOW SOLUTION IS USED	NIN	025
	MAIN	026
IBRUND INDICATES WHETHER OR NOT A BOUNDARY LAYER SOLUTION IS	MAIN	027
DESIRED	MAIN	020
IF IBOUND # 0 NO BOUNDARY LAYER SOLUTION IS NEEDED	MAIN	020
IF IBDUND = 1 A BOUNDARY LAVER SOLUTION IS NEEDED	MAIN	020
	MAIN	031
ITER CONTROLS THE ITERATION CYCLE	MATN	220
IF ITER = 0 NO ITERATION IS NEEDED	MAIN	033
YF ITER = I AN ITERATION IS NEEDED	MAIN	030
	MAIN	S NO

MAIN

	IGEOM B 36EOM + 1	MAIN	030
		MAIN	120
	TENUND = IBOUND + I	MAIN	030
		ZIVA	039
U		NAIN	040
r	GU TU (30,20), IGEUM	MAIN	041
ັບ		MAIN	0 4 2
C 20	CALL SMD0TH	NAIN	1200
202	CALL UVERLAY (4HAXSY, 6, 0, 6HRECALL)	NIW	0440
υ		MAIN	50
30	GO TO (60,50), INEUM	NIVM	910
ں د		MAIN	100
50	CALL NEUMAN	NIN	040
υ υ		MAIN	049
60	GO TO (90,80), IRUIND	NAIN	020
υ υ		NIVW	051
C 80	CALL BOUNDL	MAIN	0521
60	CALL DVERLAY(4HAXSY,5,0,6HRECALL)	MAIN	0530
υ		NIVM	920
60	GO TO (120,110), ITER	MAIN	055
J		MAIN	920
C 110	CALL ITERAT	MAIN	1420
110	CALL OVERLAY (4HAXSY, 7,0,6HRECALL)	MAIN	0580
ں ا		MAIN	039
120	IF (IFINSH "NE" 9999) GD 70 2	MAIN	000
U		MAIN	061
. U	STOP	MAIN	0621
200	CONTINUE	MAIN	063C
		MAIN	064

MAIN

SUBROUTIN	E NFUMAN					NEUM	001
<u>م</u>	* DUUGLAS	S NFUMANN PI	MENTIAL FLOW P	RUGRAM **		NEUM	200
						NEUM	003
	* CALCULA	VIION OF POI	ENTIAL FLOW AB	10UT BODIES	OF	NEUM	007
	REVOLUT	ILUN HAVING	FLUWS PARALLEL	AND PERPEN	IDICULAR	NEUM	005
	TO THE	AXIS OF REV	OLUTION.			NEUM	000
						NEUM	001
	A MAIN PR	ROGRAM				NEUM	000
						NEUM	000
COMMON /I	PSF PSF					NEUM	010
COMMON /	NBSAVE /	' NROLD, NIN				MUMA	011
COMMON	HEDRCI	O) CASE	, NG	NNN °		NEUM	012
~	, FLG03	, FLG04	, FLGOS	,FLG06	, FLG07	NEUM	013
NJ	, FLGOR	° FLG09	, FLG10	eFLG11	, FLG12	NEUM	014
М	, FLG13	PLG14	FLG15	,FLG16	, FLG17	NEUM	015
7	, FLG18	01974°	FLGZD	, FLG21	FLG22	NEUM	010
ഗ	, FLG23	, FLG24	FLG25	,FLG26	, FLG27	NEUM	017
NOWWOU	NT 。	ND(11),	MMP NINA	(5), TYPEA	1(5),	NEUM	010
9 -56	NERIS	NERZ	NMA, NSIG	A, NSIGC		NEUM	010
N	NUNC (S) .	TYPEC(5)	NLF(11), IFC,	NOIGE	<i>د</i> ،	NEUM	0 N 0
M	TYPFEC (5)) NUNEC (5)				NEUM	021
COMMUN/I7	ERF/ 1TEF	~				NEUM	27 0 7
DOUBLE PR	ECISION	HEDR, CASE				NEUM	0231
INTEGER	FLG03	, FLG04	, FLGOS	, FLG06	, FLG07	NECM	4 X O
	, FLG08	, FLG09	, FLG10	erc11	, FLG12	NEUM	025
2 2 2 2	0 FLG13	PLG14	FLG15	FLG16	, FLG17	NEUM	020
M	FLG18	,FLG19	, FLG20	6FLG21	, FLG22	NEUM	720
ан ал ал ал ал ал ал ал ал	, FLG23	, FLG24	, FLG25	, FLG26	, FLG27	NEUM	028
REAL	NM					NUMN	029
	0					NEUM	020
						NEUM	120
REWIND 3						NEUM	N NO
REWIND 4						NEUM	033
REWIND 8						NEUM	034
REWIND 9						NEUM	SMO

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NEUM

NEUM

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※ ※ ※ ※ ※ ※ ※ ※ ※ ※ ※ ※ ※ ※ ※ ※ ※ ※ ※			
(4HAXSY,1,0,6HRECALL) 0) GO TO 50 (4HAXSY,5,0,6HRECALL) (4HAXSY,4,0,6HRECALL)			
REWIND 10 REWIND 10 REWIND 12 REWIND 12 REWIND 12 REWIND 13 Call PARTA 40 Call PARTA 40 Call PARTA 40 Call OVERLAV 50 RETURN 50 RETURN			

NECW

ISXI

ATIC INTERPALATION 5 Une variarie 2	ເ N N N N N N N	
CONF VARTARIF	I S Z I	100
		トマン
	ISNI	004
TE FOR ETTHER	INSI	500
X VRS F(X), DR	ISNI	000
TABLE OF X VRS F(X),G(X),	ISNI	007
, SPACING IN X, EITHER LINEAR	Isni	000
ERPOLATION MAY RE USED,	1 8 N I	000
	Isai	010
	ISAI	110
2 T T	ISNI	NIC VIC
	IONI	015
JEAR ARRAY, THE FIRST WORD IS AN	ISNI	010
CODE (EITHER INTEGER FORM OR REAL &	I SZ I	015
IF THIS CODE IS POSITIVE, THE CODE	ISNI	010
ES THE NUMBER OF X,F(X) PAIRS	ISNI	017
FLY FOLLOWING THE CODE IN SUCCESSIVE	INNI	018
IF THE CODF IS NEGATIVE,	ISNI	010
E VALUE OF THE CODE SPECIFIES THE	ISNI	020
JF X,F(X),G(X) TRIPLES IMMEDIATELY	ISNI	021
IG THE CODE IN SUCCESSIVE WORDS.	ISNI	220
LUES MUST BE IN ASCENDING ORDER.	ISNI	023
OR THE CADE THE INPUT TABLE VALUES	ISNI	024
IN REAL#4 FORM	ISNI	025
	ISUI	026
.ATED VALUE UF F(X) IF TABLE(1) IS	ISNI	027
JIIVE	ISNI	028
JRD ARMAY (IF TABLE(1) IS NFGATIVE)	ISZI	020
ITAING THE INTERPOLATED VALUES	ISNI	020
R F(X) AND G(X)	ioz I	120
	ISNI	032
.ATION FLAG (INTEGER) REFERENCE	IONI	033
INEAR INTERPOLATION	ISNI	034
NUADRATIC INTERPOLATION	ISNI	032
X MONOMH FOIDH ANAL AND Y H COF IVA DAX HHOCF HXC Q HA HY AXHM MHOLA HAC Q HA HY HIVA DAX HHOC Q HA HY HIVA DAX DAX Q A HUTLOR IN MCCU SKA	<pre>RRAY, THE FIRST WORD IS AN (EITHER INTEGER FORM OR REAL*4 (EITHER INTEGER FORM OR REAL*4 (EITHER INTEGER FORM OR REAL*4 IS CODE IS POSITIVE, THE CODE NUMBER OF X,F(X) PAIRS OLLOWING THE CODE IN SUCCESSIVE COLLOWING THE CODE IN SUCCESSIVE (X),G(X) TRIPLES IMMEDIATELY (X),G(X) THE INPUT TABLE VALUES (X),G(X) THE INPUT TABLE (I) IS (THE INTERPOLATED VALUES THE INTERPOLATED VALUES (INTERPOLATION IILC INTERPOLATION (IIC INTERPOLATION)</pre>	<pre>/// ION MAY RE USED. /RAY, THE FIRST WORD IS AN (EITHER INTEGER FORM OR REAL ** (EITHER INTEGER FORM OR REAL ** (EITHER INTEGER FORM OR REAL ** (IS CODE IS POSITIVE, THE CODE NUMBER OF X,F(X) PAIRS (OLLOWING THE CODE IN SUCCESSIVE INS) (OLLOWING THE CODE IN SUCCESSIVE INS) (OLLOWING THE CODE IN SUCCESSIVE INS) (CLOUT THE CODE IN SUCCESSIVE INS) (CLODE IN SUCCESSIVE WORDS, (X), 6(X) TRIPLES IMMEDIATELY (X), 6(X) TRIPLES IMMEDIATELY INS) (CODE IN SUCCESSIVE WORDS, NUST BE IN ASCENDING ORDER, INS) (K), 6(X) TRIPLES IMMEDIATELY INS) (K), 7, 7, 7, 7, 7, 7, 7, 7, 7, 7, 7, 7, 7,</pre>

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063 065 064 990 190 068 0690 054 020 120 030 020 090 00 062 040 033 620 0 10 0 230 2043 0.41.41 500 9.170 1007 040 049 036 037 041 I S Z I ISNI ISUI ISNI ISNI INSI ISNI ISZI SOZI I SOZI ISSI INGI ເ S S Z I S Z I ISZI ISNI ISNI Isal l NSI ISZ] S S Z I SN] I S Z I 0 Z BELOW TARLE, MINIMUM VALUE FURNISHED Above table, Maximum value furnished 8 X-VALUES NUT IN ASCENDING URDER NOT ENUUGH ENTRIES - NO ANSWER FOR ARGUMENT LESS THAN OR EQUAL TO LOW LIMIT INTERPOLATION SUCCESSFUL ERRUR CODE (INTEGER) NDENTR = A + 0.5E0 ANSWERS M 000 60 TO 10 - TABLE(2))40,50,60 鸙 70 20 60 70 Σ CHECK FOR NUMBER OF ENTRIES DIMENSION OTPT(2), TABLE(1) TABLE(1) .LT. 0.0) ~ N M 3 M 09 0,99E0) EQUIVALENCE (NOFNTR, ~ NDENTR .LT. 3) 11 11 11 81 11 M NOENTR GE 2 DUTPUT ABSC TABLE(1)) NLO NF. ، رو آ ا 11 ARG 140 130 9 T N NER X ~ Ĵ J 1 CHECK 60 10 N I C II N 60 10 NER U u 83 ٨ £ \sim P NER ν Σ n 99 100 H T Å M ند. هم <u>لم</u> 1 <u>نم</u> ا 4 **«** 2 2 0 **c** 20 0 ວິດ υuu

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990 000 960 098 660 000 0 0 0 0 0 0 0 0 0 0 0 0 104 076 079 60 00 000000 003 110 072 273 074 075 110 078 000 100 200 0 003 9004 900 **₩** 000 100 10 0 0 100 ISNI ISNI ISZI ISZI ISZI i s z i ISZI I N S I TON T ISNI ISNI ISNI i S Z Z Z Z Isai S N N TOZI Z ISZI ISNI I S Z I ISNI ISZI ŝ TABLE(I) TABLE(I) (TABLE(I) TABLF(I) 8 ARG 8 ARG - TABLE(I"7)) * C AKG TABLE(I-MM1) * (- TABLE(I-M) SEARCH SUCCESSFUL, TEST INTERPOLATION TYPE TABLE(1-1) TABLE(I) - TABLE(I=M))70,70,80 (TABLE(I-M) - TABLE(I)) TABLE(I) A RG IF (TABLE(I) - ARG)90,50,100 ENTRY WITHIN TABLE GO TO 110 60 10 140 USE QUADRATIC INTERPOLATION . 4 USE LINEAR INTERPOLATION TARLE(I-M)) TABLE(I-M) T TABLE(I+2) TABLE(I-7) TABLE (I+1) E IST, NOS, IF (NLO "GT" 1) ~ NOFNTR ۲ 网 n Z Z Z Ž SFARCH FUR 俶 (1)GO TO 140 GO TO 140 X GU TN 130 GO TO 130 رح 2 CONTINUE Ł Σ ŧ NER **N** ۵ 00 Ø NER R N **6**-----OTPT 1910 וו וו H ----N E R NUS ∎ S ¶ 5 00 <u>ند</u> N -C] J 100 60 68 06 20 U U U υυυ υυυ $\mathbf{u} \mathbf{u} \mathbf{u}$

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Ê N N N 0 5 5 X X X N N N O I I X X X ~ ~ ~ ~ ~ 齿 敛 = TABLE(J+1) i o x X A O TABLF(I+MP1) + (XA0 * (XA1 ~ SET OUTPUT VALUE XAO (XA1 XAO TARLE(I=M) = TARLE(I) TARLE(J=M) = TARLE(I+M) - TABLE(I+M) GU TO 120 (2) M "NE. 3) GU TU 140 TABLE(1+1) * 7 ABLE(1+2) * TABLE(1+5) * TAHLE (T-MM1) TARLE(I-1) * M . E.Q. 3) () TPT TARLF(I-M) ARG = TABLE(I+M) TABLE (J) TARLF(I) 。GE。 2*M) TABLE(I) Ð = (1) ARG = ARG -= (1) NUPMAL EXIT FRRUR FXIT (2) X † Gn TN 140 RETURN н н н н н н н н н н н н 11 # 6 0 X TF (TF (130 07PT TIPT XA1: END N 140 0 2 J $\cup \cup \cup$ υυυ

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2 Z Z Z Z Z N C O O O O O Z Z Z Z Z Z Z Z Z Z Z Z Z Z Z Z Z Z												
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DVERLAY	(AXSY,1,0)						0010
	TNF DARTS						
				·		d A A A A	800
	A CONTROL	FOR BASIC	DATA AND FORM	MATRIX		PARI	002
						PARI	900
COMMON	/ NBSAVE /	N NBOLD, N	N			PAR 2	007
NUMMOU	/SNGWNG/	/A(100,2),	VR(100.2), VAN	V(100), VATC	100)	Pari 1	008
NC M MOU	/ECF/ ECX(1	100) ECY(1)	00) · ECZ(100)			PARI	000
COMMON	10/ 01, 03	So XMXJo YM	Y "I GLXWX "LA	AVJPI S		PARI	010
CUMMON	MEDR()	10) , CASE	Z B	NNN °		PARI	110
-	, FLG03	, FLG04	FLGOS	, FLG06	, FLG07	PARI	012
N	FLG08	, FLG09	FLGIO	FLG11	, FLG12	Par:	013
м	FLG13	°FLG14	, FLG15	,FLG16	,FLG17	Par:	014
7	FLG18	FLG19	FLGZO	FLG21	, FLG22	DAR!	s I o
ر د:	, FLG23	, FLG24	, FLG25	FLG26	, FLG27	PARI	010
COMMON	NT.	ND(11) "	MN. NUN	VA(S), TYPE	A(5),	PAR I	017
6	NER1 .	NER2 "	NMA NO	IGA, NSIG	C°	PARI	010
N	NUNC (S) .	TYPEC(5),	NLF(11), IF(NSIG	۲C ,	PARI	010
M	TYPEEC (5)	, NUNEC (S)	3			PARI	020
DOUBLE	PRECISION	HEDR, CASE				DARI	0211
INTEGER	FLG03	FLGO4	, FLGOS	FLGOG	, FLG07	PARI	0 2 2 2
g~d	FLGOB	FLGNG	FLGID	, FLG11	, FLG12	PAR1	023
N	FLG13	FLG14	FLGLS	PLG16	, FLG17	PARI	きべつ
R	, FLG18	FLG19	FLGZO	FLG21	, FLG22	PARI	025
\$, FLG23	FLG24	, FLG25	, F L.G26	, FLG27	PARI	026
COMMOD	/IPSF/ PSF		•			PARI	027
REAL	Z					PAR!	0 Z 0
						PARI	029
COMMON	CL/ XICI	100), YICI	00), X2(100),	, YZ(100),	DELS(100),	PARI	020
danĝ	NIS	A(100), CUSA	(100) xP(100)	, YP(100)		D A R I	031
N	, XWAP	KE(11) , YWAK	E(11)			PARI	032
COMMON	17L/ 7X11	(100), TY1(100) , NG(100)	, TG(100),	ALFACIOOD	PARI	033
1 RSDS(100), DALF (100), CHORD,	TCNST, DUMMY (1)	315)		PARI	034
COMMON/	ITERF/ ITER	âr				PARI	580

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	INTEGER	BDN	, SUBKS					PARI	036
	REAL	X	¢ ¤ ۸	, NG				PARI	037
υ υ								l a a a	038
ن	*	START						PARI	039
U	. 4	READ INPUT	DATA					PARI	040
100	READ (5,4)	HEDR, CASE,	PSF , NBP	NNU, FLGO	3, FLG04,	FLGOS, F	: 1606,	PARI	1001
	9	FLGO7, FLGO	08, FLG09,	FLG10, FLG	11, FLG12,	FLG13,	FLGIA	PARI	042
	~3	FIG15, FLG1	16. FLG17.	FLG18, FLG	19. FLG20,	FLG21	FLG220	PARI	2003
	2	FLG23, FLG2	24, FLG25,	FLG26, FLG	27 0	NIN, IT	LER	PARI	944
CAAA	AAATRIANGUL	ARIZATION OF	THE MATRI	X (SOLVIT)	IS THE DE	FAULT SC	DLUTION	PARI	570
	IF (FL G09 E	0°0°AND FLGI	IO EG O)FLG	13=1				PARI	046
C & & &	***FLG22	IS GFNERATEC) (RESEP) B	OUNDARY CO	SNUITIONS			Pari 1	047
Cyss	AAAFLG21 .	IS EXTRA CRC	JSS FLOW					PARI	040
-	IF (FLG22,	LE_0)GN 70 5						PARI	670
	FLG21 = 1							PARI	020
	FLG03 = 1							PARI	051
	FLG04 = 1							PARI	032
CAAA	*** IF FLA	G 18 IS NOT	EQUAL TO F	LAG 14 YOU	MUST USE	DIRECT	AATRIX	PARI	053
S	IF (FLG18	NE FLG14)GO	10 2					PARI	\$S0
	IF (FLG21.	LE 0) GU TO 3						PARI	050
	FLG12 = 1							PARI	036
N	FLG13 = 1							PARI	057
	FLG09 = 0							PARI	059
	FLG10 = 0							PARI	059
1 40	CONTINUE							PARI	000
	IF (NBOLD	, EQ, 0)	NBULD	10 20 11				Par1	061
CAAA	AAACARDS (U	NIT 5) ARE 1	THE DEFAULT	METHUN OF	INPUT			PARS	062
	IF(NIN °	EQ. 0)						PARI	063
ヮ	FORMAT (1	OA6 2X A6.	8X 44/ 271	1. I2.II)				PARI	064
	READ (5,8)	CHURD, MN,	TCNST					PARI	06S
C	FORMAT (3)	FID.0)						PARL	990
Casa	AAATHE DEFA	ULT CHORD LE	NGTH IS 1.	C				PARS.	047
	TF (CHURD, G	1	VD.CHURD.LT	. 1. OF	ORD#1.0			P A R 1	068
	TALLE (0.1.	A) HEDR, CAN	SE, NG, NNU		N. TONGT.	100			000
PU 	FURMAT (1	HI ASX, VOND	DUNCE AS AL	RCRAFT COM	PANY /			PARL	010

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PAR

080 080 094 50 0 960 000 005 NO T 10 & 076 078 010 084 005 000 000 093 700 660 202 00 20 073 074 075 077 080 7 **0** 0 N 0 0 083 087 000 002 50 5 PAR 9 8 8 9 8 9 1 8 8 PARI PARI PARI DARI PAR! PARI PARI PARI PARI PAR1 PAR1 PARI PARI PARI PAR PARI PARI PARI PAR PARI PAR PAR #F12.7/ ((TIVJOS) 43HPRDGRAM EODA -- AXISYMMETRIC AND CROSSFLOW // =13/ 6X 9HCHORD SULUTION BY TRIANGULARIZATION 2F12.7/ 294***** CASE CONTROL DATA ***** /// 1046, 4X, 10HCASE NO. A6 // FORMAT (13X 30HPRESCRIBED TANGENTIAL VELOCITY) JF (FLG18,67,0) WRITF (6,69) MATRIX SOLUTION) 94MACH NO .= F12 .8/ 6X 94TCNST DIVISIUN /// VORTICITY) FURMAT (13X 22HSOLVE POTENTIAL MATRIX) TF (FLG03,GT_0) WRITE (6,16) FORMAT (13X 21HSURFACE UF REVOLUTION) =13/ 6X 9HNNU ONLY) IF (FLG07.GT.0) WRITE (6.32) FURMAT (13X 17HELLIPSE GENERATOR 94PSF NO. # A4///) FORMAT (15% 15HOFF=BODY POINTS FURMAT (15X 15HBASIC DATA DNLY FORMAT (13X 10HULD SEIDEL) IF (FLG10.GT.0) WRITE (6,44) FORMAT(13X,31HMODIFIED SEIDEL IF (FLG11.GT.0) WRITE (6,48) FORMAT (13X 14HPRINT MATRICES IF (FLG09,6T.0) WRITE (6,40) FORMAT (13X 18HPERTURBATIONS IF (FLG12,GT_0) WRITE (6,52) FURMAT (15X 22HWITH SURFACE [F (FLG06,61,0) WRITE (6,28) (F (FLG05,GT.0) WRITE (6,24) IF (FLG08,61,0) WRITE (6,36) IF (FLG13,GT.O) WRITE (6,56) IF (FLG14,G1.0) WHITE (6,53) IF (FLG15,67,0) WRITE (6,54) JF (FLG04,GT_0) WRITE (6,20) FURMAT (13X 12HSTRIP VORTEX REACH 9HCRUSSFLOW) FORMAT (13X UTHMATRIX 9 HRIDDIES PINLONG FURMAT (13X ъХ° 6 X , 2 8 X ° 11X a × 9 × × 9 M 3 S S 2 202 2 2 đ N 2 **9**8 25 s S 5 \$ 54 07 40 с С

PARS

PARI

	IF (FLG16°GT°O) WRITE (6,64)	PARI	106
64	FORMAT (13X 40HOMIT AXT=SYMMETRIC UNIFORM FLOW SOLUTION)	2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2	107
	IF (FLG17,GT_0) WRITE (6,68)	PARI	108
68	FORMAT (13X 36HOMIT CROSSFLOW UNIFORM FLOW SOLUTION)	PARS	109
	IF (FLG19,GT_0) WRITE (6,72)	PARI	110
12	FORMAT (13X ZOHPRESCRIBED VORTICITY)	P A R	
	IF (FLG20 gGT g)WRITE(6,74)	PARI	217
74	FORMAT(13X 15HTDTAL VORTICITY)	PARI	123
	IF (FLG21 "GT" O)WRITE(6.76)	PAR	114
76	FORMAT (13X 16HEXTRA CROSS FLOW)	9 A A C	115
	IF (FLG22 "GT, 0)WRITE(6.78)	PARI	126
84	FORMAT(13X 82HGENERATED BUUNDARY CONDITIONS FOR 3 AXISYMMETRIC, 1	9 A 9 1	1 2 2
ent.	CRUSS, AND 1 EXTRA CROSS FLOW。)	PARI	8 7 7
	IF (FLG23 %LF% 0)60 TO 81	PARI	6 7 7
	WRITE(6,79)	PAR	120
6 M	FORMAT(13X 16HRING WING OPTION)	d A A A A	121
	FLG03 = 1	Pari	122
	$F[G_13 = 1]$	Pari Sari	125
	FLG15 = 1	PARI	124
		Para	5
8	IF (FLG19 .67, 0)FLG18 = 1	d A A A A A	126
	IF (FLG22°GT°0°AND°NB°NE°2) GO TO 82	D A Q	121
	60 TO 84	0 A R S	128
₹ 8	WRITE(6,83)	PAR1	129
©3	FURMAT (128H0 WHEN GENERATED RESEP BOUNDARY CONDITIONS ARE USED, NU	PARI	130
-	MBER OF BUDIES MUST BE EXACTLY TWO, YOU GONFED, EXECUTION TERM	PAR	131
N	INATING,)	PARI	22
	STOP	PARI	1 2 3 1
84	IF (FLG22.67,0.AND.NNU.GT.0)GO TO 86	PARI	134
	G0 T0 88	PARI	135
9 9 9	WRITE (6,87)	PAR	136
4- 60	FORMAT (984A GENERATED RESEP BOUNDARY CONDITIONS CANNOT MAVE NON-U	PARI	137
ç=4	NIFORM FLOW INPUT, EXECUTION TERMINATING,)	N N N	130
90 90	CONTINUE	PAR	129
	WRITE (6075) NIN	PAR	140

PARI

IF (FLG18, LE.0.0R, FLG14, GT.0) GU TO 125		
15 FILKMAIL (JAP)DALATOI LAFE NUG TUK TUUKULMAITO ANU MUNHUMITUKM TUU Ab oniv i ve v		9 X 9 X 9 X
TO FURMAT (140//63H FLG14 MUST BE USFD WITH FLG18 OR FLG19. EXECUTIO	PAR	
IN TERMINATED.)	PARI	146
STOP	PARI	147
125 IF (NNU, LE, 0, DR, FLG14, LE, 0) GU TO 130	PARI	1 4 8
WRITE (6,60)	PARI	671
60 FORMAT (140// 494 COLUMNS 2 AND 14 OF FLAG CARD ARE BUTH NON-ZERO,	PARI	200
A / 43H ILLEGAL COMBINATION, EXECUTION TERMINATED,)	0 V N V	5
STUP	PARI	152
C R READ DATA AND SETUP FOR UNIFORM FLOW	PARI	153
130 CALL BASICI	PARS	50
C*** ***NSIGA AND NSIGC ULTIMATELY BECOME THE NUMBER OR RIGHT MAND SIDES	PARI	153
C*** ***IN AXISYMMFTRIC FLOW AND CROSS FLOW RESPECTIVELY	PAR1	\$
133 NSIGAEO	PAR	157
IF (FLG03,GT_0,AND,FLG16,LE,0) NSIGA#1	P A R 1	5
NSIGCEO NSIGCEO	PAR	5
IF (FLG04°GT_0°AND_FLG17_LE_0) NSIGC=1	PARI	160
IF (FLG22,GT,0) GO TO 136	PARI	161
DO 135 I = 1,5	PARI	162
NUNA(I) = 123456	PARI	163
135 TYPEA(I) = 100.	PARI	164
IF(FLG23,GT, 0)60 TO 141	PARI	165
GO TO 138	PARI	166
CAAA AAAPREPARE NUNA AND TYPEA FOR NON-UNIFORM AXISYMMETRIC FLOW,GENER	PARI	167
C*** ***(RESEP) BOUNDARY CONDITIONS	PARI	168
136 DU 137 I = 1,3	PARI	169
NUNA(I) = I	PARI	170
137 TYPEA(I) = 100°0	PARI	1 2 2 3 4 3 4 3 4 5 3 4 5 4 5 5 5 5 5 5 5 5 5
GO TO 138	PARI	172
	PAR	173
	PARI	179
C *** RING WING OPTION	PARI	173

PAR

*** STRIP VURTEX FLOWS ALREADY MAVE NUNA(I) = 123456	5 8 8 8	176
*** MAKE PRESCRIBED VORTICITY FLOWS NUNA(J) = TO THEIR FLOW NO. J	PARI	415
	PARI	178
141 ICNT = 0	PARI	179
DO 142 I = 1,NB	PARI	180
JF(NLF(I) ,GT, 0) GU TD 142	PAR1	101
ICNT # ICNT + 1	PARI	102
142 CONTINUE	PARI	103
	PARI	1961
*** ICNT IS THF NUMBER OF LIFTING BUDIES	PARI	105
*** NUMBER OF FLOWS IS 2 & ICNT & 1	PARI	186
	PAR1	187
NFLOWS B 2 + ICNT + 1	pari	198
ICNTP2 = ICNT + 2	PARI	100
DO 143 I # ICNTP2,NFLOWS	PARI	190
143 NUMA(I) = I	Pari	101
138 CONTINUE	PARI	192
** ***IF FLGO2 (NON=UNIFORM FLOW) IS NOT CHECKED INITIALLY, THE FLOW	PARI	193 2
** ***DF CONTROL WILL NEVER REACH BASIC2	PAR1	194
IF (NNU) 140,150,140	Pari	190
* RFAD DATA AND SETUP FOR NON-UNIFORM FLOW	Pari	196
140 CALL BASIC2	Pari	197
150 CONTINUE	Pari	198
160 REWIND 4	Pari	661
IF (NSIGA "LF" 5)GU TO 180	P A R 1	200
170 WRITE(6,172)	PARI	201
172 FURMAT (1H1 75HAXI-SYMMETRIC UR CROSSFIUW NON-UNIFURM FLOWS EXCEED	P A R	202
A 5° EXECUTION TERMINATED)	PARI	203
STOP	PARI	204
180 IF (NSIGC ,GT, 5)60 TO 170	PARI	SOA
IF (FLG15,LE,0,UR,FLG03,GT_0) GU 70 200 Heref / / / / / / / / / / / / / / / / / / /	4 4 8 8 8 8 8	200
ARTIE (0/170) 190 FORMAT (6444)STRIP RING VORTEY OPTION MUST USE SURFACE OF REVOLUTIO		
IN OPTION, / 22H EXECUTION TERMINATED,)	1 & A	0 0 1 N
STOP	DAR	210

PAR1

(+1 5)GU TO 240 ID STRIP VORTEX UNSET FLOWS (ONE FOR EACH LIFTI TNPUT NON-HINIFORM FLOWS EXCEED 5, / MATED.) (1 235 (1 235	0 10 I = 1, NH 10 I = 1, NH VSIGA + 1 . LE. 5 JGU TO 250 F (6,220) F (6,220) TONY PUUS / SHI TNUT TOWN FLOWS (ONE FOR EACH LIFTI ONY PUUS / SHI TNUT TOWN-UNIFORM FLOWS (ONE FOR EACH LIFTI ONY PUUS / SHI TNUT TOWN-TON- TON FLOWS (ONE FOR EACH LIFTI FLG66.NE.0) GU TO 235 FLG66.NE.0) GU TO 235 MARHIX TNUE TNUE		
 (+1) 5)GU TO 250 b STRIP VORTEX ÜNSFT FLUMS (ONE TNPUT NON-IINIFORM FLUMS EXCEED 5 (n) 235 (n) 235 	10 I = 1, NB NLF(I).LE.0) J=J+1 NLF(I).LE.0) J=J+1 VSIGA + 1 .LE. 5)GU TO 240 A (6.220) A (6.220) A (6.220) A (6.220) A TNPUT NON-UNIFOW FLOWS (ONE ODY) PLUS / 34H TNPUT NON-UNIFORM FLOWS (ONE TNUE TNUE TNUE	FOR EACH LIFTI	
1+1 5)60 TO 250 TNPUT NOV-HNIFO NATED.) 1 235	$ \begin{array}{l} \begin{array}{c} & & & & & & & & & & & & & & & & & & &$	DNSFT FLUMS (UNE Am FLUMS EXCEED 5	
	10 11 11 11 11 11 12 13 14 15 15 15 15 15 15 15 15 15 15	1+1 5)60 TO 250 ED STRIP VORTEX TNPUT NON-HNIFO (NATED,) IN 235	

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10 . 2			0 0 0	000
R N			NA C	> >
E N			BASI	00
	NNU		BASI	000
FLGOS	, FLG06	<i>F</i> LG07	BASI	00
FLGIN	FLG11	, FLG12	BASI	00
FLG15	FLG16	e F L G 1 7	BASI	00
FLG20	FLG21	, FLG22	BASI	0
FLG25	, FLG26	, FLG27	8 × 8	C
NUNA	S), TYPE	A(5),	BASI	0
NSIGA	NSIG(BASI	0
1), IEC,	NS I GI	LC .	BASI	°°
•			BASI	0
			BASI	00
FLGOS	, FLG06	, FLG07	BASI	0
FLG10	FLG11	, FLG12	BASI	10
FLG15	, FL, G16	FLG17	BASI	0
FLG20	FLG21	, FLG22	BASI	NO
FLG25	FLG26	, FLG27	BASI	N 0
			BASI	NO
			BASI	NO
			BASI	N O
X2(100),	Y2(100),	DELS(100),	BASI	N O
XP(100)	YP(100)		BASI	20
			BASI	20
NGCIDOD	76(100),	ALFA(100) "	BAGI	20
DUMMY(1315	~		BASI	NO
			BASI	50
NG			BASI	50
			BASI	20
			BASI	50
			BASI	03
			BASI	0
	FLG15 FLG25 FLG35	FLGIS FLGI6 FLG2 FLG2 NUNA(5), FLG16 NSIGA, NSIG NSIGA, NSIG FLG15, FLG16 FLG15, FLG16 FLG20, FLG16 FLG20, FLG26 FLG20, FLG26 FLG20, FLG26 FLG20, FLG26 FLG20, FLG26 FLG20, FLG26 FLG20, FLG26 FLG20, FLG26 FLG20, FLG20, NSIG NG(100), YP(100), NSIG NG(100), TG(100), NSIG NG(100), TG(100), NSIG	FLGIS FLGI6 FLG17 FLG20 FLG20 FLG20 FLG20 FLG25 NUNA(5), TYPEA(5), NSIGA, NSIGC, NSIGA, NSIGC, FLG10 FLG10 FLG10 FLG10 FLG10 FLG20 FLG10 FLG10 FLG10 FLG10 FLG20 FLG20 FLG20 FLG20 FLG20 FLG10 FLG10 FLG20 FLG20 FLG10 FLG10 FLG10 FLG10 FLG20 FLG20 FLG10 F	<pre>FLGIS FLGI6 FLGI7 BASI FLG25 FLG21 FLG27 BASI NUNA(5), TYPEA(5), FLG27 BASI NUNA(5), TYPEA(5), BASI NUNA(5), TYPEA(5), BASI NSIGA, NSIGEC, BASI BASI FLG05 FLG10 FLG07 BASI FLG10 FLG11 FLG17 BASI FLG15 FLG10 FLG17 BASI FLG25 FLG24 FLG27 BASI FLG25 FLG26 FLG27 BASI FLG25 FLG26 FLG27 BASI BASI FLG25 FLG26 FLG27 BASI FLG25 FLG26 FLG27 BASI BASI NG(100), TG(100), DELS(100), BASI BASI NG(100), TG(100), ALFA(100), BASI BASI BASI BASI BASI BASI BASI BASI</pre>

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	KZHAR Katara Katara Katara	BAS1 AAS1	9 M M 0 M 0 V
	IF (FLGO5.NF.O) K2ENB¢1	e s s	038
U	* MAJOR LOUP * NU, OF BODIES + OFF BODY POINTS	RASI	039
		BASI	040
	DU 1000 L=1,K2	BASI	1 10 0
	READ (5,15) NN, MX, MY, THETA, ADDX, ADDY	BASI	042
5	FORMAT (SX IS, SF10.0)	BASI	500
1	READ (5,16) RDN, SUBKS, NLF(L), XF, YE	BASI	044
16	FORMAT (3(5X,15),2F10.0)	BASI	540
C & & & A	**ND(L) IS THE NUMBER OF PRINTS ON BODY L, OR THE NUMBER OF OFF	BASI	046
C & & & &	**BODY POINTS FUR L = NB + 1	BASI	047
·	ND(L) #NN	BASI	040
		BASI	670
	IF (SUBKS) 140,150,140	BASI	020
140		BASI	150
, P	NTIMES & NBOLD - NB REAL AND A REAL AND	BASI	052
	IF (NTIMES "LF." 0) AND GO TO 148 AND	BASI	053
	DO 145 NSKIPS and , NTIMES of a second	BASI	020
5	READ(13) (TX1(I),I=1,NN), (TV1(I),I=1,NN)	BASI	052
ଷ ସ କ	READ(13) (TX1(1), I=1, NN), (TY1(1), I=1, NN)	BASI	050
•	60 TO 220 P	BASI	057
150	IF (BDN,EQ.0) GOTTO 200 STATE AS A	0 A C I	030
	IF (FLG07) 160,200,160 %	BASI	620
ပ ပ	* ELLIPSE GENERATOR FOR X1 AND Y1	BASI	090
160	IF (XE,EQ,0,0) XEE1,	BASI	061
	TF (YF.EQ.O.) YELL, TANK TANK TANK TANK TANK TANK TANK TANK	BASI	062
		BASI	063
	DGAM=3,141593 /FN	BAS1	064
		BASI	065
	DO 170.141.NN NUMBER OF STREET, ST	BASI	060
	TX1(I)=XE+CUS(GAM)	BASI	067
	TYI(I)=YE*SIN(GAM)	BASI	068
170	GAM#CAM=DGAM	BAS!	060
	G0 T0 210	BASI	010

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BASI 071	BASI 072	BAS1 073	BAS1 074	BAS1 075	BASI 076	BAS1 077	BAS1 078	BAS1 079	BAS1 080	BAS1 001	BAS1 082	BASI 083	BAS1 084	BASI 005	BAS1 086	BAS1 007	BASI 088	BAS1 089	BAS1 090	BAS1 001	BASI 092	BAS1 093	BAS1 094	8431 045	BAS1 096	BAS1 097	BAS1 098	BAS1 099	BAS1 100	BAS1 101	BAS1 102	BAS1 103	BAS1 104	BAS1 105		
r × RFAD X1 AND V1 FRUM INDUI CADUS		RFAD(NIN, 20) TX1(T), TX1(T+1), TX1(I+2), TX1(I+3), TX1(I+4), TX1(I+5)	20 FURMAT (6F10.0)	204 CONTINUE	DD 206 I#1,NN,6	READ(NIN,20)771(I),771(I+1),771(I+2),771(I+3),771(I+4),771(I+5)	206 CONTINUE		C*** * NB = FLG14 7 1 TU NB ARE PRESCHIBED VORTICITY BODIES		IF (FLG23 LE, 0 CR, (L, LE, NB FLG14 CR, L GT, NB))GO TO 210		CAAA A IF CUNTROL REACHES THIS POINT, RING WING OPTION IS IN EFFECT AND	Cest aL IS A PRESCRIBED VURTICITY BODY	C *** LCNT IS THE RELATIVE NUMBER OF THE WAKE BODY STARTING WITH 1			XWAKF(LCNT) = TX1(NN)	YWAKF(LCNT) = TY1(NN)	C * SAVE X1 AND Y1 FOR SUBCASE	210 WRITE (13) (TX1(I), I=1, NN), (TY1(I), L=1, NN)	C BASIC DATA CALC. AND PRINT (UNTRANSFORMED COORDINATES)	220 WRITE (6,24) HEDR, NN, MX, MY, THETA, ADDX, ADDY, XE, YE	24 FORMAT (1H1 25X 26HDOUGLAS AIRCRAFT COMPANY /	1 28X 21HLUNG BEACH DIVISION /// 5X 10A6 //	2 BX 4HNN = 14, 15X 4HMX = F13,7, 4X 4HMY = F13,7 /	3 SX 7HTHETA = F13.7, 4X 6HADDY = F13.7, 2X 6HADDY =F13.7/	4 BX 4HXE = F13,7, 6X 4HYE = F13,7)	IF (BDN) 240,230,240	230 WRITE (6,28) (1, TX1(1), TY1(1), [=1,NN)	28 FORMAT (1H0 4X 36HOFF-BODY COORDINATES (UNTRANSFORMED) //	1 10X SHX=DFF 9X SHY=DFF // (1H I3, 2F14,7))	60 TO 270	240 SUMSE0.0		

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5 0 I I I I N 901 101 211 221 127 140 BAS1 BAS1 BASI BASI BASI BASI BASI BASI RAS1 BASI BASI BASI BAS1 Bas1 BASI BASI BAS! BASI BAS1 BAS1 BAS1 BAS1 BASI 36 FORMAT (140 4X 3540N-BODY COORDINATES (UNTRANSFORMED) / 1 94 BODY ND, 13// 11X 24 X 13X 14Y 11X 740ELTA S 7X 2 548UMDS 8X 740 ALPHA // 14 34 1,2F14.7 / 4X 4F14.7) 260 DALF(I) = (ALFA(I+1)-ALFA(I)) * 57,29578 WRITE (6,36) BDN,TX1(1),TY1(1),X2(1),Y7(1),DELS(1),RSDS(1) 1 DELS(I), RSDS(I), IWZ,M), NN, TX1(NN), TY1(NN) 40 FORMAT (14 IS, 2F14,7, 28X F14,7 / 4X 4F14,7) * ADJUST CUDRDINATES (TRANSFORMED) WRITE (6,40) (I, TX1(I), TY1(I), DALF(I-1), X2(I), Y2(I), TX1(1)=T1+CSTHT+TY1(1)*SNTHT TY1(I)=TY1(I)+CSTHT=T]*SNIHT Y2(I)=(TY1(I+1)+TY1(I))/2 X2([)=(TX1([+1)+TX1([))/2 DELS(I)=SQRT(T1*T1+T2+T2) ALFA(1) = ATAN2(72, 71) THETA = THETA / 57.29578 IF (THETA) 340, 360, 340 JF (ADDX) 370,390,370 IF (MX) 280,300,280 IF (MY) 310,330,310 CSTHT = COS(THETA) SNTHT = SIN(THETA) T1=TX1(I+1)=TX1(I) T2=TV1(I+1)-TV1(I) SUMS=SUMS+DELS(I) TY1(I)=TY1(I)PYT XM*(I)IXI=(I)IXI 00 290 I#1 NN DO 320 I=1 . NN 00 350 [=1,NN DD 260 Iz1,MA RSPS(I)=SUMS DO 250 I=1.M TI=TX1(I) MA=Ma 290 0000 500 270 300 038 320 330 340 360 280 C

N. 5 126 0 30 5 N 1 10 M M 96 2 62 6

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OF BUDIES. STOP.)

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	i0 T0 1150	BASI	176
1075 (. # NB+FLG14	BASI	177
		BASI	178
	01 1100 T = 1, L	Basi	179
C * * * *)	MANMA BECOMES THE NUMBER OF ELFMENTS ON THE 1ST L BODIES (IE THOSE	PASI	180
CAAA A	**NOT HAVING AN INPUT VORTICITY OR VELNCITY)	BASI	181
1100	UMA = NMA - ND(1)	BASI	182
【女女女 女)	**NR BECOMES THE NUMMER OF ELEMENTS RECEIVING AN INPUT VORTICITY	eas:	183
CAAA A)	t*nr VFLOCITY	BASI	184
1150		BASI	50
	[F (TCNST_6T_0,)60 IN 2000	BASI	66
1	20 1200 I = 1,NR,6	BASI	40
	?EAD (5,20) TG(1),TG(1+1),TG(1+2),TG(1+3),TG(1+4),TG(1+5)	BAS!	188
1200 (CONTINUE	BASI	189
ບ	* CALC, PARAMETERS WITH TRANSFORMED COURDINATES AND	8 A S 1	061
υ υ	MACH NU. ADJUSTMENT	BASI	6
2000		BASI	102
-	71 = 0	BASI	193
	JO 2500 K#1,NB	BASI	76 I
-	4] = N] +]	PAS1	6
	<pre>/ # N J (K) =]</pre>	Basi	196
)Q 2400 J=M1,N1	e a S I	101
-] 4] 4] 4	RASI	198
Ţ	f1¤X1(J1+1)∞X1(J1)	BASI	100
	72#Y1(J1+1) = Y1(J1)	BASI	002
	<pre>K2(J)=(X1(J1+1)+X1(J1))/2*</pre>	BASI	201
-	72(J)=(Y1(J1+1)+Y1(J1))/2,	HASI	202
	JELS(J)=SGRT(T1*T1+T2*T2)	BASI	NOR.
-	CDSA(J)=T1/DELS(J)	BASI	204
2400	SINA(J)=T2/DELS(J)	BASI	205
2500]]=]]+]	BASI	206
υ	A SAVE PARAMETERS	BASI	207
	4RTTE (12) (X1(1),1=1,J1), FY1(1),1=1,J1), (X2(1),1=1,N1)	BASI	208
~4	<pre>> (Y2(I),I=1,NT),(DELS(I),I=1,NT)</pre>	B∧S¦	209
	REWIND 12	BASI	012

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212	212	212	219	215	216	L TR	0 7 10	012	220	221	えて	N N	224		
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SURRUUTINE BA	SICZ					BASZ	001
						B & S &	200
\$ \$	AD DATA	AND SETUP	FOR NON-UNI	FORM FLOWS		r a s a	003
						₿≱ŝ≧	1000
COMMON / NBS	AVE / NR	NOLD, NIN				BASZ	002
COMMON	EDR(10)	ø C A S E	A K	DNN °		BASZ	000
5 e	LG03	, FLG04	, FLGOS	,FLG06	, FLG07	Basz	007
S S	LGOR	<i>,</i> FLG09	, FLG10	, FLG11	FLG12	BASZ	000
3	LG13	.FLG14	, FLG15	FLG16	, FLG17	BASZ	600
4	LGIA	, FLG19	, FLGZA	, FLG21	, FLG22	BASZ	010
S.	L623	, FLG24	FLGZS	, FLG26	FLG27	BASZ	0
COMMON NT,	0N N	M (II)	NON NUN	A(S), TYPE	A(5),	Bas≳	N 70
1 NER	e NE	R2, N	MA, NSI(SA, NSIG	້	BASZ	013
2 NUNC	(5), TY	PEC(S), NL	LF(11), IFC,	SISX .		BASZ	010
3 1 Y PF	EC(S) NU	INEC (S)				BASZ	015
DOUBLE PRECIS	ION MED	R CASE				BASZ	0161
INTEGER	1003	PLGA4	, FLGOS	, FLGO6	, FLG07	BASZ	017
	LGOR	05LG09	, FLG10	FLG11	, FLG12	B A S Z	018
~	LG13	PLG14	, FLG15	, FLG16	, FLG17	BASZ	019
5	LG18	PLG19	, FLG20	, FLG21	, FLG22	B A S &	0 2 0
4 °	1623	, FLG24	, FLG25	, FLG26	, FLG27	BASZ	021
REAL	Z					B A S R	023
						8 × 8 ×	220
COMMON /CL/	X1(100)	· Y1(100)), X2(100),	Y2(100),	DELS(100),	BASZ	024
	SINACIO	0) , COSA(1(00),XP(100),	VP(100)		BASZ	025
	"XZAKE(1	1) VWAKE((1)			BASZ	026
COMMON /11/	TX1(100) TYICIOC	0) . NG(100) .	TG(100),	ALFA(100),	BASS	027
I RSPS(100) P	ALF(100)	CHURD, TCA	VST, DUMMY(13)	15)		BASZ	020
INTEGER B	NO					BASZ	029
REAL	×	۶ M	, rg			BASS	020
						BASZ	031
*	ART	-				BASS	032
	TS DF ND	NOUNIFORM	FLOW LONP			BASS	230
NSIGEC # 0						BASZ	034
C II X						BASZ	025

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	KCE0	BASZ	036
		8 a 3 2	037
	DO 1000 L=1.NNU	8 A 3 2	038
	READ (5,20) NUN, MSF, TYPE, FG	BASZ	039
0	FDRMAT (2(5% I5), 2F10.0)	BA\$2	040
ı İ	IF PASF,EQ.1.OR.MSF.EQ.2.OR.MSF.EQ.5) GO TO 30	BASZ	041
	Xalitate States and Stat	8 A 3 2	542
	NSTGARNSIGA+1	8 A S S S A S S S S A S S S S S S S S S S	0 Ø 3
	NUHA (KA) ENUN	B asz	0 4 6
	TYPEA(KA)=TYPE	BASZ	045
0 M	IF (MSF,FQ,0,0R,MSF,EQ,2,0R,MSF,EQ,4) GO TO 35	9 a 3 2	046
	XCHXC+1	6 A S 2	047
	NSTGCENSTGC+1	BABZ	040
	NUNC (KC) #NUN	8 a 3 2	600
	TYPEC(KC) # TYPE	8 A 8 2	020
ю М	IF (MSF.LI.2.OR.MSF.EQ.3) GO TO 40	s s s s	051
1		g a s 2	052
	NSIGEC # NSIGEC + 1	B A 3 2	053
	NUNEC(KEC) # NON	8 a s z	058
	TYPEFC(KEC) & TYPE	N S N N	500
00	IF (TYPE) SO,70,70	BASZ	036
	* COMPUTED TYPE	BAB2	057
50		N 0 × 0	030
Ì	NG(1) #Y2(1)	BASZ	020
09	76(I)=FG=X2(I)	BASZ	000
		BASZ	061
	* (X,Y) DR (N,T) TYPE * READ TNPUT	BASZ	062
70		BASS	063
•	READ(5 ,80)NG(1),NG(1+1),NG(1+2),NG(1+3),NG(1+4),NG(1+5)	BASZ	000
0	FORMAT (6F10.0)	BASZ	065
00	CONTINUE	BASZ	066
	DO 100 IS1, NT, 6	BASS	067
	READ(5 ,80)7G(1),7G(1+1),7G(1+2),7G(1+3),7G(1+4),7G(1+5)	BASZ	060
001	CONTINUE	BASZ	000
011	TF (TYPE) 120,140,120	BASZ	040

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₹20 070 075 076 070070 140 073 077 000 082 08300 065 080087 180 BASZ BASZ BASZ 150 FORMAT (1M1 25% Z6MDOUGLAS AIRCRAFT COMPANY / 1 28%, 21MLONG BEACM DIVISION // 5% 1046 // 2 6% 54MSF = 14, 10% 6MTYPE = F10,4, 10% 4MFG = F13,7 3 1H0, 4%, 20MNON=UNIFORM FLOW NO.16 / 140 WRITE (6,150) MEDR, MSF, TYPE, FG, NUN, (NG(I), IE1, NT)

 IM0. 4X. 10HLIST OF NG// (14 6F14.7))

 WRITE (6.160) (TG(I), I = 1. NT)

 FORMAT (140 4X 10HLIST OF TG // (14 6F14.7))

 WRITE (4) MSF, (NG(1), I=1,NT), (TG(1), I=1,NT) TG(I)= T1*COSA(I)+TG(I)*SINA(I) NG(I)= T1*SINA(I)=TG(I)*CUSA(I) z 68 DO 130 I TI=NG(I) CONTINUE RETURN END NMS 02] 160 120 1000 U

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SURRNUT	INE MA	TRIX						MATX	001
								MATX	200
	ບ *	MPUTE	MATRIX APP	3, 7 OR	X , Y , Z			MATX	003
								MATX	000
COMMON	I	IEDK(10) , CASE	~	16	NNU		MATX	002
54		2097.	°FL604	<u>لال</u> ت م	L605	, FL G06	, FLG07	MATX	000
		8097.	, FLG09		1010	FLG11	, FLG12	MATX	001
		L613	, FLG14		LG15	FLG16	, FLG17	MATX	009
े - -	<u>6</u>	LG18	, FLG19	لد. •	L620	FLG21	, FLG22	MATX	000
ີ ເດ		LG23	0 FLG24		625	, FLG26	, FLG27	MATX	010
COMMON	Z 4		0(11) ON	w N e	NUN	IS) TYPE	A (5),	MATX	3 0 1 0
	NER		NERZ	N M A o	NSIC	BA, NSIG	<u>ں</u>	MATX	018
N	UNDN	(2)	TYPEC(5),	NLFCI	J, IEC.	NSIG	EC,	MATX	013
M	TYPE	EC(5),	NUNEC(S)	н ^с			1	MATX	014
DOUBLE	PRECIS	NOI	EDR, CASE					MATX	1210
INTEGEF	La	LG03	, FLG04	6	۴605	, FLG06	, FLG07	MATX	016
-	<u>ы</u>	1008 1	, FLG09		1610	, FLG11	, FLG12	MATX	110
		.LG13	FLG14		1613	, FLG16	, FLG17	MATX	010
M		1618	FLG19		LGZO	FLG21	, FLG22	MATX	610
3		L G 2 3	, FLG24		1625	, FLG26	, FLG27	MATX	020
REAL	2	z		•	I			MATX	021
LOGICAL	d S							MATX	NNO
								MATX	023
COMMON	/FCF/	ECXCIC	DO), ECY(10	00), EC	(001)7:			MATX	024
COMMON	/RNG	ING V	1(100,2),	VRCIOC	0 2 3 , VAN	(100) , VATC	100)	MATX	520
COMMON	/10/	XICIC	00) VICIO	00) / 2	(2(100),	Y2(100),	DELS(100),	MATX	026
-		SINA	(100), CUSA	(100))	(P(100),	VP(100)		MATX	027
ŝ		XWAKE	E(11) PWAKE					MATX	028
COMMON	111/	A (100), B(100	0)。 4	1X(100),	AY(100),	AZ(100) "	MATX	020
-		CXCIC	00)" CA(1(00), (0	2(100) e	AXV(100),	AVV(100),	MATX	020
N		VIJNA	00,50,VT(1(00,51,E	NON NO	IAC		MATX	120
M		-	5	- y	6 40	ູ້	08,	MATX	032
4		°×0	٥Υ ،	æ	4 Z <i>o</i>	× C ×	4 ل م	MATX	033
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065 063 066 600 00000 00000 025 000 000 000 000 000 020 090 062 064 067 0690 060 0 M C 0 M C 030 039 070 200 200 043 040 500 040 047 048 050 0.0 010 MATX £ 4 4 -H 23 88 22 Ħ 8 AND LEC 1EC IEC TEC IEC LEC LEC U L L IAC=0 O i I O 8 4 . SET INDICATORS LAC 8 60 88 63 88 IAC TAC TAC LAC IAC TAC ***AXISYMMETRIC, CRUSS, AND EXTRA CRUSS ***AXTSYMMETRIC AND EXTRA CRUSS FLOW ***CRUSS FLOW AND AXISYMMETRIC FLOW ***CRUSS FLOW AND EXTRA CROSS FLOWW ₩ × .0) ASSIGN 102 TO VZERN=0,0 ***TEST TYPE OF FLOW AND ***AXISYMMETRIC FLOW ONLY ***FXTRA CRUSS FLOW UNLY INITIALIZE ***CRUSS FLOW ONLY JF (FLG03) 30, 10, 30 TF(FLG21)50,53,50 IF (FLG04)25,15,25 .40.3 ASSIGN 110 TO KI START (FLG15,G7 TFIFLGO4)35 O I=1 省 22 VAN(7)=0. 11 60 TN 45 Gn TN 55 IAC = -1 GI) TO 45 4 60 TN 55 IEC = -1 IAC = 0 c TAC # 1 BON=0.0 C **(L** ° **1**) **1** V ے د TEC = TEC # 00 65 IAC = LIENT VNCI 00 4 5 K K ¢9 C ្រ 52 0 1 2 2 3 20 5 5 \$ 10 CAAA C & & & > C & & & & Ceee Casa 1 4 4 4 U CAAA Ceee $\circ \circ$

MATX

071 076 070 079 002 085 000 000 060 200 093 073 074 075 077 000 000 063 000 000 60 MATX COORDINATE COUNTER J IS THE ELEMENT COUNTER MIDPOINT LOUP J ELEMENT LOOP 0)CALL NOTS JI IS THE IF (FLG23 .67. DO 110 K#1,NB -100 I=1.1.1 VIENIAND(K) ... 氡 VAT(I)=0.0

avv(J)*COSA(I) AYV(J)*SINA(I) 0)60 10 PF = FLG18.GT.0,AND.J.GT.NMA.DR.FLG20.GT.0 * COMPUTE X,Y,Z MATRICES \$ OR. FLG15 LE. A VN(I,K) +AXV(J)*SINA(I) # VT(I,K) +AXV(J)+COSA(I) IF (NLF(K), GT 0) GO TO 110 IF (BON, E4.0,) GO TO 105 VNCI.K) = VNCI.K)+AXV(J) VTCI.K) = VTCI.K)+AYV(J) 60 TO KI, (102,110) DO 103 J # M1, N1 DO 106 J = M1, N1 IFC FLGOR .LE.O IN IMEL OOI OO GO TO 110 CALL XYZ VT(I,K) (X°I)NA 1410810 1417810 103 50 106 100 50 10 2 110

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پیچ (سچ نيچ	FORMATCIHISIH STRIP VORTEX MATRICES ON BODY //)	MATX	0
222	FORMATCIM1, 31H STRIP VORTEX MATRICES OFF BODY //)	MATX	© ø
	WRITF(6,114)1,(AXV(J),J=1,NT)	MATX	10(
	WRITE(6,115) (AYV(J),J=1,NT)	MATX	10
122	FORMAT(1H0,5H ROW,14/9H X MATRIX / (6E20,7))	MATX	64 64
51	FORMAT(9H Y MATRIX / (6E20.7))	MATX	() () ()
611	IF (ROW)120,210,120	MATX	
2	* SAVE X, Y, Z ON TAPE #UFF BODY POINTS	MATX	() () () () () () () () () () () () () (
Casa	***SAVE X, Y, Z ON TAPE * OFF BODY POINTS	MATX	-
Cooo	***AXISYMMETRIC FLOW * TAPE 9	MATX	- -
の食食な	AAACROSS FLOW A TAPE 10	MATX	
Caaa	***EXTRA CROSS FLOW * TAPE 8	MATX	() () ()
120	IF (IEC "EQ "")GO TO 125	MATX	9 9 9 9
122	WRITF(A) (ECX(J), JEL, NT), (ECY(J), JE1, NT), (FCZ(J), JEL, NT)	MATX	
	IF (IEC) 125,400,125	MATX	2
50	IF(IAC) 140,130,130	MATX	
021	WRITE (9) (AX(J), JE1, NT), (AY(J), JE1, NT), (AZ(J), JE1, NT)	MATX	N
	IF (IAC) 400,140,400	MATX	N
140	WRITE (10)(CX(J),J#1,NT),(CY(J),J=1,NT),(CZ(J),J=1,NT)	MATX	1
	G0 T0 400	MATX	(V)
	***SAVE ON TAPE * ON BODY	MATX	~
のものの	***AXISYMMETRIC FLOW * TAPE 9	MATX	N
Caaa	***CROSS FLOW * TAPE 10	MATX	N N
CARA	***EXTRA CROSS FLOW * TAPE 8	MATX	Ň
C 4 4 4	***IEC = =1 MEANS NO EXTRA CROSS FLOW	MATX	2
210	IF (IEC,EQ,F) 60 70 240	MATX	(M) (M)
220	DO 230 J # 1,NT	MATX	Ř
	A(J) = FECX(J) + SINA(I) + ECY(J) + COSA(I)	MATX	2
0 10	B(J) # FCX(J) * COSA(I) + ECY(J) * SINA(I)	MATX	10°1
	WRITE (8) (A(J),J=1,NT), (B(J),J=1,NT), (EC2(J),J=1,NT)	MATX	2
	IF (IEC) 240,400,240	MATX	Š
240	IF (IAC) 310,250,250	MATX	1
250	DO 260 J#1,NT	MATX	2
	A(J)E=AX(J)*9INA(])+AY(J)*COSA(])	MATX	10
260	R(J)=AX(J)*COSA(I)+AY(J)*SINA(I)	MATX	10

ERITE (9) (A(J),J=1,NT),(B(J),J=1,NT),(AZ(J),J=1,NT)	MATX	1 17 1
270 [F (JAC) 400,310,400	MATX	142
310 DD 320 J=1.NT	MATX	143
A(J)==CX(J)*SINA(I)+CY(J)*COSA(I)	MATX	144
320 B(J)=CX(J)*COSA(I)+CY(J)*SINA(I)	MATX	145
WRITE (10) (A(J),J=1,NT),(A(J),J=1,NT),(CZ(J),J=1,NT)	MATX	146
400 CONTINUE	MATX	147
IF (FLG15,LE,0) GO TO 1400	MATX	148
IF (BON NE.0.) GO TO 1200	MATX	149
	MATX	051
READ (4)	MATX	151
	MATX	2 2 2
CAAA A IF FLG23 GT O INPUT NNU MUST BE NONE MENCE NNU = 0 HERE	MATX	1 S J
	MATX	130
IF (NNU_LE_0) GU TO 600	MATX	155
DO 500 I # 1, NNU	MATX	156
READ (4) ASF (A(J), JHI, NT), (B(J), JH1, NT)	MATX	157
500 WRITE (3) MSF,(A(J),JE1,NT),(B(J),JE1,NT)	MATX	150
REWIND 3	MATX	159
REWIND 4	MATX	160
READ (4)	MATX	161
	MATX	162
IF (FLG16,GT,1) NENSIGA	MATX	165
C*** ***N # 0 MEANS 1 RHS ONLY NO NON-UNIFORM FLOW	MATX	164
C*** * IF FLG23 GT. O INPUT NNU MUST BE NONE, MENCE N # 0 HERE	MATX	165
	MATX	166
IF (N ₆ FG ₆ 0) GO TO 800	MATX	167
DO 700 I = 1, N	MATX	168
READ (3) MSF, (A(J), J=1, NT), (B(J), J=1, NT)	MATX	169
700 KRITE(4) MSF,(A(J),J#1,NT),(B(J),J#1,NT)	MATX	170
800 M#0	MATX	171
C*** * SKIP PRESCRIBED VORTEX INPUTS ON 4 SH THAT STRIP VORTEX	MATX	N 1 1 1
C*** * SUMMATIONS CAN GO BEHIND IT	MATX	175
	MATX	174
JF(FLG23 GT 0)READ(4)	MATX	175

DÜ 900 J = 1, NB	MATX	176
IF (NLF(J),GT,0) GO TO 900	MATX	123
NSIGa=NSIGa+1	MATX	178
NN(1=NNU+1	MATX	179
WRITE (4) M _p (VN(I _p J),Imi _p NT),(VI(I _p J),Imi _p NT)	MATX	160
900 CONTINUE	MATX	191
	MATX	1 0 7
C*** * SINCE NO NNU IS INPUT WITH FLG23 GT 0, NSIGC IS MAX OF 1 AND M	MATX	103
Cata a SHOLD BE O IF FLG17 LE 0. DONT USE FLG17 WITH FLG23	MATX	184
	MATX	105
IF (FLG23 "LE, 0)GO TO 975	MATX	136
	MATX	107
C*** * RING WING OPTION ~ FORM COLUMN (PARTLY) FOR PRESCRIBED VORTICIY	MATX	60
	MATX	109
	MATX	190
	MATX	191
DO 950 JalrNB	MATX	192
IF(NLF(J) _ GT = 0)GU TO 950	MATX	193
1800 = 1800 + 1	MATX	194
	MATX	195
Cata CONVERT (ON BODY) X, Y TO NORMAL, TANGENTIAL	MATX	196
	XAVM	197
DO 925 1#1.MT	MATX	198
VAN(I) = VAN(I) + VA(I,IBOD) #SINA(I)	MATX	199
925 VAT(I) = VAT(I) + VA(I,IBOD)+COSA(I) + VR(I,IBOD)+SINA(I)	MATX	200
WRITE(4)(VAN(I),I=1,NT),(VAT(I),I=1,NT)	MATX	201
950 CONTINUE	MATX	202
975 M # NSIGC # 1	MATX	203
IF (FLG17,GT,O) MENSIGC	MATX	200
IF (M.LE.O) GO TO 1100	MATX	205
DO 1000 I = 1, M	MATX	206
READ (3) MSF, (A(J), JH1, NT), (B(J), JH1, NT)	MATX	207
1000 WRITE (4) MSF, (A(J), Ja1, NT), (B(J), Ja1, NT)	MATX	208
1100 REWIND 3	MATX	209
GŪ TT 1400	MATX	210

212 211 3 214 512 216 200 238 MATX * TEST IF OFF BODY .EQ.O.OR.BON.NE.0.) GO TO 1600 * INITIAL FOR OFF BODY * TMFN RF∞ENTER I,J LOOPS WRITE(4) (VA(I, IBOD), Imi, L1), (VR(I, IBOD), Imi, L1) $\mathsf{WRITE}(d) \quad (\mathsf{VN}(\mathbf{I},J), \mathbf{I} = \mathbf{I}, \mathbf{L}\mathbf{I}), \quad (\mathsf{VI}(\mathbf{I},J), \mathbf{I} = \mathbf{I}, \mathbf{L}\mathbf{I})$ * TEST IF OFF BODY COMPLETED IF(NLF(J) .6T. 0)60 TO 1350 IBOD = IBOD + 1 IF (NLF(J),GT.0) GO TO 1300 IF(FLG23 "LE" 0)60 TO 1400 1200 DD 1300 J = 1, NB 1400 IF (FLGOS,EQ.0 DO 1350 J=1,NB DO 1500 I = 1 XZ(I) = XP(I)V2(I) = YP(I)LIEND(NB+1) CARA ARADFF BUDY 0 CONTINUE IBDD = 0CONTINUE GO TO 60 REWIND 9 ത I GNING REWIND RETURN BUNE1. REWIND END 1300 1350 1500 1600 6 C C

MATX

L NOVENS	ZAX JAL				-	ZAX	100
		· · ·	·			ZAX	206
	A CONTRI	OL FOR X, Y, Z	MATRICES CON	MPUTATION		XYZ	00
	-		4			ZAX	000
COMMON	10/ 010	D3. XMXJ, VMY	SULANA SU	VMVJPL S		ZXX	500
COMMON	N C C C C C C C C C C C C C C C C C C C	(10) CASE	s s	DWN °		242	90 <i>0</i>
1949	. FLG0	3 FLG04	FLGOS	, FLG06	, FLGOT	2 A X	007
N	"FLGOI	R ,FLG09	FLGIO	, FLG11	, FLG12	XVZ	000
M	, FLG1	S FLGIA	, FLG15	, FLG16	, FLG17	ZAX	000
4	FLG14	B FLG19	, FLGZO	JELG21	, FLG22	XYZ	010
۰ ۲	FLGZ	S FLG24	, FLG25	, FLG26	, FLG27	ZAX	012
COMMON	N 4°	NDC1170	MN.	UNA(S), TYPE	(S) »	XYZ	018
-	NER! ,	NERZO	NMA, N	SIGA, NSIG	, C,	ZAX	013
~	NUNC (5)	" TYPEC(S),	NLP(11), II	EC. NSIG	, EC ,	XYZ	010
P41	TYPFEC	5), NUNEC(5)				ZAX	015
DOUBLE	PRECISION	HEDR, CASE				ZAX	010I
INTEGER	FLGO	3 <i>FLGO4</i>	, FLGOS	,FLG06	r F L B O 7	XYZ	017
-	, FLG01	8 ,FLG09	, FLG10	er cit	, FLG12	ZAX	010
N	FLG1	3	, FLG15	, FLG16	, FLG17	XYZ	010
1971	, FLG14	e FLG19	, FLGZO	, FLG21	FLG22	XYZ	020
8	, FLG2	3 FLG24	FLG25	, FLG26	, FLG27	XYZ	021
REAL	Z					XYZ	022
LOGICAL	1					XAX	022
						XYZ	8 N O
COMMON	/RNGWNG/	VA(100,2),	VR(100,2), VI	ANC1003 . VAT	(00)	ZAX	50
COMMON	CLA X10	(100), VI(10	0) × × × (100)	3, Y2(100),	DELSCIDON	XYZ	026
-	110	NA(100), CUSA(100), XP(100)	3 vP(100)		XYZ	027
N	XN/	AKE(11) ° YWAKF	(11)			XYZ	820
COMMON	/TL/ A()	100), B(100), AX(INO)	3, AY(100),	AZ(100) /	ZAX	020
e =1	х U	(100), CY(10	0) · CZ(100), AXV(100),	AVV(100) 0	ZAX	020
N	Z	(100,5),VT(10	0,53,80N,	IAC		ZAX	031
۲ ۰	с Т	ي 1	_ * _	SJ.	DS,	ZAX	032
4	XO	۰ ۵۷ و	s T s	×J.	۲Jo	ZAX	220
د بر بر	¥ ×	eek,	RKK "	× ,	8	ZAX	034
						ZAX	520

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920 0200 000 062 063 064 066 0.67 0.68 0.90 039 000 041 10 4 8 0 4 8 0 4 8 047 036 037 0.30 043 940 057 061 010 m (Y1(J1P1) = Y1(J1))**2 15.01 * INITIAL Y COURDINATE MID-PUINT FOR ZERO I MIDPOINT * COMPUTE MINIMUM DISTANCE TO D2#(X2(1)=X2(J))**2*(Y2(1)=Y2(J))**2 D3 = XMXJP1**2 + YMYJP1**2 ÷ SURT((X1(J1P1) = X1(J1)) **2 * J NOT EQUAL 1 PATH PAJN XMXJP1 = X2(I) = X1(J1P1) YMYJP1 = Y2(I) = Y1(J1P1) Caalyay & Caalywx a Co (D1=D2) 130,130,120 (D2=D3) 150,150,140 XJ=X2(J)+T2+COSA(J)=DX YJ=Y2(J)+T2+SINA(J)=DY YMYJ = YZ(I) = YI(J1) x x 2(1) - x1(J1) * J EQUAL I 30,30,40 100,10,100 110,20,110 YZEROWYZ(I) m.000001 START DS=(71=72)/32. J \$ 1Ω T1 = 5 + DELS(J) SJ=T1/Y2(J) DX=DS+COSA(J) DYEDS&SINA(J) IF (SJ=_08) 3 CALL XYZ1 GU TD 1000 T2m,08*Y2(J) \$ CALL XYZZ GD TO 300 (]-]) CALL XYZI (NO8) ຮູງຮູດອ 8 N [= 33 JPI DXXX XXXX 8 110 100 120 с 2 C M $^{\circ}$ 0 7 6 \sim C cυ

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ZAX

085 010 200 084 088 0 0 0 0 0 0 0 N 60 0 0 0 000 960 260 098 243 074 075 110 040 640 000 08% 087 160 094 120 072 ZAX ZAX ZAX NNNN >>>> XXXX ZAX ZAX ZAX 242 NNNNNN >>>>>>>> XXXXXXX 2 X X ZAX (SO) COMPUTE NO. OF INTERVALS(NI) AND DELTA S FOR SIMPSON RULE INTEGRATION IF (DM.EQ.0.0) GO TU 200 MI=R.*DELS(J)/DM+0.9 IF (NI-128) 210,200,200 IF (D1-D3) 160,160,140 IF (NI) 180,180,190 DS=DELS(J)/128. DSEDELS(J)/XNI DS=DFLS(J)/2. OX#DS#COSA(J) UY=DS+SINA(J) XO-(IC)IX=CX YO-(IL) Yary PM=SQRT(D1) DM=SGRT(03) DM=SQRT(D2) 叡 GO TO 170 GO TO 170 GO TO 220 GO TO 220 CALL XYZZ INAINAIN IAINEIN NI=129 RETURN INEINX NIES END 130 140 05 160 170 081 061 00*≷* 210 220 200 0001

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	×		10)						Z	Z	Å	No N	u I						VAC	001			4				600	100	000			
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065 000 036 120 030 620 000 043 0 0 0 045 900 000 670 020 20 053 050 053 920 057 020 650 000 0 6 8 9 0 063 064 066 067 690 041 N 80 007 150 061 010 12 a X 1 2 a X 1 Z A X 8 Z A X 127X 127X 1 Z A X 1 Z A X 1 Z A X IZAX 3ZAX ZAX 82AX **IZAX** XYZE **ZAX** IZAX XYZI 3 Z A X **ZAX** 1 Z A X XYZL XYZZ IZAX XYZI XYZZ 124% XYZI XYZ1 ECX(J) = 6.283185 * SINA(J) + 2.0 * SINA(J) * COSA(J) * SJ ECY(J) = 6.283185 * COSA(J) + SJ * T14 ECZ(J) = 8.0 * (1.6666667 + 72) * SJ IF (IEC) 15,1000,15 IST TERM OF X(I,I), Y(I,I), Z(I,I)) #T11/12;) AZ(J)=Y2(J)+T8+(1,=T2+T1+(2,=T12+5,*T2+(1,+T12))/144,) *T3*T2*(T5=1。))) T14 m .3333333 h (16.0 + 6.0 h T3) + 2.0 h T2 **AX(J)**#T10+S1NA(J)*CUSA(J)*(T7+(T4+2,166667 **AY(J)ZT7***T**4mT9m**(1_e**+**T2**mT5mT6**)***T**1**1**/8_e CZ(J)==78*(1,+72=713*(1,11111 IF (IEC,EQ,m1) GO TO 15 ***FXTRA CROSS FLOW 1 * CROSS FLUW INITIALIZE T9=6.283185 *CUSA(J) TIOE6.283185 *SINA(J) A AXIS FLOW IF (IAC) 30,30,100 T3ESINA(J) *SINA(J) IF (IAC) 30,20,20 IF (PF) GO TO 200 START TF(PF) GO TO 25 T2=ALOG(SJ/8.) 75m。6666667 气 叡 713=71/16e TIJ=TIASJ 712271471 74E72473 T6=15+13 7=5J+9J LOSCONT' T8=T7+T7 0 M 0 s 0 5 N 100 C 4 4 4 4 υU U S

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	SUBROUTIN	IE XYZZ						22XX	001
υ υ								X Y Z Z	005
J		* CUMPUT	E XOYOZ MAT	RICES USI	NG SIMPS	BON RULF	INTEGRATION	XYZZ	003
J								22XX	0 Q 4
	REAL LIJZ	0						227X	0020
	COMMON /D	/ RISOR,	R2SQR, XMX	OCAWA OC	AMXJP1.	0 I drawa	Ś	224X	900
	COMMON	HEDR(10) CASE	D Z		, NNU		224X	001
	6	, FLG03	, FLGO4	FLG	0.05	FLGOG	, FLG07	XYZZ	008
	≥	, FLGOB	, FLG09	FLG	10	FLG11	, FLG12	227X	000
	м	FLG13	FLG14	e FLG	5	FLG16	, FLG17	ZZAX	010
	4	, FLG18	PFLG19	, FLG	20	, FLG21	, FLG22	224x	012
	Ś	, FLG23	PLG24	FLG	23	, FLG26	, FLG27	XYZZ	012
	COMMON	х Т ,	(11)QN	MNO	NUNAC	S) TYPE	A(5),	XYZZ	013
	¢	NERI,	NERZ	NMA .	NSIGA,	SISX .	C .	224X	014
	N	NUNC (5) &	TYPEC(5),	NLF(11)	IEC,	NSIG	rc,	x y z z	50
	\$	TYPEEC(S	() NUNEC (5)					2 X A Z S	010
J	DOUBLE PR	RECISION	MEDR, CASE	•				XYZZ	0171
	INTEGER	FLGO3	PLG04	FLG,	03	, FLG06	PL607	XXXX	018
	6	, FLG08	FLG09	, FLG	10	FLG11	, FLG12	22XX	010
	∧ J	, FLG13	, FLG14	, FLG	15 1	FLG16	1617	XYZZ	020
	M	FLG18	PLG19	, FLG	50	, FLG21	, FLG22	XXZZ	120
		FLG23	FLG24	FLG	5	, FLG26	, FLG27	XYZZ	222
	COMMON /E	CF/ ECX(100), ECY(1	100) , ECZ(1003			X Y Z Z	023
	COMMON	RNGWNG/	VA(100,2),	VR(100,2	J VANCI	DOD VATC	(001	XYZZ	020
	DATA NSM	121						2 Z A X	6 2 0
Coco	A & & R S M A L	L will B	IE TRUE IF 1	IS "LT" EP	60	AND THERE	FORE SMALL EL	XYZZ	026
	LOGICAL R	ZSMALL						277X	027
	REAL	Z						XYZZ	020
	LOGICAL P	4						22AX	020
υ								XVZZ	030
	COMMON /C		100), Y1(]	100), XZC	10030	12(100)	DELS(100),	XYZZ	1 1 0
	~		ACTOD/COSM	V(IOO) AF	1003	rP(100)		XYZZ	Nrc
	N	A W Y	XF(11) VWA	(F(11)		:		2 Z Z X	0 3 3
	COMMON /1	L/ ACI	00), 8(10	D) & AX(1003.	AV(100),	AZ(100),	XYZZ	034
	1	UX C	100), CY(1	00) · CZ(1001.	AXV(100) /	AYV(100),	22XX	030

22 A X

n	VN (1 0 0 - 2	1. VT (100.51	AUN.	TAC		SLAX	0 7 60
· ~		J			, DS,	X Y Z 2	120
5	DX.	٩, ٩	"TN	۵ ر ہ	۲J "	XYZZ	038
	× ×	л К К	n X , X	×	PF.	XYZZ	039
	•	•		•		XYZZ	070
4 4	START					XYZZ	041
*	INITIALIZE					22AX	042
6 8 8 9 0 ° 0						XYZZ	045
ASSIGN 570	TO X1					XYZZ	044
门袋装装 发发放风的 昆 四〇 严	DR NON-SMALL	- ELEMENT AX	ISYMMETRIC			XYZZ	045
ASSIGN 80 T	0 KS					XYZZ	046
门袋袋袋 装装装入的 目 2.0	S FOR NON SI	MALL ELEMENT	CROSS	LOW		XYZZ	0.47
ASSIGN 295	TO X6					XYZZ	048
IF (FLG15 L	E, 0. OR NLF ()	<pre></pre>	TC 15			22 A X	049
10 ASSIGN 420	TO KI	T				XYZZ	020
15 S2= 6666667	の () () () () () () () () () ()					224X	051
COL N SUNN	33 * DS					XYZZ	052
53 a 8 0/3	10 4 0					XYZZ	053
SUL B SSYS	33 * S1					XYZZ	020
20420 # 70						XYZZ	055
TIEY2(I)4Y2	(1)					XYZZ	050
ASSIGN 28 T	N N					N N Z S	057
ASSIGN 410	TD K3					XYZZ	020
ASSIGN 570	TO X4					XYZZ	050
IFC NOT P	F) 60 TO	N				XYZZ	0.60
ASSIGN 110	10 K2					XYZZ	061
ASSIGN 420	70 K3					XYZZ	062
ASSIGN 560	10 K4					XYZZ	063
12 IF ((I ,NE	: ".J) "OR" (I	BON NE 00	()) GO TO	16		XYZZ	9064
C & * * * * * * * * * * * * * * * * * *	ON BUDY					X Y Z Z	065
R DELS(I)	/ 2°0					XYZZ	066
RSMALL = (R / Y2(I))	elt. EPS				XYZZ	067
						XYZZ	068
GO TO 17						XYZZ	069
16 R = SGRT(A	MAX1 (RISUR,	R230R))				XYZZ	010

X Y Z Z

094 960 098 660 040 003 000 080 000 000 093 560 100 100 102 03 207 208 072 073 074 015 076 077 070 000 002 003 004 000 007 00 071 002 XYZZ XYZZ XYZZ XYZZ XYZZ XYZZ XYZZ 22XX XYZZ 224X XYZZ XXZZXX X Y Z 2 X Y Z 2 2222 2222 2222 2222 2222 XYZZ XYZZ XYZZ XYZZ XYZZ XYZZ C*** ***CALCULATE DUANTITIES WHICH MAVE NUT YET BEEN CALCULATED FOR I=4 2ND TIME THROUGH CRUSS FLOW CAAA AAASMALL ELEMENT -- FORM XIJ2D, YIJ2D, LIJ CAAN AAAKS & 105 FOR SMALL ELEMENT AXISYMMETRIC ASSIGN 105 TO KS THROUGH THROUGH IF (ABS(Y2(I)) "LT" INE"30)GU TU 13 RSMALL = (R / Y2(I)) "LT" EPS TIME TIME # 320 FOR SMALL ELEMENT 13 RSMALL = FALSE. 17 IF(NOT, RSMALL) GU TO 19 X ž ZND TIME THROUGH FOR I NE J FOR I EQ J 157 FOR I EQ J 2ND 5 8 CAAA AAAI = J IST TIME THROUGH **NSW = 3 FOR I EQ J 2N GO TO (14, 21, 22), NSW 4 巘 XMXJP1 = X2(T) = XRIGHT VLEFT = V1(J1) XRIGHT = VLEFT + 32,0 VRIGHT = VLEFT + 32,0 ###GET NSW READY FOR I XMXJ = X2(I) - XLEFT YMVJ = YZ(I) = YLEFT XRIGHT = XI(J1P1) VRIGHT = VI(J1P1) ASSIGN 320 TO K6 XLEFT = XJ + DX YLEFT & YJ & DY XLEFT = X1(J1) で や つ 11 N 8 I N XOZAAA 60 70 23 60 TO 17 NSW = 3 Cass assel H J NON N **秋金金灰**¹ ろの乙名名名 国の乙会会会 N 3 a N 门齿会设 に会会会 いままな C & & & & の会会的 പ

XYZZ

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XYZZ

XY ZZ 206 107 103 103

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(500) (500) (500) 110

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004 666 666

22AX XYZZ 22AX 22XX XYZZ X Y Z Z XYZZ XYZZ XYZZ 22YX XYZZ XYZZ XYZZ XYZZ XYZZ XYZZ XYZZ XYZZ 22AX XYZZ XYZZ XYZZ 22AX ZZAX XYZZ 22XX 22AX XYZZ XYZZ ZZAX 22 A X X V Z Z 22AX XYZ2 ZAX (4096°0 * 71**2) (YLEFY - YRIGHT) **2 * CUSA(J)) + (YMYJP1 * SINA(J) * (ATAN(EL1/H) - ATAN(EL2/H)) IF((EL1 * EL2) *LT* 0.0) DPHIDY = ~6.283186
XIJ2D = (COSA(J)*DPHIDX) = (SINA(J)*DPHIDY) + (COSA(J)*DPHIDY) * CUSA(J) * SINA(J) * OPHIOX *RRIGHT) IF(ABS(H/EL1) .LT. 10.0E-10)60 TO 7 \$ (YMY) CAMA) - ((H/2°0) & DPHIDY (=(EL1 + EL2) / 4,0) OF INTERVAL LOOP ALOG((RLEFT DPHIDX ==ALOG (RLEFT / RPIGHT) = XRIGHT)**2 11 FLI = (XMXJ + COSA(J))+ (SINA(J)*OPHIDX) CAAR RANDW FORM XIJ2D, YIJ2D, H H ((SINA()) * - YRIGHT SMALL FLEMENT S = SORT((XLEFT 75=(Y2(I)+YJ)**2 **"** » (S/4°0) °CN IN 1221 000 102 = Y2(I) RRIGHT = R250R DPHIDY = -2.0 RLEFT = RISOR EL2 = (XMXJP1 8 DPHIDY = 0.0 I3=X2(I)=XJ 4 TTESCAT(T6) # V2(I) RRIGHT . R RLEFT = R တ D JN Lake 16274475 T2=YJ+YJ 74e73473 18072474 60 TO 11 VIJZD = XU¢CXECX YO+CY=CY 60 70 8 LIJ20 = IdCAWA ÷ 402 - N 17 0 درسم درست œ -Caaa C

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2000 2000 0 - 0 0 0 0 0 0 0 0 0 0 0 0 10 5 6 000 160 99 69 170 565 99 1 . 150 **N N** 5 174 543 5 XYZZ 22AX XYZZ X 7 2 2 X 7 2 2 XYZZ XYZZ XYZZ X V Z Z X Y Z Z XY22 XYZZ 22AX XYZZ 22AX XYZZ XYZZ 22AX 22 A X 224X XYZZ 22AX X Y Z Z 2211 XVZZ ZZAX XYZZ XYZZ 224X 22 a x 224x XYZZ XYZZ XYZZ 22AX IS ZERO THEN MAKE TZI FAIL ALL TESTS 卓 YJ * T3) / (TB**1.5 IF(RSMALL _AND, FLG21 _EQ, 0)60 TO 18 XX=4, ±VJ*V2(I)/T6 Y FORMULAS AXISYMMETRIC FLOW * COMPUTE ELLIPIC INTEGRAL LT. 10.0E-30)GN TN 29 = (EKK*EEK*(71=18)/710)/77 FV3 = Y2(1)/710 + 73/77 + EEK IF (T21.LT.0.01) GO TO 24 T12 = YJ/Y2(1) 御 71 / 78 > IF (IEC) 18,575,18 IF (IAC) 200,20,20 * AXIS FLOW IF (RSMALL)GO TO 25 \$70796 74 - 72 ABA IF DENOM (18) FV4 = FV2*T3/Y2(1) 18442 TIOA = SGRT(T10) F1 = FV3#712 F2 B FV2#T12 T21 = SQRT(60 T0 27 IFC ABS(78) 79 = 79A##2 TILY = 11T 721 = 0.10 FJET114EKK CALL ELIP IF (IEC) 710=79+74 244SMALL 0 ° ° 60 70 26 FV4 # 0. 6 723 8 7 N FV2 = M H H F V N FVJ 724 50 0 N 21 8 7 8 Cees v v v6 U

XYZZ

X V Z Z

	-	1 (1.0 + (.75 + (.3.0 + 72 + 2.0 + 74) + 723))	224X	176
		F2 = (1,570796 * YJ * Y2(1)) * (724 / (78**2,5))	22XX	177
		F3 = 1.570796 * YJ * (1.0 + (.25 * 723 * (*724))) / SGRT(78)	XYZZ	178
		GO TO 26	227X	611
	52	T32 = T3 / T10A	2242	081
		T33 = T9A / T10A	X 7 Z Z	161
		T34 = T33**2	XYZZ	102
		T35A = T10A / (8,0 * Y2(I))	22 A X	183
		T35 = ALOG(T35A)	X Y Z Z	184
		136 = 79A/Y2(1)	224X	6 6 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7
		T40 = T10A / Y2(L)	S Y Y Z	186
		T37 = (T40**2)*0,125	22AX	187
		T38 = 0 _e 250 * T36 * T35	X Y Z Z	188
		T39 = 0,125+T36	XYZ2	6 8 1
		734A = 2.0*734	XYZZ	
		734B = 734A + 3°0	XYZZ	6
		F1 = (= 2 ° 0 = 732 = (= 735A = 735) = (0 °5 = 733)	22AX	26 I
		1	X Y Z Z	501
		F2 ==((0 ₆ 25 ± 736 ± 735) =734 =1 ₆ 0 = (759 ± 7348)) / Y2(I)	XYZZ	194
		F3 = (T35 = (T36 = (0,25 = T36==2) = 737)) = 736 = 737	ZZAX	50
	20	GO TO K2, (28,110)	XYZZ	196
ပ		* SIMPSON RULE INTEGRATION	X X Z Z	103
	80 N	IF (ISH1) 30,30,40	XYZZ	198
ပ		A PIROT PAGO	SZAX	661
	0 M	A YON YA	XYZZ	200
		AYSEFZ	SIAX	201
		A Z S # F Z	22XX	202
		IASO	XYZZ	203
		GO TO 110	2242	204
	40	IF(IS_EG_NI)GO TO 75	22 A X	502
	ទ	IF (IA) 70,60,70	XYZZ	206
د		* EVEN PASS	XYZZ	207
	60	AXGHAXG+4 e +F 1	XYZZ	208
		AYSHAYS+4, FFP	224 X	209
		AZSEAZSe4. * FF3	XYZZ	210

X Y Z Z

236 238 539 072 243 233 234 235 237 242 244 245 221 222 232 241 212 215 219 224 225 231 211 213 217 210 XY22 XYZZ 527X 527X 527X XY22 XYZ2 XYZZ XYZZ 22YX XYZZ XYZZ XYZZ XYZZ \$2 X X XYZ2 X 7 22 X 7 22 X 7 22 XYZZ XYZZ XY22 **YYZ**Z XYZZ 22AX XYZZ XYZZ XYZZ XYZZ XYZZ XYZZ XYZZ 227X XYZZ ŝ -123 30 • (AYS -S F2) "OR" (BON "NE" 0.0))60 TO 107 48 * . (AZS + P3) ø (AYS S 5 Y2(1) đ F1) # . M 10 -4 (LIJZD . / Y2(1) 4 4 CAXS SMALL ELEMENT -(2,0 * LIJ20) (AXS + F1) (AZS 220 0 ON OR UFF BODY (J-I) 100,90,100 (BDN,NE,0,0) GO TO 10 • 10 AY (J) = AY (J) = 82 + (AYS+F2) AX (U) HAX (U) HOUR (AXO+F1) AZ(J)=AZ(J)+84+(AZS+F3) + (LIJ2D -2.0 * LIJZD + + XIJ2D V1J20 CROSS FLOW 0.04160 200,200,400 (RSMALL)GO TO 223 * LAST PASS PASS AX(J)=SQ=(J)XA AY (J) == S2* (AVS+F2) K5, (80,105) DN BODY AZ(J)=94+(AZ8+F3) 4 000 -VIJZD .NE.1) AVCJ AX (J) XIJZD AYS=AYS+F2+F2 AZSEAZS+F3+F3 = AZ(J) . AXSEAXS+F1+F1 1 ###LAST PASS 4 ÷. 60 70 110 GO TO 110 110 GO TO 110 GO TO 110 3 (IAC) (721 5 n 43 ARAT NE S TD GO 70 AY (J) AZ (J) AX(J) (L)Z AX (J) AYCJI IA=0 IAsi 111 60 CAAA AAAI 4 -1 105 07 110 200 10 13 00 66 0 の金金谷 Canan 10 -U

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712 E 71 + 7A	XYZZ	24
F1=T3/Y2(1)+(EKK=EEK+T12/T10)/T7	XYZ2	24
F2=(FEK×(T8×T8+T1×(T4=T2))/T10=EKK×T8)/T1/T7	XY22	246
F3=T7+(EKK+T12/76=EEK)/T1	XYZZ	249
GU TN 230	XYZZ	250
CARA AAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAA	XYZZ	251
220 T23 = 71 / T8**2	XYZZ	25
729 = (1,570796 + T2) / (T8**1,5)	XYZZ	52
726 = 4,0 ± 74 = 72	XYZZ	250
731 = 726 ± 723	XYZZ	25
F1 = ((~4.712389) * 72 * 73 × 72(1)) / (78**2.5)	22YX	25
$F_{2} = T_{2}9 \pm (1_{0} - (1_{0}125 \pm T_{3}1))$	XYZZ	25
F3 = 729 = (1.0 = (.375 = 731))	XYZZ	256
GO TO 230	XYZZ	23
CARA REFLAC LT O MEANS NO AXISYMMETRIC FLOW	XYZZ	26
223 IF(IAC)225,227,227	XYZZ	26
*** ***CALCULATE SMALL FLEMENT QUANTITIES THAT DID NOT GET CALCULATED	224X	260
CARA AAABECAUSE THERE WAS NO AXISYMMETRIC FLOW	22AX	26
225 T32 E T3 / T10A	XYZ2	266
T33 = T9A / T10A	XYZZ	26
734 m 733**2	XYZZ	26
735A = 710A / (8.0 * Y2(1))	XYZZ	261
735 = ALOG(735A)	XYZZ	261
736 = 79A/Y2(I)	22XX	26
740 = 710A / Y2(I)	XYZZ	27(
T37 = (T40**2)*0.125	XYZZ	27
738 E 0 250 2736 135	XY22	27
CARA ARACALCULATE SMALL ELEMENT F1.F2.F3 CROSS FLOW	224X	27
227 T3RA = =5.0 * T38	XYZZ	271
740A = 740**?	XYZZ	27.
T36A = T36**?	22XX	27
F1 = (T32 / Y2(1)) * ((=0.75 ± 740 ± 755) + 733	22YX	27
$1 + (0_125 + 740 + (2_0 + 734 = 5_0)))$	XYZ2	276
F2 = (738A + 734 + 3.0 + (0.25 + 736 + (734 - 6.50)) / Y2(1)	XYZZ	27
F3 = ((T36 = (0,375 * T40A) = (0,25 * T36A)) * T35 = 4,0 + T36	XYZZ	28

XYZZ

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XYZZ

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XYZZ

555

/ YZ(I) SIMPSON RULE INTEGRATION a 757 a IF (RUN, NE.0.0) 60 TO 310 CX(J)=CX(J)+S2*(CXS+F1) CY(J) = CY(J) + S2 * (CYS+F2) CZ(J)=CZ(J)+S2*(CZS+F3) (IS-NI) 260,290,260 IF(J .NE. 1)60 Th 310 (IS-1) 240,240,250 * FTRST PASS * LAST PASS * EVEN PASS ~ (0°,00 * T36A) (IC) 280,270,280 PASS TO K6, (295, 320) CY(J)=S2*(CYS+F2) CX(J)=S2*(CXS+F1) CZ(J)=S2*(CZ3+F3) 000 CYSECYS+4,*F2 CZSECZS+4,*F3 ICE1 CXSECXS+F1+F1 CYSECYS+F2+F2 CXSECXSed #F1 CZSECZS4F34F3 4 4 GO TN 400 GO TN 400 GO TO 400 GO 70 400 GO 70 400 CXS#F1 CYS#F2 CZSEF3 I C ≈ O ICWO 00 . 14. 14. (<u>)</u> <u>لما</u> 230 240 260 270 500 200 200 200 250 280 290 310 6 ت C C Ć

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308

ROD TE C ('.NE.J) .DR. (BUN .NE. 0.0)) GO TO 340	224X	316
C*** ***! AST PASS SMALL FLEMENT 1#J UN RODY	2271	317
CX(J) = CX(J) + XIJ2D + (CXS + F1) * S1	2272	8 1 2
CY(J) = CY(J) + YIJ2D + (LIJ2D / Y2(I)) + (CYS + F2) + S1	2242	6 M
CZ(J) = CZ(J) =(2,0 * LJ2D / YZ(I)) + (CZS + F3) * S1	224X	320
60 70 400	ZZAX	320
C*** ***I NE J DR ANY OFF BODY	XYZZ	222
340 CX(J) # XIJ2D + (CXS + F1) * S1	XYZZ	323
CY(J) = YIJ2D + (LIJ2D/Y2(I)) +(CYS + F2) * S1	2272	324
CZ(J) = =(2,0 + LJ2D / Y2(I)) + (CZS + F3) + SI	SZYX	50
C*** ***K3 = 420 FOR SURFACE VORTICITY PF TRUE	XYZZ	326
400 GO TO K3, (410,420)	XYZZ	327
CAAA AAAKI H 420 FOR STRIP VORTEX	XYZZ	328
410 GO TO K1, (570,420)	2772	625
C*** ***FLOW OF CONTROL REACHES HERE FOR (PF#TRUE) OR ((FLG15 GT 0 AND	XYZ2	330
C*** ***NLF LE 0 (LIFTING BODY)) AND (I NE J DN BODY OR ANY OFF BODY))	224X	M M
420 IF (RSMALL)GO TO 542	22 A X	2 2 2
FV1 = (T2=T1) / T7 + EEK / T10	XYZZ	333
IF (IS,GT,1) GO TO 440	XYZZ	334
C * FIRST PASS	XYZ2	335
AX1 B FV1	XYZZ	336
AX2 8 FV2	XYZZ	337
	227X	300
AY2 = FV4	XYZZ	\$ 2 Q
	22XX	340
60 TO 570 11 570 11 11 11 11 11 11 11 11 11 11 11 11 11	ZAX	341
440 IF (IS,EG,NI) GO TO 500	ZZAX	342
IF (IV) 460,450,460	SZAX	343
C * EVEN PASS	XYZZ	344
450 AX1 = AX1+4.s+FV1	224X	345
AX2 = AX2+4 *FV2	XYZZ	346
AYI = AY1+4 AFV3	XYZZ	347
AYD B AY244 AFV4	X Y Z Z	348
	XYZZ	349
	XYZZ	350

CIAX

376 370 0 0 0 0 M M 352 358 500 9 2 2 0 251 350 0 360 362 363 364 500 561 XYZZ X Y Z Z X Y Z Z X Y Z Z XYZZ XYZZ 2ZAX 22AX XVZZ XYZZ X 7 2 2 XYZZ XYZZ XYZZ 22XX SZ*(AXZ+FVZ) S2* (AY2+FV4) 8,0 (T32**2) ~ (T39 * T34C) AXV(J) E =S4*(AX1+FV1) =S2*(AX2+FV2) AYV(J) = =S4*(AY1+FV3) +S2*(AY2+FV4) GO TO 550 AXV(J) = AXV(J) = S4+(AX1+FV1) = AVV(J) = AVV(J) = S4+(AY1+FV3) + GO TO 570 544 IF(IS "EQ" NI)GO TO 548 IF(IV "NE" 0)GO TO 546 C*** ***EVEN PASS SMALL ELEMENT SMALL FLEMENT IF (BON, NE.0.) GO TO 540 FV1 + FV1 4.0 x FV1 4.0 x FV2 * LAST PASS IF (J#I) 540,520,540 * UPD PASS AX2+FV2+FV2 = AY24FV44PV4 AX14FV14FV1 AY1+FV3+FV3 T34C = T348 = FV1 = (T38 + FV2 = (T32 / 4 * 1×* C*** *** ODD PASS AX1 = FV1 AY1 = FV2 60 70 550 60 70 570 GO TO 570 IV = 0 n I V = 0 IV = 1 546 AX1 = N Û. <u>د ×</u> 5 X X **AX 1** ¥ 8 460 540 N 3 10 **门会会员** C C

XYZZ

XYZZ

0 0 0 0 0 0 7 7 7 7 22 415 415 617 389 900 230 414 4.5 2 386 387 388 390 202 293 390 305 395 298 0000 0000 0000 404 205 407 010 0 2 N XYZZ X X Z Z X X Y Z Z X X Y Z Z X X Y Z Z X XYZZ XYZ2 XYZ2 XYZZ XYZ2 22XX XYZZ XYZZ XYZZ ~ m ~ TEMP1 #((=8,0*T8**3) = (12,0*T1*T19) + (26.0*T15*T8) 1 + (2.0*T18*(2.0*T1 =5.0*T2)))* EFK/T10 TEMP2 # EKK * ((8.0*T19) + (4.0*T1*T8) = (2.0*T15) = (4.0*T18) F2 # (TEMP1 + TEMP2) / (T13 * T7) 16 ŧ. 504 (1 A 4 4 (T16 = T15) * EKK) * (T16 = 3,0 * T15) = -YIJ2D + (LIJ2D / Y2(I)) + (AX1 + FV1)*S1 AX1 035 IS TRUE C*** ***LAST PASS SMALL ELEMENT 548 IF ((I "NE" J) "UR" (BUN "NE" 0"0))GN TU C*** ***I = J ON BODY ~ TRUE AXV(J) = AXV(J) - YIJ2D + (LIJ2D / Y2(1) AYV(J) = AYV(J) + XIJ2D + (AY1 + FV2)*S1 \sim \sim <u>له</u>) * ((EEK / 710 <u>له</u> <u>له</u> AYV(J) = XIJ2D + (AY1 + FV2)*S1 C*** ***K4 = 560 FOR SURFACE VORTICITY 550 GD TD K4, (560,570) C*** ***FLOW OF CONTROL REACHES HERE ~ T20 = SQRT(T2 / (T1 + T4) CARA ARAI NE J OR ANY OFF BODY IF (T20 LT.0.01) GO TO 590 AY(J) = AYV(J) IF (IEC.EQ.=1) GT TU 1000 IF (T21.LT.0.08)GU TD 595 FV2 =(13 / (117 +17) TIS # YJ # YZ(I) ##3 \$ = (77/113) r T2 * F1 = 714 * 714 = 71 * 71 = 71 * 71 FV2 CT14 * EKK)) AX(J) = AXV(J) \$ 1B 2014 ✦ IVA = GO TO 550 i aC ┣─ GU TO 570 ---549 AXV(J) 1 v = 110 63 714 141 . ₩ 560

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FXTRA CHOSS FLOW EXTRA CROSS FLOW 1 727 -73 * 71 Y2(1)) F1 = (2.945245 - 1.2. F2 = 7.068584 + 128 + (3.0 F3 = 1.767146 + 128 /(T30**2.5 叙 * 叡 125 725 保 IF (IS - NI) 660,690,660 IF (IS - 1) 640,640,650 IF (IE) 680,670,680 ***SMALL YJ FORMULAS ***SMALL Y FORMULAS 4 -F1 = (2,945243 F2 = ((=14,13717) F3 = = F2 / 8,0 ***SIMPSON#S PULE **و** پ 4 ° 0 o T25 * Y2(1) 4 . 1 6 730**3°5 ***FIRST PASS FCXS = ECXS + AAAFVEN PASS T4 + T1 SAA UUUAAAA ECYS ECYS ECZS FCZS = FCZS= ECXS T25 = YJ**3 GO TN 1000 GO TO 1000 ECYS = F2 ECZS = F3 GU TR 630 ECXS = F1 ECVS = 11 89 IE = 0 1E = 1 125 123 1 11 FCYS ECXS FC7S 130 630 590 500 640 650 660 670 680 のななる Caaa Casa C & & & & Cooo の会会を

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55 10,700,710 10,700,710 10,700,710 10,700,710 10	420	2 457	2 458	2 459	2 460	2 461	2 462	2 463	2 464	2 465	2 466	2 467	2 468	2 4 6 9	2 070	2 471	2 472							
SS 10,700,710 * ELEMENTS ON MAIN DIAGONAL 0.0) GU TO 710 0.0) GU TO 710 SS4 * (ECVS + F1) 7(J) *S5 * (ECVS + F1) 7(J) *S5 * (ECVS + F2) 7(J) *S5 * F2) 8 * (ECVS + F1) 5 * (ECVS + F2)	ZXX	ZAX	ZAX	ZAX	ZAX	ZAX	ZAX X	ZAX	ZAX	ZAX	ZAX	ZAX	XYZ	ZAX	XYZ	ZAX	ZAX							
SS 10,700,710 * C ELEMENTS (IN MAIN DIAGONAL * C ELEMENTS (IN MAIN DIAGONAL * C ECXS + F C * C ECXS + F C ECXS + F C * C ECXS + F C C ECXS + F C ECXS + F C C C C C ECXS + F C C C C C C C C C C C C C C C C C C																								
55 10,700,710 * ELEMENTS ON MAIN DIAGONAL 0,0) GU TN 710 0,0) GU TN 710 0,0) GU TN 710 0,0) GU TN 710 *(J) #55 * (ECX5 + F2) 7(J) #53 * (ECX5 + F2) 7(J) #53 * (ECX5 + F2) 5 * (ECX5 + F1) 5 * (ECZ5 + F3) 5 * (ECZ5 + F3)																								
<pre>655 * * 700 ~ 10 * * 700 ~ 10 * * 700 ~ 10 * * 710 ~ 500 ~ 10 * * 710 ~ 500 ~ 10 * * 710 ~ 710 * * * 710 ~ 710 * * * 710 ~ 710 * * * 710 ~ 710 ~ 710 * * * 710 ~ 710</pre>					IN DIAGONAL				· · · · · · · · · · · · · · · · · · ·		<pre>> PUINTS</pre>													
О О </td <td></td> <td></td> <td></td> <td></td> <td>FUTS ON MA</td> <td>710</td> <td>(ECXS + FI</td> <td>(ECYS + F2</td> <td>(EC75 + F3</td> <td></td> <td>ON OFF BODY</td> <td>* F1)</td> <td>+ F.2)</td> <td>* F3)</td> <td></td>					FUTS ON MA	710	(ECXS + FI	(ECYS + F2	(EC75 + F3		ON OFF BODY	* F1)	+ F.2)	* F3)										
			S	0.700.710	* ELEN	0, 0) GU TN	* 7S= (())	(()) =S5 *	<pre>(1) +S3 *</pre>		U DIAGUNAL	+ * (ECXS	s * (ECYS	5 * (EC2S										
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4	, FLG	18	er619		FLG20	, FLG21	, FLG22	ELIP	000
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~3	NUNCCS	0 TYP	EC(5),	NLFCI	1), IEC,	GIGZ	iec,	ELIP	013
м	TYPEEC	(S), NUN	EC(S)					ELIP	1 0 1 0
DOUBLE	PRECISIO	N MEDR	, CASE					ELIP	010
INTEGER	FLG	M O	FLG04		FLG05	<i>,</i> FLG06	, FLG07	el lo	010
6 24	° FLG	08	, FLG09	- 43	FLGIN	FLG11	, FL612	f, I P	017
N	, FLG	13	eFLG14		FLG15	FLG16	, FLG17	FLIP	010
PN	, FLG	18	eFLG19		FLGZO	"FLG21	, FLG22	elip	010
5	, FLG	M ال	0 FLG24		FLG25	<i>,</i> FLG26	, FLG27	ELIP	020
REAL	Z X			N				FLIP	221
LOGICAL	5							EL I P	N N O
								6118	2023
COMMON	/CL/ X	1(100)。	¥1 (10	1010	XZ(100),	Y2(100) s	DELS(100),	EL 1 D	N O
লা	60	INAC100) , COSA (1003	XP(100),	VP(100)		ELLP	50
N	×	WAKE(11) , YWAKE	(11)				el la	920
COMMON	/TL/ A	(100),	8(100	• > •	AX(100) 0	AY(100) 0	AZ(100) "	EL I P	027
-	υ	X(100),	CYCLO	0),	CZ(100),	AXV(100) 0	AV(100) .	FLIP	0 N 0
2	>	N(100,5	J , VT (10	0,50	BUN,	IAC,		ELIP	029
м		8	ۍ م		J2°	SJ.	05,	FLIP	030
5		Χ,	٥٧,		NI,	×J.	٩٦٩	ELIP	031
ŝ	×	×	REX .		m x x °	X Ž	<u>لە</u>	ELIP	n N N N N
								ELIP	n n C
	A STAK							FLIP	034
FTA H	×× ××							FLTP	500

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ELIP 42 (ETA * FTA \sim FORMAT (140 36H *** ERROW IN SUBROUTINE ELIP * ETA# F15,8 -1249859E0))) = ELN * ETA * (.6260601E-1 * ETA * ETA ETA ETA * (,3328355E+1 ·5 + ETA * WRITE(6,800) [,XJ,DX,YJ,DY,X2(1),Y2(1),XK (• 9666344E=1 (. 3742564E=1 5264496F=2 736506F=1 9200180F-1 噄 ¢))) - FLN * ETA & ♦ ETA 42 * ETA * • + F.TA * (.4432514F0 5 1 3 2 FTA FTA * (6880249E=1 ()))))FORMAT(1H , 15, 7F15,6) [3590092E-1 .4069698Em1 .4757384E-1 .4417870E=2 2499837E0 IF (FTA) 20,20,40 .1451196Fm1 20 WRITE (6,30) ETA 1 386294F0 FTA = 0.00005 40 ELN=ALNG(ETA) RE TURN г Х П 61 E E K F N D N 3 N ŝ 800 8

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020

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	SICA JAI					nloz	00
COMMON	HEDR(1)	O) CASE	80 N °	NNC NNC		NOTS	002
1	,FLG03	,FLGO4	, FLGOS	FLGO6	, FLG07	NOTS	200
∩ ;	e FLGOR	, FLG09	FLGIO	e FLG11	, FLG12	NOTS	000
ک	,FLG13	, FLG14	FLG15	FLG16	FLG17	NOVS	002
3	,FLG18	0FLG19	FLGZD	, FLG21	, FLG22	NOTS	000
ŝ	, FLG23	0 FLG24	, FLG25	, FLG26	, FLG27	NOTS	001
			•			NOTS	000
COMMON	N T o	ND(11) »	MN. NUI	VA(S), TYPE	A(5),	NOTS	600
	NERIO	NERZO	NMA, NSI	IGA NSIG	, , ,	NOTS	010
2	NUNC (S) .	TYPEC(5),	NLF(11), IE(SI NSIG	EC,	NOTS	011
•7	TYPEEC (5)	, NUNEC (S)				NO 7 S	012
DOUBLE	PRECISION M	EDR, CASE				NOTS	50
						NO4S	910
COMMON	RNGWNG/ V	A(100,2),	VR(100,2) , VAN	ICLOOD VATC	[00]	NO1S	015
						NOTS	016
INTEGER	FLG03	, FLG04	FLGOS	, FLG06	, FLG07	N010	017
	, FLG08	, FLG09	FLGIN	FLG11	, FLG12	NOTS	018
2	, FLG13	o FLG14	, FLG15	, FLG16	, FLG17	NOTS	019
2	, FLG18	FLG19	FLG20	<i>r c c s i</i>	0 FLG22	NO1S	020
17	, FLG23	, FLG24	FLG25	FLG26	, FLG27	NOTS	021
			• .			NOTS	222
COMMON ,	/CL/ X1(1	003 " YICI	00), X2(100),	, Y2(100),	DELS(100),	NOTS	023
5×4	SINA	(100), COSA	(100), XP(100)	, YP(100)		NOTS	024
ŝ	· X Z A X	E(11) , YWAK	E(11)			NOTS	025
						NDTS	026
COMMON	/TL/ ACIU	0), B(10	0), AX(100),	, AY(100),	AZ(100)»	NOTS	027
	CXCI	00), CY(1)	00) · CZ(100)	• AXV(100) •	AVV(100),	NUTS	028
ŝ	I)NN	1)TV . (2,00	00,5),BUN,	IAC		NUTS	029
~	Ι 0	ي م	J1,	51,0	05,	NOTS	030
1	DX .	DY .	NI.	× J ×	٩Jø	NOTS	031
ŝ	N X N	E E E E E E E E E E E E E E E E E E E	m k k	×	5	NOTS	032
						NOTS	033
REAL MI	N.KAY					NOVS	034
LOGICAL	PF P	19 m.				NOTS	035

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υ	S 104	9 M O
C _{***} FULLOWING ARE 3 ARTHMETIC FUNCTIONS	のトロイ	037
	S L O N	038
DWFG(Z_SMALLR_BIGR) = 1.0 + ((Z**Z + (SMALLR=BIGR)**2) /	NOTS	039
(2.0*SMALLY * BIGR)	NOTS	040
BETAF(Z_SMALIR_BIGR) = ARSIN(Z / (SORT(Z**2 + (SMALLR=BIGR)**2)))	NU1S	041
	NUTS	042
	NOTS	043
AKAYF(Z,SMALLR,BIGR)= SGHT((4,0 + SMALLR + BIGR) /	NUTS	044
(Z**2 + (SMALLR + BIGR)**2))	NO1S	045
	NO13	046
DO 100 1800 =1,FLG14	NOTS	047
Z z X2(I) = XWAKE(IBOD)	NUTS	048
OMEGA = OMEG(Z, Y2(1), YWAKE(IBOD))	NOVS	049
BETA HBETAF(Z, YZ(I), YWAKE(IBUD))	N015	020
KAY HAKAYF(Z, YZ(I), YWAKF(IDUD))	NOTS	
CALL QC(DMEGA, QM, Q)	NO13	052
	NOTS	053
C *** SMALLR IS Y2(I)	NOTS	054
C *** BIGR IS YWAKE(IBDD)	NOTS	055
IF (YZ(I) "LE " YWAKE(IBOD)) GN TO 30	NOTS	036
	NOTS	057
C *** SMALLR GT BIGR	NOTS	050
	NOTS	050
BIGK = [Z / [SQRT(Y2(I) * YWAKE(IBUP))*2.0)) * QM =	NOTS	000
1 (1 570796 * HLAMB(BETA/KAY))	NO7 S	061
GO TO 40	NOTS	062
	NO1S	063
C*** * SMALLR LE RIGR	NOTS	064
	NOTS	065
30 BIGK # 3,141593 + (2 / (SQRT(Y2(1) + YWAKE(IBOD))+2,0)) +0M +	NO1S	066
1 (1,570796 * MLAMB(BETA,KAY))	NO1S	067
	NOTS	068
Ca** * NOTE THAT VA AND VR WILL NOT YET BE MULTIPLIED BY DGAMMA/DZ	NOVS	060
CAAA & WHICH IS REALLY THE INPUT PRESCRIBED VORTICITY	NO7S	040

NO73

NO13

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FUNCTION HLAMB (BETA.K) S subdouting faithiates the hfumans's Lambda	FUNCTION C	BETA	AND	×	HLAU HLAU	000 000
000000 E PRECISION A.F.	- - 9				H A B B B B B B B B B B B B B B B B B B	0031
HEAL R Data twop/0.6366197724/					HLAB	002
CALL INEL (FI,FI,PI,BETA,BETA,1.0+K**2 A = 1 0 = K ++2	e0.1.01)				H L A B B B A L A B A C A B A C A C A C A C A C A C A C	000
CALL FLLC (A PEPE)					H H H H H H H H H H H H H H H H H H H	000
CALL FLLC (A PERC2)					HLAB Alab	
HLAME H ISUFACTATI + (TEFJATI) Return FND					HL AB	200 200

NLAB

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HLAB

SUBROUTINE CALCULATES THE LEGENDRE FUNCTIONS OF THE SECOND KIND HALF ORDER, THE ARGUMENTS ARE# OMFG ARGUMENT FOR WHICH LEGENDRE FUNCTIONS WILL BE FOUND OM VALUE OF LEGENDRE FUNCTION OF MINUS ONE HALF ORDER OVALUE OF LEGENDRE FUNCTION OF PLUS ONE HALF ORDER OVALUE OF LEGENDRE FUNCTION OF PLUS ONE HALF ORDER OUBLE PRECISION OMEGD, ARG, A, F, E, QMD, QD UBLE PRECISION OMEGD, ARG, A, F, E, QMD, QD MEGDEOMEG MEGDEOMEG MEGDEOMEG MELELLC (A, F, E, 1) ALL ELLC (A, F, E, 2) MELELLC (A, F, E, 2) MELELLC (A, F, E, 2) MELELLC (A, F, E, 2) MELELLC (A, F, E, 2) MEDEFARGENOS	00000000000000000000000000000000000000	N M 3 N 36 N 8 M 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
HALF ORDER, THE ARGUMENTS ARE# THALF ORDER, THE ARGUMENTS ARE# THEG ARGUMENT FOR WHICH LEGENDRE FUNCTIONS WILL BE FOUND Q VALUE OF LEGENDRE FUNCTION OF MINUS ONE HALF ORDER Q VALUE OF LEGENDRE FUNCTION OF PLUS ONE HALF ORDER OUBLE PRECISION OMEGD, ARG, A, F, E, QMD, QD UBLE PRECISION OMEGD, ARG, A, F, E, QMD, QD MEGD=OMEG	00000000000000000000000000000000000000	00000000000000000000000000000000000000
THEG ARGUMENT FOR WHICH LEGENDRE FUNCTIONS WILL BE FOUND A value of Legendre Function of Minus one Malf Order Value of Legendre Function of Plus One Malf Order Ubble precision omego, arg, a, f, e, qm0, qd MgGD=OMEG MgCD=OMEG Mged=0, s Mdef=Argeto, S Mdef=Argeto, S Mdef=Argeto, S Mdef=Argeto, S Mdef=Mged, S Mged=Mged, S Mged=Mged, S Mged=Mged, S Mged=Mged Mged=Mged Mged=Mged Mged=Mged Mged=Mged Mged=Mged Mged=Mged Mged	00000000000000000000000000000000000000	2 N 9 P 8 9 0
QN VALUF OF LEGENDRE FUNCTION OF MINUS ONE HALF ORDER Q VALUE OF LEGENDRE FUNCTION OF PLUS ONE HALF ORDER JUBLE PRECISION OMEGD,ARG,A,F,E,QMD,QD WEGD=OMEG RG=2,0/(OMEGD+1,0) E1,0=ARG ALL ELLC (A,F,E,1) ALL ELLC (A,F,E,2) ALL ELLC (A,F,E,2) ALL ELLC (A,F,E,2) ALL ELLC (A,F,E,2)	00000000000000000000000000000000000000	N 9 N 9 N 9 N 9 N 9 N 9 N 9 N 9 N 9 N 9
Q VALUE OF LEGENDRE FUNCTION OF PLUS ANE WALF ORDER DUBLE PRECISION OMEGD,ARG,A,F,E,QMD,QD WEGD=OMEG RG=2,0/(OMEGD+1,0) E1,D=ARG ALL ELLC (A,F,E,1) ALL ELLC (A,F,E,2) ALL ELLC (A,F,E,2) ALL ELLC (A,F,E,2) ALL ELLC (A,F,E,2) ALL ELLC (A,F,E,2)	0000000 000000000000000000000000000000	9 N 80 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
DUBLE PRECISION DMEGD,ARG,A,F,E,QMD,QD MEGD=DMEG RG=2,0/(DMEGD+1,0) #1.0=ARG ALL ELLC (A,F,E,1) ALL ELLC (A,F,E,2) ALL ELLC (A,F,E,2) ALL ELLC (A,F,E,2) AD=FAARG*40,5	00000 00000	
WEGDENMEG RGE2.0/(OMEGD+1.0) E1.0=ARG ALL ELLC (A.F.E.1) ALL ELLC (A.F.E.2) ALL ELLC (A.F.E.2) ANEF*ARG*0.5	0000 0000	
RGE2.0/(OMEGD+1.0) #1.0=ARG ALL ELLC (A.F.E.1) ALL ELLC (A.F.E.2) ADEF*ARG*40.5		
E1.D=ARG All EllC (A,F,E,1) All EllC (A,F,E,2) MD=F*ARG*40,5	000	010
ALL ELLC (A,F,E,1) ALL ELLC (A,F,E,2) MD=F*ARG**0,5	000	
ALL ELLC (A,F,E,2) Md=FAARG*+0,5		012
	000	810 0
	000	013
0==F×{?~0*(CMEGD+1~0))**0.540MEGD*9MD	000	014
	000	015
	000	016
FTURN	000	017
	000	018

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SUBROUTINE ELLC (A,K,E,I)	U L L L L L	00100
THIS SUPROUTINE CALCULATES THE ASSUCIATED COMPLETE ELLIPTIC INTEGRALS	R L L L	200
OF THE FIRST OR SECOND KIND	ELC ELC	003
THE ARGUMENTS AREX		004
A ARGUMENT (K SQUARED) FOR WHICH EZ OR KZ WILL BE FUUND	FLC	002
K VALUE OF ASSOCIATED COMPLETE ELLIPTIC INTEGRAL OF FIRST KIND	FLC FLC	000
E VALUE OF ASSOCIATED COMPLETE ELLIPTIC INTEGRAL OF SECOND KIN	ELC FLC	007
I IF EQ 1, COMPUTE K J IF EQ 2, COMPUTE E	FLLC	008
DQUBLE PRECISION K, E, CON(32), A, LN4, CF(29), CL(3), DLOG	ELLC	1600
DOUBLE PRECISION CON(32), CF(29), CL(3)	FLC	0100
EQUIVALENCE (CON, CF), (CON(30), CL)	ELLC	110
DATA CF /9 65735907975890180 - 7.3 08855734867526940 - 2,1 4978988178	FLC	012
1704629Dm2,9_6587579861753113Dm3,1_1208918554644092Dm2,1_3855601247	ELLC	013
215656Dm2,6.6905509906897936Dm3,6.499844332939018Dm4,1,249999999411	FLC	014
37923D=1,7 ₈ 0312426464627361D=2,4.8818058565403952D=2,3,706839893415	ellc	015
454220-2,2,7189861116788250-2,1,41053807761580480-2,3,1831309927862	S L L L L	016
5886D=3,1.5049181783601883D=4,4.4314718112155806D=1,5.6805657874695	SIL SIL	017
6358n=2,2,1876220647186198D=2,1,2510592a10844644D=2,1,3034146073731	ELLC	018
74320=2,1,53771025285520190=2,7,33561649742903650=3,7,0980964089987	FLC	010
8229D=4,2.4999999995617622D=1,9.57499202496A0113D=2,5.8582839536559		020
9024D=2,4,23828074569479D=2,3.0302747728412848D=2 /	ere Flo	021
DATA CL / 1 55251299480407210=2,3,48386794358964920=3,1,642721079	FLLC	022
17048025D=4 /	ELLC	023
LN4 = 1 ₈ 38629436111989D0	ELLC	024
IF (A EQ.O.O) GO TO 4	FLLC	025
GO TO (1,2),I	ELLC	026
1 K = LN4 + ((((((CON(8)*A+CON(7))*A+CON(6))*A+CON(5))*A+CON(4))*A	FLC	027
1+ CON(3))*A+CON(2))*A+CON(1))*A = DLOG(A)*(0,5+(((((CON(16)*A+	ELLC	0 7 8 0
2CON(15))*A+CON(14))*A+CON(13))*A+CON(12))*A+CON(11))*A+CON(10))*A	FLC	020
34 CON(9))*A)	FLC FLC	030
GO 70 3	ELLC	120
2 E = 1 000+(((((CON(24)*A+CON(23))*A+CON(22))*A+CON(21))*A+CON(20)		032
<pre>1))*A+CON(19))*A+CUN(18))*A+CON(17))*A = DLOG(A)*((((((CON(32)*A)</pre>	ELLC	033
2+ CON(31))*A+CON(30))*A+CON(29))*A+CON(28))*A+CON(27))*A+CON(26))*	ELLC	034
34+CON(25))*A)	FLC	035

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	CIDDOUTINE STITUTES XXSD. XN. PHT. PIEL		001
1 4 6	TE SUBDUITING FAIFIN ATES THE INCOMPLETE ELLIPTIC INTEGRAL OF THE	FLNT FLNT	002
		ELNY	N 0 0
r - 		ELNT	004
ى ر	VN VALUE OF MINUS ALPHA SQUARED	ELNI	500
		ELNT	000
<u>ں</u>	DATE VALUE OF THE PRESENTE THE CRAL OF THIRD KIND	ELNT	007
ء • ر		FLNT	0 0 Q
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	DATA DIND / ADADASA/	ELNT	010
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	75 / ARS/Pel. 570796) . LE. 10.000 (∞7)) GO TO 10	ELN7	025
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	10 10 10 10		NT 03(
	X X Z 1 .		
	GUTULI		120 11
	PIEE(XX+1,)*A*D		11 03
	G17047		NT 041
	X X X Z = 1 =		NT 041
	xx=xx+2°		11 04
	P#2°*KPeP1		VT OU
	607011	2	NT 0.01
	PIFHA* (XX*D+XXX*SUM)	193	NT OU
	G07047		VT 041
0	IF(SK,EQ,1,)_GOTO48	1	17 0.4
	IF(FN_EQ_(~1)) GO TO 48	<u> </u>	47 046
6344	IF(P_GT,10,E=4)G01013	2	17 00
	IF(FN_GT_0.)GOTO12	EL I	11 050
	SUMEP		120 11
	G07045	R L	NT 05
N	RRT#SORT(FN)	2	120 11
	SUMSATAN (P*RRT)/RRT		NT 051
	601045		11 050
P			NT 050
	02×40×45		11 050
			VT 050
	IF(SK_GT_0 % 64)GOTO20		4T 03.
	IF(ABS(FN),GE,0,6)GOTO15		190 11
	POWER SERIES IN N AND K SQUARED		VT 06
	GARL .	2	NT 061
	SB#SK/2,		NT 06
	CBESAC		11 061
			VT 06!
			47 066
	SUMEP		NT 06
	X # SUM *		47 061
3			NT 06
	CAr(=CB/(2°*(FM+1°)))+(1°=°5/(FM+1°))+CA		11 070

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ELNT

ELNY

0 1 2 0 1 1 2 0 1 1 073 074 540 076

610 010 070

Eger/(2,4FM)+(1,00,5/FM)4E 101 3 POWER SERIES IN K SQUARED 0 IF((SB*CA),GT,X) GO TO IF(ABS(Y) ,LT,X) GO TO IF (RT NE . 0.) GO TO 16 Gas/C IF(C.GT.4.E.S)G0T017 G#(HP=(C/(RT=S))/RT 工師工々(1。80。D/(FIT41。)) G以目工々GをPK IF(G2°LE°G1)G0T045 GEATAN(RT+S/C)/RT RTESORT(1 +FN) SUM#SUM462 Ga(E-G)/FN 61 m G # 1 = E = 8 メやぼつの言語つの DAPEL . BOX FMEFM+1. Coecoaco FMUFM41 NO A X O B X O くしゃ くの 御 入 601019 607018 607014 607018 この中に日本 PX BOX · O · W · SUMBG Net. 101 6) 9 **\$** ¢ 0 N

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ELNT

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υ υ	ADDITION FORMULA	ELNT	101
21	ZPESGRT(1.=SK*SZ)	ELNT	108
	RTTESORT(ABS(FN*(FN+1,)*(FN+SK)))	FLNT	601
	SST#(1.=ZP)/(SK*(C+1.))	FLNT	033
	(dZajatosatissatis) / (ltzastosatis) ada	FUNT	
	IF (FN) 22, 29, 25	ELNT	NII
える	IF(RT1,NE,0,) GO TO 24	ELNT	211
	RES/(C+1.)	ELNT	
	IF(FN _e Ne _e (-1.)) GO TO 23	ELNT	573
	CFE(2,*R*SK*SST*S=(S/C)*ZP)/SKP	ELNT	116
	607030	ELNT	117
23	CF=(SST+(S=(2,/R))+S+C/ZP)+(SK/SKP)	ELNT	81
	601030	ELNT	6 5 8
24	IF(FN*(FN+SK) "LT.0,) GO TO 26	ELNT	021
5	CFE(FN/RT1)*ATAN(XP)	ELNT	121
	607030	FLNY	25
26	IF(ABS(XP)。GE_0。1)GOTO27	ELNT	123
	Y x z X P z * 2	ELNT	128
	YX82。☆XP¢(1。∻YX¢(1。/3。∻YX¢(。2∻YX/7。)))	FLNT	521
	G07028	FLNT	126
r	YX=ALOG((1,+XP)/(1,"XP))	ELNT	127
60 RJ	CFE(FN*YX)/(2,*RT1)	ELNT	0 2 J
	GOTO30	FUNT	129
0 N	CF to b	FLNT	130
0 M		ELNT	131
	S=SQRT(SST)	ELNT	132
	CESORT(1, ~SST)	ELNT	133
	607032	ELNT	130
31		ELNT	521
	GDT045	ELNT	136
n M	UES/C	FLNT	137
	Val./C	FLNT	130
		ELNT	139
		ELNT	140

ELNT

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ELNT

1034 1106(U+V)		N
UG (I) ♦ V)	FLZT	43
		3 1
FT SKP) GOTOS7		n 4
2 SERIFS IN 14N AND 1 - (K SQUARED)		47
		80
0 5 * 0 × P	E N L	49
T & R) / 2 。	ELNT	00
2 × 5 × 5	FLRT	S.
	EL NT	2
ÄL	FLNT	5
UM # 1 . E = B	FLNT	54
	ELNT	5
BE=(2°×FM+1°)*AL)/(2°4(FM+2°))	FLNT	0
	ELN	23
SUM+X	ELNT	50
BS(X)。LT。T1)GUTU44	ELNT 1	59
M + 1	FLNT	60
((2°*FM+1°)/(2°*(FM+1°)))*CB*SKP	FLNT	6.1
9S(BE) "LT,10°E=30) 8E=0.	ECZ	62
	FLN	5
36		6.0
R SERIES IN 1 = (K SQUARED)	E Z J	6.9
RAT (ABS (FN))	FLNT	66
N)38,39,40	ELNT	29
DG((1°+K1*S)/(1°=KT*S))/(2°*RT)	ELNT	6
	ELNT 1	6.9
	ELNT	70
		7 2
AN (RT+S) / RT	ELNT	N
	ELNT	1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
SKP		74
0 • 5	ELNT	5

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\$ 1 \$ 673 00 N 00 63 8 60 99 ~ 0 0 0 0 4 0 0 0 0 0 4 192 194 5 96 190 00 200 613 611 197 ELNT ELNT ELNT ELNT ELNT ELNT ELNT ELNT FLNT ELNT ELNT ELNT ELNT ELNT ELNT ELNT CASE UF PI(1,1,PHI) 50 PIE = 0,5*(TAN(P)/ COS(P)+ALDG(TAN((HP+P)/2,0))) 60 T0 47 RHT/(2.4FM)=(1.5/FM)4R IF (ABS(X) .LT .T1) GOT043 SUM=SUM/D IF(AB.LT.0.)GUTU31 XIAPA (FN&Q+R) APKP PIF=PIE+PIE*RUUND APHEAPA(1. + S/FM) THSUMAL EMB ERROR RETURN PXPHPXP&SXP F(B)5,9,46 SUMESUMex 0-(0-2)=D PIFEA+SUM FMRFM41. 607042 RETURN PIFED G01047 TUTAN FMEL END 22 10100 1010 1010 **1** υ

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<pre>FIRST, SECOND AND THIRD KINDS, THE AGUMENTS AFE# F VALUE OF INCOMPLETE FLLIPTIC INTEGRAL OF THE FIRST KIND NALUE OF ALPHA SQUARED NALUE OF ALPHA NALUE OF ALPHA SQUARED NALUE OF ALPHA NALUE OF ALPHA NALU</pre>	SUBROUTINE INEL (F,E,PI,A,PHI,SKT,K3,K2,K1) THIS SUBROUTINE CALCULATES THE INCOMPLETE ELLIPTIC INTEGRALS OF THE		100 00 00
<pre>F VALUE OF INCOMPLETE FLLIPTIC INTEGRAL OF THE FIRST KIND INEL 004 A VALUE OF NUCOMPLETE FLLIPTIC INTEGRAL OF THE SECOND KIND INEL 005 A VALUE OF ALPHA SQUARED SHI VALUE OF ALUE OF NOT SUBLE OF ALPHA SQUARED SHI VALUE OF ALUE SHI VALUE /pre>	TRST, SECOND AND THIRD KINDS. THE ARGUMENTS ARE#	INEL	200
F VALUE OF INCOMPLETE ELLIPTIC INTEGRAL OF THE SECOND KIND INEL 000 PI VALUE OF PHI WALUE OF PHI WALUE OF PHI WALUE OF PHI WALUE OF NORMELETE ELLIPTIC INTEGRAL OF THE THIRD KIND INEL 000 WAS IF E0 0, DD NOT COMPUTE F I F NE 0, COMPUTE F WALLE OF SOUND AND COMPUTE F I F NE 0, COMPUTE F WALLE OF SOUND AND COMPUTE F I F NE 0, COMPUTE F WALLE OF SOUND AND COMPUTE F I F NE 0, COMPUTE F WALLE OF SOUND AND COMPUTE F I F NE 0, COMPUTE F WALLE OF SOUND AND FOUND F I IF NE 0, COMPUTE F WALLE OF SOUND AND FOUND F I IF NE 0, COMPUTE F WALLE OF SOUND AND FOUND F I IF NE 0, COMPUTE F WALLE OF SOUND AND FOUND F I IF NE 0, COMPUTE F MARCH OF SOUND AND FOUND F I IF NE 0, COMPUTE F MARCH OF SOUND AND FOUND F I IF NE 0, COMPUTE F MARCH OF SOUND AND FOUND F I IF NE 0, COMPUTE F MARCH OF SOUND AND FOUND F I IF NE 0, COMPUTE F MARCH OF SOUND AND FOUND F I IF NE 0, COMPUTE F MARCH OF SOUND AND FOUND F I IF NE 0, COMPUTE F MARCH OF SOUND AND FOUND F MARCH OF SOUND AND FOUND F MARCH OF SOUND AND FOUND F MARCH OF SOUND F MA	F VALUE OF INCOMPLETE ELLIPTIC INTEGRAL OF THE FIRST KIND	INEL	004
PI VALUE OF ALLPHA SQUARED INEC NTE PI NEL 007 PH VALUE OF ALLPHA SQUARED INEC NOF NEL 007 PH VALUE OF ALLPHA SQUARED INEC NOF NEL 007 SKI VALUE OF ALL NALUE OF ALL NEL 007 SKI VALUE OF ALL NALUE OF ALL NEL 007 SKI VALUE OF AL NALUE OF ALL NEL 000 SKI VALUE OF ALL NALUE OF ALL NEL 000 SKI NALUE OF ALL NALUE OF ALL NEL 000 SKI IF EQ 0, DO NOT COMPUTE F IF NE 0, COMPUTE F NEL 013 DOUBLE FARCISTON ARG, FD, ED NOT COMPUTE F IF NE 0, COMPUTE F NEL 013 DATA PIT/1.570706337 SKIPA NEL 013 NEL 013 FE0.0 CONDUCT F IF NE 0, COMPUTE F NEL 013 NEL 013 FE0.0 CALL ELINT3 SKIPA NEL 023 <td>F VALUF OF INCOMPLETE ELLIPTIC INTEGRAL OF THE SECOND KIND</td> <td>INEL</td> <td>002</td>	F VALUF OF INCOMPLETE ELLIPTIC INTEGRAL OF THE SECOND KIND	INEL	002
A VALUE OF ALPHA SQUARED INEL 000 FH1 VALUE OF KH1 NULE OF KSQUARED SK1 FE0 0, DO NOT COMPUTE F1 I IF NE 0, COMPUTE F NULL 000 K2 IF E0 0, DO NOT COMPUTE F1 I IF NE 0, COMPUTE F NULL 000 K1 IF E0 0, DO NOT COMPUTE F1 I IF NE 0, COMPUTE F NULL 000 DOUBLE PRECISION ARG, FD, ED NO NOT COMPUTE F1 IF NE 0, COMPUTE F NULL 010 DATA PIT/1.57079633/ NULL 000 NOT COMPUTE F1 IF NE 0, COMPUTE F NULL 012 DATA PIT/1.57079633/ NULL 010 NOT COMPUTE F1 IF NE 0, COMPUTE F NULL 012 DATA PIT/1.57079633/ NULL 010 NOT COMPUTE F1 IF NE 0, COMPUTE F NULL 012 DATA PIT/1.57079633/ NULL 010 NOT COMPUTE F1 IF NE 0, COMPUTE F NULL 012 DATA PIT/1.57079633/ NULL 010 NOT COMPUTE F1 IF NE 0, COMPUTE F NULL 012 DATA PIT/1.57079633/ NULL 010 NOT COMPUTE F1 IF NE 0, COMPUTE F NULL 012 DATA PIT/1.57079633/ NULL 010 NOT COMPUTE F1 IF NE 0, COMPUTE F NULL 020 TF (X1.60.0) GO TO 240 NULL 010 NOT COMPUTE F1 IF NE 0, COMPUTE F NULL 020 TF (X1.60.0) GO TO 240 NULL 010 NOT COMPUTE F1 IF NE 0, COMPUTE F NULL 020 TF (X2.60.0) GO TO 240 NULL ELINT3 (SKI1.00 NOT COMPUTE F	PI VALUF OF INCOMPLETE ELLIPTIC INTEGRAL OF THE THIRD KIND	INEL	000
PHT VALUE OF PHI SK1 VALUE OF K SQUARD SK1 VALUE OF K SQUARD K2 IF E0 0, DO NOT COMPUTE F I IF NE 0, COMPUTE F K2 IF E0 0, DO NOT COMPUTE F I IF NE 0, COMPUTE F N2 IF E0 0, DO NOT COMPUTE F I IF NE 0, COMPUTE F DATA PIT/1,57079633/ NEL 012 DATA PIT/1,57079633/ NEL 012 F0008LE IF NE 0, DO NOT COMPUTE F I IF NE 0, COMPUTE F DATA PIT/1,57079633/ NEL 012 F0008LE INEL 012 DATA PIT/1,57079633/ NEL 012 F0008LE INEL 012 DATA PIT/1,57079633/ NEL 012 F0008LE INEL 012 F0008LE INEL 012 F1 (K3.EG.0) GO TO 220 INEL 012 F1 (K3.EG.0) GO TO 240 INEL 012 F2 (ABS/FH=PIT).6F.10.00**(=7)) GO TO 230 INEL 022 ARGE1,0=SKI INEL 012 ARGE1,0=SKI INEL 012 F1 (ARS.FD.0) GO TO 240 INEL 022 F2 (ABS/FH=PIT).6F.10.00**(=7)) GO TO 250 INEL 022 F2 (ABS/FH=PIT).6F.10.00**(=7)) GO TO 250 INEL 023 ARGE1.00.SKIPALE INEL 023	A VALUE OF ALPHA SQUARED	I n e (001
SKI VALUE OF K SQUARED INEL 010 K2 IF E00.00 NOT COMPUTE F1 IF NE 0.00 K3 IF E00.00 NOT COMPUTE F1 IF NE 0.01 K3 IF E00.00 NOT COMPUTE F1 IF NE 0.01 DOUIGLE PRECISION ARG, FD, FD NOT COMPUTE F1 IF NE 0.01 DATA PIT/11.57070633 NCCOMPUTE F1 IF NE 0.014 DATA PIT/11.57070633 NCCOMPUTE F1 IF NE 0.014 DATA PIT/11.57070633 NCCOMPUTE F1 IF NE 0.014 DATA PIT/11.57070633 NCCOMPUTE F1 INEL 013 PAGE NCCOMPUTE F1 INEL 013 NCCOMPUTE F1 INEL 013 PAGE NCL NCCOMPUTE F1 INEL 013 NCCOMPUTE F1 INEL 013 F100 NCT NCCOMPUTE F1 INEL 012 NCCOMPUTE F1 INEL 013 F100 NCT NCT NCT NCT NCCOMPUTE F1	PHI VALUE OF PHI	infl	000
K3 IF E0 0, DO NOT COMPUTE F I F NE 0, COMPUTE F INEL 012 K2 IF E0 0, DO NOT COMPUTE F I F NE 0, COMPUTE F INEL 012 DATA PIT/1.57079633/ DATA PIT/1.57079633/ INEL 013 DATA PIT/1.57079633/ E00 DO NOT COMPUTE F I IF NE 0, COMPUTE F INEL 013 DATA PIT/1.57079633/ E00 DO NOT COMPUTE F I IF NE 0, COMPUTE F INEL 013 DATA PIT/1.57079633/ E00 DO NOT COMPUTE F I IF NE 0, COMPUTE F INEL 013 TF 00 IF 00 DT 220 INEL 010 INEL 010 TF 00 TF 012 DT 240 INEL 010 INEL 010 TF (K1,EE0,0) GO TO 240 TO 240 INEL 020 INEL 020 ARGE10.05KHI=PIT).6T.10.0**(=T)) GO TO 230 INEL 020 INEL 020 ARGE10.05KHI=PIT).6T.10.0**(=T)) GO TO 250 INEL 020 INEL 020 TALL ELLNT3 (SKI.0*PLO.0) GO TO 260 TO 260 INEL 020 INEL 020 TF (K2.E0.0) GO TO 260 TO 260 TO 260	SKI VALUE OF K SQUARED	1 N FL	000
K2 IF E0 0, DO NOT COMPUTE E ; IF NE 0, COMPUTE F INEL 012 K1 IF E0 0, DO NOT COMPUTE F ; IF NE 0, COMPUTE F INEL 013 DATA PIT/1.57070633/ FE0.0 DOUNT COMPUTE F ; IF NE 0, COMPUTE F INEL 013 DATA PIT/1.57070633/ FE0.0 DOUNT COMPUTE F ; IF NE 0, COMPUTE F INEL 013 FE0.0 CALL ELIN'3 (SK1, AA, PH1, P1) INEL 014 INEL 014 IF (K1.E00,0) GO TO 220 CALL ELIN'3 (SK1, AA, PH1, P1) INEL 023 INEL 019 IF (K1.E00,0) GO TO 240 TO 240 INEL 023 INEL 023 AGET1.05KITAPIT).GT.10.0**(F)) GO TO 230 INEL 023 INEL 023 AGET1.05KITAPIT).GT.10.0**(F)) GO TO 230 INEL 023 INEL 023 AGET1.05KITAPIT).GT.10.0**(F)) GO TO 230 INEL 023 INEL 023 AGET1.05KITAPIT).GT.10.0**(F)) GO TO 250 INEL 023 INEL 023 AGET1.05KITAPIT).GT.10.0**(F)) GO TO 250 INEL 023 INEL 023 F#FD IT INEL 020 INEL 023 AGET1.05KITAPIT).GT.10.0**(F)) GO TO 250 INEL 020 INEL 023 F#FD IT INEL 020 INEL 023 F#FD IT INEL 020 INEL 020 <t< td=""><td>K3 IF EQ 0, DO NOT COMPUTE PI / IF NE 0, COMPUTE PI</td><td>INFL</td><td>0.50</td></t<>	K3 IF EQ 0, DO NOT COMPUTE PI / IF NE 0, COMPUTE PI	INFL	0.50
K1 IF 0. DO NUT COMPUTE F I IE NE 0131 DATA PIT/1.57079633/ FE0.0 INEL 0141 DATA PIT/1.57079633/ FE0.0 INEL 014 FE0.0 INEL 014 INEL 014 FE0.0 INEL 014 INEL 014 FE0.0 INEL 016 INEL 014 IF (K3.E9.0) GO TO 220 INEL 016 INEL 016 IF (K3.E9.0) GO TO 240 INEL 018 INEL 019 IF (K18.E9.0) GO TO 240 INEL 019 INEL 019 IF (ABS(PHI=PIT).GT.10.0**(=7)) GO TO 230 ARGE1.0*SKI INEL 023 CALL ELLNTS (SKI.0.0,PHI.F) INEL 023 INEL 023 CALL ELLNTS (SKI.0.0,PHI.F) INEL 024 INEL 024 CALL ELLNTS (SKI.0.0,PHI.F) INEL 024 INEL 024 IF (ASER) INEL INEL 024 INEL 024 CALL ELLNTS (SKI.0.0,PHI.F) INEL INEL 026 INEL 026 IF (K2.E0.0) <td< td=""><td>K2 IF EQ 0, DO NOT COMPUTE E / IF NE 0, COMPUTE E</td><td>lnel</td><td>011</td></td<>	K2 IF EQ 0, DO NOT COMPUTE E / IF NE 0, COMPUTE E	lnel	011
DGUBLE PRECISION ARG, FD, ED DATA PTT/1,57079633/ F=0.0 F=0.	KI IFEG 0, DO NOT COMPUTE F JIF NE 0, COMPUTE F	INEL	ev 10
<pre>DATA PIT/1.57070633/ F=0.0 F=0.</pre>	DOURLE PRECISION ARG, FD, ED	INEL	1210
F=0.0 F=	DATA PIT/1,57079633/	INCL	010
<pre>F=0.0 IF (K3.EG.0) GO TO 220 IF (K3.EG.0) GO TO 220 IF (K3.EG.0) GO TO 240 IF (K3.EG.0) GO TO 240 IF (M5(PHI=PIT).GT.10.0**(=7)) GO TO 230 ARG#1.0*SKI ARG#1.0*SCI ARG#1.0*SCI ARG#1.0*SCI ARG#1.0*SCI ARG#1.0*SCI ARG#1.0*SCI ARG#1.0*SCI ARG#1.0*SCI ARG#1.0*SCI ARG#1.0*SCI ARG#1.0*SCI ARG#1.0*SCI ARG#1.0*SCI ARG#1.0*SCI ARG#1.0*SCI ARG#1.0*SCI ARG#1.0*SCI ARG#1.0*SCI ARG#1.0*SCI ARG#1.</pre>		iner	510
<pre>IF (K3.E9.0) GD TD Z20 IF (K3.E9.0) GD TD Z20 IF (K1.EG.0) GD TD 240 IF (ABS(PHI=PIT).GT*10.0**(=7)) GD TD 230 IF (ABS(PHI=PIT).GT*10.0**(=7)) GD TD 230 ARGE1.0**XI ARGE1.0**XI F#FD GD TD 240 GD TD 240 GD TD 240 GD TD 240 IF (K2.E0.0) GD TD 240 IF (K2.E0.0) GD TD 240 IF (K2.E0.0) GD TD 240 IF (K2.E0.0) GD TD 250 IF (ABS(PHI=PIT).GT*10.0**(=7)) GD TD 250 IF (K2.E0.0) GD TD 250 IF (K2.E0.0) GD TD 260 IF (K2</pre>		INEL	910
CALL ELINT3 (SKI, =A, PHI, PI) IF (K1, EQ, 0) 60 TO 240 IF (ABS(PHI=PIT).6T, 10.0**(=7)) 60 TO 230 ARGE1,0=SKI CALL ELLC (ARG, FD, ED, 1) F#FD CALL ELLC (ARG, FD, ED, 1) F#FD CALL ELLC (ARG, FD, ED, 1) F#FD CALL ELLC (ARG, FD, ED, 1) IF (K2, EQ, 0) 60 TO 260 IF (K2,	IF (K3.EQ.0) GO TO 220	INEL	017
<pre>IF (K1.EG.0) GD TD 240 IF (ABS(PHI=PIT).GT=10.0**(=7)) GD TD 230 IF (ABS(PHI=PIT).GT=10.0**(=7)) GD TD 230 AGE=1.0=SKI CALL ELLC (ARG.FD.ED.1) F#FD CALL ELLC (ARG.FD.ED.1) F#FD CALL ELLC (ARG.FD.ED.1) F#FD CALL ELLC (ARG.FD.ED.1) F (K2.EG.0) GD TD 260 IF (K2.EG.0) GD TD 260 IF (K2.EG.0) GD TD 250 IF (ASG.FD.ED.2) F (ASG.FD.ED.2) F (ASG.FD.ED.2) F (ASG.FD.ED.2) F (ASG.FD.ED.2) F (ASG.FD.ED.2) IF (ASG.FD.ED.</pre>	CALL ELINT3 (SKI, #A, PHI, PI)	INEL	010
<pre>TF (ABS(PHI=PIT).GT.10.0**(=7)) GO TO 230 ARG=1.0=SKI ARG=1.0=SKI CALL ELLC (ARG.FD,ED.1) F#FD CALL ELLC (ARG.FD,ED.1) F#FD F#FD F#FD F#FD F#FD F#F0 F#F0 F#F0</pre>) IF (M1,EQ,0) GO TO 240	INEL	019
ARGH1,0=SKI CALL ELLC (ARG,FD,ED,1) F#FD CALL ELLC (ARG,FD,ED,1) F#FD GO TO 240 GO TO 240 IF (K2.EQ.0) GO TO 260 IF (N2.EQ.0) GO TO 260 IF (NEL 029 INEL 029 INEL 029 INEL 029 INEL 029 INEL 029 INEL 029 INEL 029 INEL 029 INEL 030 INEL	<pre>IF (ABS(PHI=PIT)_GT_810_0**(=7)) GO TO 230</pre>	INFL	020
CALL ELLC (ARG,FD,ED,1) F#FD 60 T0 240 50 T0 240 50 T0 240 50 T0 240 50 T0 240 50 T0 240 50 T0 260 1F (K2.EQ.0) GO TO 260 1F (K2.EQ.0) GO TO 260 1F (K2.EQ.0) GO TO 260 1NEL 029 1NEL 0		INFL	081
<pre>F#FD 60 T0 240 60 T0 240 1F (K2.EQ.0) G0 T0 260 1F (K2.EQ.0) G0 T0 260 1F (K2.EQ.0) G0 T0 260 1F (ABS(PHI=PIT).GT.10.0**(=7)) G0 T0 250 ARG=1.0=SKI ARG=1.0=S</pre>	CALL ELLC (ARG,FD,ED,1)	INEL	2 2 2 3
<pre>G0 T0 240 CALL ELINT3 (SKI,0.0,PHI,F) Tr (K2.E0.0) G0 T0 240 TF (K2.E0.0) G0 T0 260 TF (K2.E0.0) G0 T0 260 Tr (ABS(PHI=PIT).GT.10.0**(=7)) G0 T0 250 ARG=1.0*SKI ARG=1.0*SKI ARG=1.0*SKI.NEL 029 CALL ELLC (ARG.FD.ED.2) CALL ELLC (ARG.FD.ED.2) CALL ELLC (ARG.FD.ED.2) CALL ELLC (0.058 CALL ELLC (0.058) TNEL 033 CALL ELLNT3 (SKI,*SKI,PHI,E) CALL ELLNT3 (SKI,*SIN(2.0*PHI)/SQRT(1.0*SKI*SIN(PHI)**2) TNEL 033 FND FND FND FND FND FND FND FND FND FND</pre>		INEL	023
<pre>CALL ELINTS (SKI,0,0,PHI,F) IF (K2.EQ.0) GO TO 260 IF (K2.EQ.0) GO TO 260 IF (K2.EQ.0) GO TO 260 IF (ABS(PHI=PIT).GT.10.0**(=7)) GO TO 250 ARG=1,0=SKI CALL ELLC (ARG,FD,ED,2) E=ED GO TO 260 GO TO 260 GO TO 260 CALL ELINT3 (SKI,=SKI,PHI,E) CALL ELINT3 (SKI,=SKI,PHI,E) CALL ELINT3 (SKI,=SKI,PHI,E) RETURN F=(1.0=SKI)*F+0.5*SKI*SIN(2,0*PHI)/SQRT(1,0=SKI*SIN(PHI)**2) INEL 038 F=0 INEL 038 INEL 03</pre>	GO TO 240	INEL	020
<pre>IF (K2.EQ.0) GO TO 260 IF (ABS(PHI=PIT).GT.10.0**(=7)) GO TO 250 ARG=1.0=SKI CALL ELLC (ARG.FD.ED.2) CALL ELLC (ARG.FD.ED.2) E=ED GO TO 260 GO TO 260 GO TO 260 GO TO 260 CALL ELINT3 (SKI.=SKI.PHI.E) CALL ELINT3 (SKI.=SKI.PHI.E) CALL ELINT3 (SKI.=SKI.PHI.E) E=(1.0=SKI)*F+0.5*SKI*SIN(2.0*PHI)/SQRT(1.0=SKI.*SIN(PHI)**2) INEL 033 RETURN E=(1.0=SKI)*F+0.5*SKI*SIN(2.0*PHI)/SQRT(1.0=SKI.*SIN(PHI)**2) INEL 033 RETURN</pre>	CALL ELINTS (SKI,0,0,PHI,F)	INFL	020
<pre>IF (ABS(PHI=PIT).GT.10.0**(=7)) GO TO 250 ARG=!.0=SKI ARG=!.0=SKI CALL ELLC (ARG.FD.ED.2) E=ED GO TO 260 INEL 033 CALL ELINT3 (SKI.*SKI.PHI.E) INEL 033 CALL ELINT3 (SKI.*SKI.PHI.E) INEL 033 F=t(1.0=SKI)*F+0.5*SKI*SIN(2.0*PHI)/SQRT(1.0*SKI*SIN(PHI)**2) INEL 033 F=tURN INEL 033 INEL 033 INEL 033 INEL 033</pre>) IF (K2.EQ.0) GO TO 260	L NEL	026
ARG=1,0=5KI Call ElLC (ARG,FD,ED,2) E=ED GO TO 260 GO TO 260 Call ElINT3 (SKI,=SKI,PHI,E) Call ELINT3 (SKI,=SKI,PHI,E) E=f1.0=5KI)*F+0,5*5KI*SIN(2,0*PHI)/SQRT(1,0=5KI)*PHI)**2) INEL 035 E=fURN E=fURN INEL 035 INEL 035	IF (ABS(PHImPII).6T.10,0**(#7)) GO TO 250	INEL	027
CALL ELLC (ARG,FD,ED,2) E=ED GO TO 260 GO TO 260 CALL ELINT3 (SKI,#SKI,PHI,E) CALL ELINT3 (SKI,#SKI,PHI,E) E=f1.0=SKI)*F+0,5*SKI*SIN(2,0*PHI)/SQRT(1,0*SKI*SIN(PHI)**2) E=f1.0=SKI)*F+0,5*SKI*SIN(2,0*PHI)/SQRT(1,0*SKI*SIN(PHI)**2) INEL 033 RETURN END INEL 035		INEL	028
E=ED GO TO 260 GO TO 260 CALL ELINT3 (SKI,#SKI,PHI,E) CALL ELINT3 (SKI,#SKI,PHI,E) E=(1.0=SKI)*F+0,5*SKI*SIN(2,0*PHI)/SQRT(1,0*SKI*SIN(PHI)**2) E=(1.0=SKI)*F+0,5*SKI*SIN(2,0*PHI)/SQRT(1,0*SKI*SIN(PHI)**2) E=(1.0=SKI)*F+0,5*SKI*SIN(2,0*PHI)/SQRT(1,0*SKI*SIN(PHI)**2) E=(1.0=SKI)*F+0,5*SKI*SIN(2,0*PHI)/SQRT(1,0*SKI*SIN(PHI)**2) E=(1.0=SKI)*F+0,5*SKI*SIN(2,0*PHI)/SQRT(1,0*SKI*SIN(PHI)**2) E=(1.0=SKI)*F+0,5*SKI*SIN(2,0*PHI)/SQRT(1,0*SKI*SIN(PHI)**2) E=(1.0=SKI)*F+0,5*SKI*SIN(2,0*PHI)/SQRT(1,0*SKI*SIN(PHI)**2) INEL 035 E=0	CALL ELLC (ARG,FD,ED,2)	INEL	029
GO TO 260 CALL ELINT3 (SKI,#SKI,PHI,E)) CALL ELINT3 (SKI,#SKI,PHI,E)) CALL ELINT3 (SKI,#SKI,#SIN(2,0*PHI)/SQRT(1,0#SKI#SIN(PHI)**2) E=(1,0#SKI)*F+0,5*SKI*SIN(2,0*PHI)/SQRT(1,0#SKI#SIN(PHI)**2)) RETURN E=(1,0#SKI)*F+0,5*SKI*SIN(2,0*PHI)/SQRT(1,0#SKI#SIN(PHI)**2) INEL 033 E=0 INEL 035		INFL	020
) CALL ELINT3 (SKI,#SKI,PHI,E) E=(1.0=SKI)*F+0,5*SKI*SIN(2,0*PHI)/SQRT(1,0=SKI*SIN(PHI)**2) INEL 033) RETURN E END END	GO TO 260	INEL	031
E#(1.0=SKI)*F+0.5*SKI*SIN(2.0*PMI)/SQRT(1.0*SKI*SIN(PHI)**2) INEL 033 Return END) CALL ELINT3 (SKI, SKI, PHI, E)	INEL	N M O
END END INEL 034	E#(I ° 0 = SKI) #F + 0 ° 5 * SKI * SIN(2 ° 0 * PHI) / SGRT(1 ° 0 = SKI * SIN(FHI) * * 2)	INEL	033
END INEL 035	RETURN	INEL	0 3 ¢
	END	INEL	035

INEL

INEL

0020 0031 001C 1410 202 023 020 025 020 027 8 Z 0 020 020 032 610 © 2 0 120 500 034 035 010 015 018 900 700 800 600 010 210 200 010 0 0 G 002 3 3 O PREP P R F P PREP PREP PREP PREP FLG17 FLG22 FLG07 , FLG12 FL622 FLG07 FLG17 • FLG27 5 (MATSOL) TYPEA(S), NSIGEC, NSIGC, -0 7(100) ø ,FLG06 FLG11 , FLG16 FLG21 PL626 FLG16 , FLG26 , FLG06 PLG11 °FL621 AND 11 FUR USE BY LINK N M 3 5 $\mathbf{\circ}$ С М " NNU 8 Ħ NUNA(5) . е) Т 60 X භ ක S T භ 2 න 2 NSIGA, ARAXISYMMETRIC, CRUSS, AND EXTRA CROSS FLOW FF(100) 0 IECO FLG10 FLG15 FLGOS FLG20 FLG25 FLG15 FLG20 FLG25 FLG05 FLG10 FLOW NLF(11) " 8N 8 R(100,5), NMA. ***AXISYMMETRIC AND EXTRA CROSS NN 0 ***AXISYMMETRIC AND CROSS FLOW DIMENSION COSSOR(100), RMS(100) ***CRUSS AND EXTRA CRUSS FLOW TYPEC(5), , FLG04 e FL 609 PFLG19 , FLG24 • FLG24 MEDR, CASE FLG14 PLG04 , FLG09 FLG14 FLG19 DIMENSION TEMP(105), Y2(100) CASE NUNEC (5) PREPARE TAPES 3 ND(11), ***AXISYMMETRIC FLOW ONLY COMMON/SPACER/WKAREA(5000) ***EXTRA CROSS FLOW ONLY NERZO FOURPI/12,5663706/ A(105), HEDR(10) ***CRUSS FLOW UNLY TYPEEC (5) , FLG03 , FLG13 FLG03 PFLG13 FLG08 , FLG18 , FLG23 , FLG23 FLG18 NUNC (S) . DVERLAY (AXSY, 3,0) DOUBLE PRECISION PREP Z NERI N 7 ° PRIGRAM PREP 敛 SUBROUTINE DIMENSION INTEGER NCK180 NCKUBO COMMON COMMON DATA REAL C & & & CAAN の合会な のような Cass Caaa (* * * 御御 ູ υu

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036 10 M 4 0.39 000 2002 0 a a 045 900 047 040 049 0 1 A M 5 5 5 5 5 0 0 0 0 920 000 000 000 000 050 090 062 041 2003 061 064 065 066 067 000 060 010 8 8 9 8 8 8 9 8 9 8 9 6 6 11 11 11 11 11 11 PREP PREP PREP 9 R F 9 PREP M þ 0 ೮ READ(12) (TEMP(1), I = 1, NI), (TEMP(1), I = 1, NI), IF (FLG12,EQ,0,0R,(FLG04,FQ,0,ANU,FLG21,E0,0)) IF (FLG05,EQ,0) GO TO 4 ***SKIP OFF BODY COORDINATES * PREPARE AXISYMMETRIC MATRIX TAPE 0 5 C F (TEMP(I), I = 1, NT), (YZ(I), I = 1, NT) 60 READ (4) (A(I), Iml, NT), (FF(I), Iml, NT) IF (MS.EG.1.OR.MS.FG.2.OR.MS.EQ.5) IF (FLG19,67,0) 60 TO 2000 IF (FLG22.67.0) GO TO 255 READ (4) (R(I,1), ISNR,NT) IF (FLG14, LE. 0) GO TO 290 READ (4) MS, (A(I), IE1, NT) IF (FLG16,NE.0) GO TO 20 IF (FLG03) 5,800,5 IF (NNU) 60,60,30 DO 50 J = 1, NNU DU 10 I = 1, NT PO 40 I = 1, NT R(I,K) = A(I)R(T,K) = A(I) L = NT+NSIGA REWIND 12 NRE NMA+1 NINTANB REWINO 3 READ(12) CONTINUE X H X A Z NCK 3 BO NCK410 NCKSEO NCKONO 0 文員 000 N N N n đ M 2 N O 保保 Cees U

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REWIND 4	PREP	071
00 220 I = NR. NT	PREP	072
220 R(I,1) = R(I,1)-FF(I)	PREP	073
1F (FLG14 EQ NB) 60 TO 245	PREP	074
DN 240 1 # 1, NMA	PREP	010
READ (9) (A(J), Jal, NT)	PREP	076
$A(N7+1) = R(I_01)$	PREP	077
240 wRITF (3) (A(J),J=1,L)	PREP	078
245 DO 250 I = NR, NT	PREP P	019
READ (9) (A(J),J=1,NT),(A(J),J=1,NT)	9 R E P	080
A(NT+1) # R(1,1)	PREP	081
250 WRTTE (3) (A(J),J=1,L)	PREP	6 6 6 6 7 6
C PRESCRIPED TANGENTIAL VELOCITY INPUT TO SOLVIT ON TAPE 3	PREP	083
C OUTPUT FROM SOLVIT ON TAPE 3	9 A E P	064
C TAPES I AND Z ARE SCRATCH TAPES	PREP	085
CALL SULVIT(WKAREA,NT,NSIGA,5000,3,1,2,3,NCK1)	PREP	080
IF(NCK1 "F.G. 1) GO TO 9010	Prep	067
251 REWIND 9	P 25 P	088
GO TN 800	PREP	009
C*** ***AXISYMMETRIC FLOW * GENERATED (RESEP) BOUNDARY CONDITIONS	PREP	000
Case assNPB1 = THE NUMBER OF ELEMENIS ON BODY 1	9 A E P	160
CAAA AAANPBZ = THE NUMBER OF ELEMENTS ON BODY 2	PREP	200
255 NPR1 = ND(1) = 1	PREP	2003
NPB2 = ND(2) = 1	PREP	1004
NSIGA = 3	PREP	36 0
NSIGC = 1	PREP	096
NSIGFC # 1	PREP	097
L = NT + NSIGA	P R P	098
CAAA AAAL IS THE TOTAL WIDTH OF THE MATRIX FOR AXISYMMETRIC FLOW INCL	PREP	660
C*** ***RIGHT HAND SIDES	PREP	100
READ (4)	PREP	201
READ(4) (COSSGR(1),I = 1,NPB1), (RHS(1),I = 1,NPB1)	PKEP	102
REWIND 4	PREP	103
D() 260 I = 1, NPB1	PREP	104
R(T,1) = 0,0	PREP	105

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212 22 000040 00040 32 130 521 23 290 108 220 222 33 1.06 101 109 © 7 8 949 954 954 (64) (54) (54) 17 T 5 \$ 5 5 1.88 0 974 1974 1974 40 9 8 8 9 8 8 9 9 8 9 PREP 9860 PREP PREP PREP PREP PREP M READ (9) (A(J),Jz1,NT),(A(J),Jz1,NT),(A(J),J31,NT) OUTPUT FROM SOLVIT ON TAPE INPUT TO SOLVIT ON TAPE 3 TAPES 1 AND 2 ARE SCRATCH TAPES Call Sulvit(Wkarea, NT, NSIGA, 5000, 3, 1, 2, 3, NCK2) IF(NCK2 , EQ. 1) GO TO 9020 * PREPARE CROSSFLOW MATRIX TAPE (11) READ (4) (A(I), IE1, NT), (A(I), I=1, NT) IF (FLG04,EQ.0) GU TH 1610 IF (FLG12,NE,0) ASSIGN 300 TO M IF (FLG17,NE,0) GD TD 820 IF (FLG22,GT.0) GU TD 910 E NREGIN, NEND READ (9) (A(J), J=1, NT) 700 WRITE (3) (A(J), J#1, L) DO 600 J = 1, NSIGA NP81 + NP82 DO 700 I = 1, NT GO TO M, (300,400) = COSSOR(I) I + I8dN = ASSIGN 400 TO M AXISYMMETRIC FLOW R(I,J) 0 * 1 L = NT+NSIGC = 1°0 0°0 = 0.0 GO 70 500 89 X N N +J REWIND 9 REWIND 4 X U X R(I,3) R(T,1) R(T,2) R(1,3) NBEGIN NEND . 00 265 A(X)B R(1,2) C N X 600 008 500 400 260 265 290 300 701 **你** 会会

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	DU 810 I # 1, NT	PREP	2 4 2
810	R(I,K) = A(I)	PREP	1 & 2
028	IF (NNU) 900,900,830	PREP	143
020	DD 850 J # 1, NNU	PREP	144
	READ (4) MS, (A(1), [E1, N1)	PREP	145
	IF (MS.EQ.0.0R.MS.EQ.2.0R.MS.EU.4) GU TO 850	PREP	146
		PREP	147
	Lv "1 # 1 078 Ug	PREP	148
0 19 60	R(],K) = =A(])	PREP	149
950	CONTINUE	PREP	150
006	REWIND 4	PREP	121
•	GO TO 1000	PREP	22
冬冬冬 1	***CRUSS FLOW * GENERATED (RESEP) BOUNDARY CONDITIONS	PREP	153
016	DO 920 I = 1, NPB1	PREP	\$
920	R(I,1) # -KHS(I)	PREP	55
	DO 930 I = NBEGIN,NEND	PAEP	156
020	R(1,1) = 0,0	PREP	157
1000	ASSIGN 1300 TO M	PREP	150
	IF (FLGL2, NE.O) ASSIGN 1200 TO M	PREP	159 1
	DO 1600 I = 1, NT	PREP	160
	GO TO M. (1200,1300)	PREP	161
1200	READ (10) (A(J),JH1,NT),(A(J),JH1,NT),(A(J),JH1,NT)	PREP	162
になきる	***FORM PHI MATRIX FROM THETA (CROSS FLOW) MATRIX	9259	163
	DO 1250 J = 1,NT	PREP	164
1250	A(J) = Y2(I) + A(J)	PREP	165
	GO TO 1400	9259	166
1300	READ (10) (A(J), JE1,NT)	PREP	167
1400	DO 1500 J = 1, NSIGC	PREP	168
		PREP	169
1500	A(K) HER(I,J)	PREP	170
1600	WRITE (11) (A(J),JEL,L)	PREP	
C CR	OSS FLOW INPUT TO SOLVIT ON TAPE 11	PREP	172
e	DUTPUT FROM SOLVIT ON TAPE 3	PREP	173
C TA	PES I AND 2 ARE SCRATCH TAPES	PRE P	174
	CALL SOLVIT(WKAREA,NT,NSIGC,5000,11,1,2,3,NCK3)	PREP	175

PAEP

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P R F P

	IF (NCK3 _ EQ_ 1) GO TO 9030	PREP	176
1605	REWIND 10	PREP	177
1610	CONTINUE	PREP	178
Caaa	***FXTRA CROSS FLOW	PREP	611
	REWIND 11	PREP	180
	IF (FLG21°EQ.0.AND FLG22.E0.0)RETURN	PREP	5 60 5 6
		PREP	202
	L # NT + NSIGER	PREP	503
	IF (FLG22,67,0) 60 TN 1800	PREP	
C & & &	***EXTRA CROSS FLOW * NON-UNIFURM FLOW ONLY	PREP	501
	APASKIP RECORD WITH SINES AND COSINES	PREP	186
	READ (4)	PAEP	187
	DO 1650 JE1, MNU	PREP	100
	READ(4) MS, (A(1), I=1, NT)	PREP	668
	IF (MS.LT,2,DR,MS,EQ,3) GU TU 1050	PREP	66
		PREP	
	DO: 1640 . I = 1, 1, NT	PREP	202
1640	R(I,K) H A(I)	8 2 2 2 2 3 2 3 2 3 2 3 2 3 2 3 2 3 2 3	101
1650	CONTINUE	PREP	194
	GO TO 1900	PREP	503
のなる	***EXTRA CRNSS FLOW * GENERATED (RESEP) BOUNDARY CONDITIONS	PREP	196
1800	DD 1820 1 # 1,NPB1	PREP	101
1820	R(1,1) = COSSQR(1)	PREP	961
	D_0 1840 I = NBEGIN, NEND	PREP	66
1940	$R(I_{0}1) = 0_{0}0$	PREP	200
1900	REWIND	PREP	0 0 0 0
1. 4 4 4	**** IS 1920 * SOLVE A MATRIX	PREP	N N N
	ASSIGN 1920 TD M	PREP	203
0 * * *	**** IS 1940 * SOLVE POTENTIAL MATRIX	PREP	204
	IF (FLG12.NE_0)ASSIGN 1940 TO M	PREP	205
	D() 1980 I = 1,NT	PREP	90°
	GU TU M, (1920,1940)	PREP	201
今日の	***SOUVE A MATRIX	PREP	200
0201	READ (B) (A(J), J = 1, NT)	PREP	209
	GO TO 1960	PREP	210

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0761	READ (8) (A(J),J=1,NT),(A(J),J=1,NT),(A(J),J=1,NT)	0. 12 12 12 12 12 12 12 12 12 12 12 12 12	212
C & * *	***FORM PHI MATRIX FROM THETA (EXTRA CROSS FLOW) MATRIX	PREP	212
	Dij 1950 J = 1 "NT	PREP	213
1950	A(J) = Y2(I) + A(J) / 2.0	P R F P	a I v
1960	00 1970 J = 1,NSIGEC	PREP	512
		PREP	210
1970	A(K) = R(I,J)	PREP	217
1980	ERITE (11) (A(J),JH1,L)	PREP	218
Cate	###FXTRA CRASS FLOW INPUT TO SOLVIT ON TAPE 11	PREP	219
Ceee	AAACUTPUT FROM SULVIT ON TAPE 3	PREP	220
Caaa	***TAPES 1 AND 2 ARE SCRATCH TAPES	PREP	223
	CALL SOLVIT (WKAREA, NT, NSIGEC, 5000, 11, 1, 2, 3, NCK4)	9 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2	222
	IF(NCK4 "EQ, 1) GO TO 9040	9 X R P	223
1985	REWIND B	PKEP	220 X
	REWIND 11	PAEP	572
ں	RETURN	PREP	2261
		PREP	2270
2000	IF(FL623 "GT。0)GU TO 3000	PRF	8 2 2 8
	NO U N S NAA	P R F P	229
		PREP	230
	READ (4) (R(I,1),III,NMA)	PRFP	231
	READ (4) (FF(I), IEI, NR)	PREP	23
	DO 2100 I = 1, NR	A M M M	233
2100	FF(I) = FF(I)/FOURPI	PREP	334
	BACKSPACF 4	PREP	235
	WRTTF (4) (FF(1),IS1,NR)	PREP	236
	REWIND 4	200	237
	DO 2300 I FUI, NMA STREAM ST	PKEP	8 7 7 8
	READ (9) (A(J),J=1,NMA),(T(J),J=1,NK)	PREP	239
	DD 2200 J = 1, NR	925	240
2200	R(I,1) = R(I,1) = T(J) + FF(J)	PREP	241
	$A(L) = R(I_{\rho}1)$	PREP	242
2300	WRITE (3) (A(J), J=1,L)	P R P	243
2 2 2 2	ESCRIBED VORTICITY INPUT FOR SOLVIT ON TAPE 3	9 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2	2 2 2 2 2
υ	UUTPUT FROM SOLVIT ON TAPE 3	PREP	245

PREP

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C TAPES : AND 2 ARE SCRATCH TAPES	04	206
CALL SULVIT(WKAREA,NMA,L - NMA, S000, 3,1,2, 3, NCKS)	PREP	247
IF(NCK5 , EG, 1) GO 70 9000	PREP	248
2500 REWIND 9	PREP	249
GU TN 800	PREP	250
3000 NR B NT - NMA	PREP	52
NMAPI & NMA + 1	PREP	252
Cat CALCULATE THE NUMBER OF RMS	PKEP	253
L	PREP	250
	PREP	255
DU 3100 Is1,NB	PREP	256
IF(NLF(I) 667 0)60 TO 3100	PREP	252
LL = LL + 2	PREP	250
3100 CONTINUE	PREP	259
	PREP	260
	PREP	261
CAAA A READ SINS FOR STREAMFLOW AMS	PREP	262
	PREP	263
READ(4)(R(1,1),IB1,NMA)	PREP	26.0
•	PREP	265
CAAA & READ INPUT PRESCRIBED VORTICITIES	PREP	266
	PREP	267
READ(4) (FF(1), IENMAP1, NT)	PREP	26.0
WRITE(6,8001) (FF(1),ISNMAP1,NT)	PREP	269
8001 FORMAT(1H1.# THE INPUT PV ARE #/(6E20.7))	PREP	270
DO 3125 I # NMAP1,NT	PREP	272
3125 FF(I) = FF(I) / (=FOURPI)	PREP	212
	9 R F P	513
CAAA A READ STRIP VORTEX RHS	PREP	274
	PREP	275
LLD2P1 = LL/2 + 1	PREP	276
DO 3150 J=2, LD2P1	PREP	277
3150 READ(4)MS, (R(I,J),I=1,NMA)	PREP	278
	PRFP	279
C*** * IPV IS HODY NUMBER OF IST PRESCRIBED VORTICITY BODY	PREP	280

	PREP	2 B 1
IPV # NB + FLG14 + 1	PREP	282
J800 = LLD2P1	PREP	283
	PKEP	204
	PREP	285
DD 3300 KCNT = IPV,NB	PREP	286
JBOD = JBOD + 1	PREP	287
NN = NN + ND(KCNT) = 1	PREP	200
U	PREP	682
CARA & READ COLUMN OF RMS CALCULATED BY NOTS FURMULA	PREP	296
υ	PREP	291
READ(4) (R(ICNT, JBOD), ICNT = 1, NMA)	PREP	292
	PREP	202
C*** * MULTIPLY NOTS COLUMN BY LAST PRESCRIPED VORTICITY ON THAT BODY	Prep	294
	PRE P	502
DO 3300 ICNT #1, NMA	Prep	296
3300 R(ICNT,JBOD) = R(ICNT,JBOD) = FF(NN) = (=FOURPI)	PREP	297
ų	PREP	290
REWIND 4	PREP	599
DO 3400 Is1, NMA	PREP	300
NEND BUNA	PREP	301
JBOD = LLD2P1	PREP	302
READ(9) (A(J),JE1,NMA), (T(J),JENMAP1,NT)	PREP	303
	PREP	202
DO 3350 KCNTEIPV,NB	PREP	305
JBOD = JBOD + 1	PREP	306
NBEG = NEND + 1	PAFP	307
NEND # NEND 4 ND(KCNT) #1	PREP	308
÷	PKEP	209
C*** * SUM PV VORTEX ELEMENTS * INPUT PV AND ADD TO NOTS RMS	PREP	M10
	PREP	311
DO 3350 NCNT=NREG,NEND	PREP	312
C	PREP	313
C *** WHEN CUMING OFF UNIT 9, THE VORTEX ELEMENTS(T(J)) ARE STILL	PKF P	310
C *** WHILE NOTS COLIMNS COMING OFF UNIT 4 ARE RMS. THE TWO SMOULD	8	5

316	517	518	519	025	N N N	322	323	328	50	326	327	320	329	330	531	N M M	2 M M	334	500	336	337	330	339	340	341	342	343	344	345	346	347	348	349	0
A LA	REP	KEP	REP	0. 20 20 20 20 20 20 20 20 20 20 20 20 20	REP	REP	850	AFP AFP	REP	REP	REP	A B B	REP	REP	REP	 860	REP	REP	REP.	828	REP	0.00	REP	REP	REP	REP	REP	REP	REP	REP	REP	REP	REP	A LA
a I	0.	0	a .	<u>a</u>	EA .	G.	12		a .	G .	Q.	<u>a</u>	6 2.	e .	Q.,	<u>IX</u> .	E.	a.	a.	EF.	DRT P	61.	<u>64.</u>	93.	NG F	64.	W	4	ید بر	а <u>а</u> .	6 <u>8</u> .	L	L	e.
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BTRAC													M	M											8 8 8				R AX				R CR(
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TO FOF	NW (: R(I,		L RHS			NANN	*	R L F		J), J:	140 0			I (WK AF	G ~ ~				NDT			- 		JC T T Y		121)	NOT			51)	NOT 6	
DDED 1	F T(J)		800) =		ACH AL		0	75 1(I CRH			(3)(V)	G WINC			SOLVII	K6 .FG	6 0	800	(6,90(T(61H	~	90806	(06*9)	417JH	LVELC	90806	(6,91	T(58H		90806	(6,90	T (51H	00000
* A1	C a		R(1,J)		ATT		LRHS	DO 33	LRHS .	ACTCN		WRITE	NIX			CALL	IF (NC	REWIN	60 10	WRITF	FORMA	TCITY	GO 70	WRITE	FURMA	ENTIA	G0 10	WRTTF	FORMA		GO 70	MATTE	FORMA.	GU 10
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				1					

SOLV

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sol v

<pre>10 k = (KORE = NEL) / NEL = 7 EST TO SEE IF THE REST OF THE MATRIX WILL FIT IN CORE LAST = K .6E NN I F (LAST) K = NN = PEAD #K# ROWS OF THE AUGMENTED #A# MATPIX 30 NT = 0 NT = 1, K N0 q OF 18 = 1, K N0 q OF 18 = 1, K N1 = NT + NEL 40 READ (WIN) (A(TO), IO = N3, NT) = CHECK TO SEE IF WE EUNLUCKY ENDUGH TO END UP WITH ONLY OWE ROM TF (K .E0, 1) GO TO 90 = CHECK TO SEE IF WERE UNLUCKY ENDUGH TO END UP WITH ONLY OWE ROM TF (K .E0, 1) GO TO 90 = K## IS GREATER THAN #1# SO WE CAN START THE TRIANGULARIZATION NELP1 = NEL + 1 NELP2 =</pre>	SOLV 036	SOLV 038	SULV 039	50LV 040	SOLV OUL	30LV 042	SOLV 043	SOLV DAG	30LV 045	50LV 046	SULV DAT	50LV 048	30LV 049	SOLV 050	SOLV 051	30LV 052	SOLV 053	SOL V 054	SOLV 055	201 V 056	SOLV 057	201 V 056	80LV 059	SOL V 060	SOLV OGI	SOLV OG2	SOLV 063	SOLV 064	SOL V 065	50LV 066	SOL V 067	50LV 068	50LV 069	SULV 070	
	· · · · · · · · · · · · · · · · · · ·	JO R H (RURE WEL) / NEL	□ □ TEST TO SEE IF THE REST OF THE MATRIX WILL FIT IN CORE		LAST ZK "GE"NN	IF (LAST) K = NN		READ #K# ROWS OF THE AUGMENTED #A# MATPIX		30 NT # 0	DU 40 IB 2 1 6 K		NT & NT + NEL	40 READ (NIN) (A(IO), IO = NS, NT)		CHECK TU SEE IF WE WERE UNLUCKY ENOUGH TO END UP WITH ONLY ONE ROW		IF (K "EQ" 1) GO TO 90				NELPI = NEL + 1	NG = NEL	NELP2 # NELP1 + 1		FORM THE FIRAPEZOIDALF ARMAY (8)		PO 50 IB = 2s K	NP & NELP2 = IB				NT = NT + NEL		

SOL V

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30° V

- NNANSH - NNAHAH - NNAHAH - NNAHAH - N M 3 M 0 0 0 0 0 0790 000 001 000 000000 00040 80000000 8000000 8000000 260 260 960 0.97 000 660 100 2000 2010 V SOLV SOLV SOLV SOLV SOL V 80L < < 201 V 201 V <</pre><</pre> SOLV SOLV SOLV MUDIFY THIS ROW BY THE ZTRAPEZOLDALZ ARRAY WRITE THE ZIRAPEZUIDALZ MATRIX UN TAPE (LZ = NS, KORE) r NG, A(NT) * A(NB) WRITE (MT) NP, (A(IB), IB A(NT) = (-A(NT)) / A(NS) = (-A(MN)) / A(NT) œ, NN II NF, KURF -READ (NIN) (A(IB), TF (LAST) GO TO 90 \$ Z, NP I, NP READ ANDTHER ROW \$ NEL ¥ ¥ R NS & NELPI = A(MN) 63 (2000) = NT + NEL 8 60 IU = . 00 80 IO = H NEL NEL KORE L d Z H ◆ N¥ N 00. 50 NF 70 IB L N E N d Z S Z H ග Z 10 Z Z Z I N NT 0 A (MN) 00 65 (NM) A n 18 11 IJ 80 N N N N 00 R N 80 Z Z ග Z න 2 a Z ഗ Z C N a Z Z a Z r z Z **0**9 20 0 6 8 8 ŧ

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SOLV

solv

	SOLV	901
¢ς atuni x a(NNi ↔ a(MNi ↔ a(NRi	> 108	709
	SOLV	808
70 NT = NT + NELPI	SOLV	109
	SOLV	110
- WRITE THE MUNIFIED ROW ON TAPE	30C V	97 97 97
	SOLV	211
80 WRITE (NOUT) (A(NT), NT 2 MN, KURE)	SOLV	113
REWIND NOUT	SOLV	52
REWIND NIN	SOLV	115
	80L <	9 1 2
	2 C C C C C C C C C C C C C C C C C C C	
	SULV	
NIN B NOUT	SOLV	120
NOUT = NT	80° V	171
	SOLV	N
- RE-CALCULATE ROW LENGTH AND LOOP BACK	SOLV	n N
	SOLV	5 (N (
	2 C K	
	SOLV	121
	SOLV	128
- REWIND ALL TAPES	SOLV	621
	SOLV	130
90 REWIND MT	SOLV	2
REWIND NIN	SOLV	2
REWIND NOUT	SOLV	2
	SOLV	120
- CUNDENSE THE MATRIX	SOLV	5
	SOLV	9 I M M
	50LV	127
		00
	SOLV	2001
•		i Que ar

SOLV

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271 40 5 30 0 50 00 \$ 9 163 64 65 99 67 66 140 172 543 170 0 5 21 3 4.4 5 90 47 5 B 3 5 5 sol v sol v 201 V 201 V 201 V sor v sor v SOL V SULV SOLV SOLV SOLV SULV SUL V SOLV SOL V SOLV SOLV SOLV SUL V SOLV SOL V SOL V SOLV SULV SOLV SULV SOLV SOLV SULV SULV SUL V SOLV SOLV SULUTIONS IS A(NI) ROMS SOLVE FOR THE ANSWERS CORRESPONDING TO #K# THERE, NOW WE CAN START THE BACK-SOLUTION Note, the first available location for the 70 130 (SN) Y 4 0) 60 Σ¥ N T ØĽ. * × SZ N NELPI ⋪ Z е Н ື ແ A (NF) щ С ۲ NE × NPAGS # NPASS ă A(10) وبد ہے۔ م Z X മ 2 60 68 8 * 00 130 MN 120 IU 4 0 KORF IOO IB ß NEL & NPM 125 IB 10 X NFL NREM # N ¢ A(NF) # S Z H 88 = NS đ 63 (K M I NF Z 8 1 S Z H NZ II Z × NS # NL Z 0 100 81 88 NPAGS 10 A (NL) u LAST 11 NUS X Z × Ø 00 00 00 o Z Z ŝ 2 ia. 8---N Z 00 Fz R N N P N ž Þ2 105 011 100 ₿ ≪ 8 4 ß ġ. υυυ υυυυ

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SULV

			SOLV	176
			SOLV	177
	Ň	SUM = SUM + A(NN) + A(NP)	sol v	170
		5 A(NF) = (A(NF) = SUM) / A(NT)	SOLV	179
-		CONTINUE	30° V	00 1
e	1		SOLV	101
ພ	e R	MOVE THE SOLUTIONS TO CONTIGUOUS LOCATIONS STARTING AT A(NI)	80LV	102
ບ			SOLV	263
)		NI Z KÜRE + 1	80° V	184
		DO 140 XN # 1, X	80° V	50 î
			80L V	186
			80L <	187
			80° V	198
		5 A(N1) = A(NL)	306 V	1 6 0
			80L V	100
C			80L V	101
. 0		• WRITE THE SOLUTIONS ON TAPE	80L V	192
0			80L V	86
ı		WRITE (NIN) K	306 V	1961
			\$0 C	6 6 7
		00 145 MW 8 1, M	SOL V	196
			801 V	2 6 \$
	8	S WRITE (NIN) (A(IO), IO = NT, KORE, M)	80LV	196
U			SOLV	667
Ú	8	P TEST IF THIS IS THE LAST PASS	BOLY	200
υ υ			SOLV	201
		IF (LAST) GO TO 200	SOLV	202
U			SOLV	203
د		- WE MUST NOW MODIFY THE TRIANGULAR MATRIX TO REFLECT THE EFFECT OF	SOLV	200
e U		THE SOLUTIONS DETAINED SO FAR (EQ 21)	SOLV	202
ں ا	会	A NOTE. LOCATIONS A(1) TO A(NIW1) ARE NOW FREE TO USE	SOLV	206
υ υ			SOLV	207
e	6	CALCULATE THE NEXT VALUES OF #NEL# AND #NREM#	301 V	208
C			SOLV	209
		NELOLD & NEL	30° V	210

\$OF V

SOLV

2 2 2 2 2 2 2 2 2 2 2 2 241 ~ ~ ~ ~ 6 N 6 N 5 5 200 **SOL V SOL V** SOLV SOLV SOLV SOLV ¢ Ľ 睿 ñ 4 L 儆 + IFIX(SQRT(0,25 + FLOAT(4 NOW APPLY THE INCREDIBLE FORMULA FOR THE NEW #K# NN. (A(IO), IO # NS, NT) READ IN THE ROWS TO BE MODIFIED (TB "LE" NROW) GO TO 160 «LT. NREM) GO TO 150 A (NA) - NELOLD)))) X B (I G A K B I) / S A (N2) * KOLO X 190 IB # 1. NREM 9 文 今 I X X ه ۲۰ × X D L O X NT = NFLOLD + TRUE . × B NN A Z Z B NREM NRFM = NREM Z * (KURE ♦ dN 1 3UM = 0.0 DO 165 IO r Z NN NN SUM B SUM 4 77 11 DO 170 MN x v NFL = NEL X II NKEN N N NZ N X II O IOX LAST U NROW U S Z N Z AN NA Z NS = 1 K K MUNN READ 8) 00 Z N Z a Z 00 Z n: z 4 ග Z Z u Z Z 0 160 051 0 ₿ 8 υυυ υu C

SOLV

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<pre>c NA + M = N2 + MN = 1 = N2 + MN = 1 = N2 + MN = 1 = N1 = M + 1 = N1 = M + 1 = N1 = M + 1 = N1 = K01 T0 190 T0 100 T0 100 T</pre>	SOLV 246 SOLV 246 SOLV 248	SOLV 249	50LV 252	SOLV 255	50LV 256 50LV 257	SOLV 258	SOL V 260	SOLV 261 SOLV 262	SULV 263	50LV 264 50LV 265	50LV 266	50LV 267	SOLV 269	50LV 270	SOLV 272	20LV 275	801 < 274	SOLV 276	SOLV 277	201-V 278
E NA + M E N2 + MN = 1 U2) E A(N2) = SUM TTF THE MUDIFIED ROW TAPE OR E NT = M + 1 (IB «GE« NROW) GO TO 175 E NL = KP1 TO 190 E NL = KOLD 180 MN E NL« NT TO 190 E NF + 1 TT 190 MN E NL« NT TT 190 MN E NL« NT TT 10 MT TTCH THE TAPES E NT TTCH THE TAPES E NT TTCH THE TAPES E NT TTCH THE SOLUTION E NF TT 10 MT TT 10 TT 10 MT TT 10 TT 10		CUNDENSE THE ROW		NF), (A(TO), IO = NL, NT)																
	r NA ♦ M s N2 ♦ MN = 1 12) r A(N2) = SUM	TF THE MODIFIED ROW ON TAPE OR	= NT = M + 1 (IB .6€. NRO₩) GO TO 175	ENL TRPI TF (NOUT) NN, (A(IO), IO E NS, 20, 20	10 140 8 NL - KOLD	180 MN 2 NL 0 NT (F) 2 A(MN)		ITINUE Ind Mt	IND NOUT	TCH THE TAPES		R MT B NOUT		IP BACK THRU THE SOLUTION				RT TO WRAP IT UP		

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SULV 281 SULV 282	SOLV 283	SOLV 285	SOL V 286	SULV 287	50L V 288	SOLV 289	50LV 290	SOLV 292	SOLV 293	SOL V 294	SOL V 295	80L < >90	SOLV 297	SOL V 208	SULV 299	SULV 300	SOLV 301	SULV 302	SULV 303	SOLV 304	80L V 305	SOLV 306		SULV 3091	SOLV 3101	SOLV JIII	WA SOLV 3121	SOLV 7131		5 S S S S S S S S S S S S S S S S S S S
ARE FREE																											RIGHT SIDES			
HRU A(KORE)																											TH 14. 35H			
I (I) V S N I) I																											PH MATKIX WI	MINUTES.)		
INT ALL LUCAT	ASS					IDNS		N INO IN	•				T TAPES				NS ON TAPE						N NN N		/ 60.	N, M, BB	P 2H X IS, 1	IN F8.3, 9H		
NOTE AT THIS PO.	DO 220 IH = 1, NP.		IZ II SZ	NT = N2		READ IN THE SOLUT		READ (NIN) (A(NN))	N + N I IN	Z + OZ II OZ	NZ H NI H I		" REWIND ALL INPU	REWIND NIN	REWIND MT	REWIND NOUT	WRITE THE SOLUTIO		NT = 0	00 230 IO # 1, M	NS = NT + 1		WRITE (NW) (A(NN)	CALL TIMEV(AA2)		WRITE (6, 300) No	FORMAT CUHOTHE IS	IS SOUVED DIRECTLY	RETURN	
* * UU					ں د	ו י ט	د			210	220	υ υ	د د				ہ ء د	υ					0 5 7 0	<u>ں</u> ر) U	د	C 300	- -		

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PROGRAM PART4					7 7 7 8 7 8 7 8 7 9	- N 0 0 0 0
SUBRAUTINE PARTA					PARG	003
					Para	000
* COMPUTE	VELOCITY C	OMPONENTS AND	PRINT		P A R C	500
					PARG	000
COMMON / IPSF / PSF					PARG	001
COMMON MEDR(10)) "CASE	, NB	DNN.		PARG	000
L FLG03	.FLG04	FLGOS	.FLG06	, FLG07	PARG	000
2 1608	, FLG09	FLGIN	FLG11	, FLG12	PARG	010
5 5 5 FLG13	PLG14	FLGIS	, FLG16	, FLG17	PARG	110
ercie	, FLG19	FLGZO	FLG21	FLG22	PARG	010
S FLG23	, F L G 24	, FLG25	, FLG26	FLG27	PARG	013
COMMON NT.	ND(11) &	MN NIN	1(5) TYPI	EA(S)	PARG	014
NER1 .	NERZ	NMA, NSI	A. NOL	SC -	PAPA	S C
> NUNC(S),	TYPEC(5),	NLF(11), TEC.	ISZ	GEC	PARG	936
TYPEEC(S),	, NUNEC (S)				PARG	017
DOUBLE PRECISION H	HEDR, CASE				PARG	016
COMMON / COMBIN/CHAY	(2)				PARG	010
INTEGER FLG03	, FLG04	, FLGOS	, FLG06	, FLGOT	PARG	020
FLG08	, F L G 0 9	, FLG10	FLG11	FLG12	PARG	021
2 FLG13	, FLG14	, FLG15	FLG16	1617 1617	PARG	220
S FLG18	FLG19	, FLG20	, FL G21	, FLG22	PARG	N N
L C C S S	0 F L G 2 4	, FLG25	, FLG26	, FLG27	PARG	020
REAL					PARA	020
					PARG	026
COMMON /C4/ XI(10	00) VI(10	0) × X2(100)	Y2(100) .	DELS(100),	PARG	NC
SINA	(100), CUSA(100), XP(100),	VP(100)		PARG	820 0
COMMON /TC/ RB(10	0,10),	STG(100,51,	A(100),	B(100) .	PARG	020
Z (100	~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~	PHICLOOSS	ZN(100.5),T(100,5),	PARG	080
2 73(10	0,53,	NSIG	NP.	NI.	PARG	03
3 SUMA		SUMM(5)			PARG	032
					PARG	033
A START					PARG	034
nn 20 J = 1,10					PARG	500
						ı

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PARG

	nn 20 f ≡ 1,500	PARG	036
20	RH(I,J) = 0,0	PARG	037
	REWIND 3	PARG	038
	IF (FLG05,FQ,0) GU IN 30	PARG	030
J	A READ DFF-RUDY XP,YP	PARG	000
	NPEND (NR+1)	PARG	041
	READ (12) (XP(I), [=1,NP), (YP(I), [=1,NP)	PARA	002
υ υ	* READ X1, Y1, X2, Y2, DELS WITH WACH NO. ADJUSTMENT IF ANY	PARG	043
0 %		PARG	10 10 C
	READ (12) (X1(I),I¤1,NI),(Y1(I),I¤1,NI),(X2(I),I¤1,NI)	PARA	005
	1 / / / / / / / / / / / / / / / / / / /	PARG	046
υ	* RFAD SINA, COSA, NO, TO, S	PARA	047
	READ (4) (A(I), IE1, NT), (B(I), IE1, NT)	PARA	000
	NEAD! H NEA + 1	PARG	640
	IF (FLG23 ,G7. 0)READ(4)(Z(1),IENMAP1,NT)	PARA	020
		Para	3 0 0
	0, 1, 0, 1 = 1, NT	PARG	052
	SINA(I) = A(I)	PARA	203
	COSA(I) = B(I)	PARA	054
100	SUMV # SUMV + B(I)*DFLS(I)*YZ(I)**Z	PARG	055
	SUMV # SUMV#3.141593	PARG	056
	IF (FLG03,LE,0) GO TO 1000	PARG	057
		PARG	050
		PARG	059
	IF (FLG16,NE.0) GO TO 200	PARG	060
	PO 150 I H 1, NT	PARG	061
	RB(I,L) # A(I)	PARG	062
150	RR(I, L+1) = R(I)	PARG	063
202	IF (NNU) 600,600,300	PARC	064
300	DO 500 J # 1, NNU	PARG	065
	READ (4) MS, (A(I), I=1, NT), (B(I), I=1, NT)	PARG	066
	IF (MS.EQ.1, NR.MS, EQ.2, UR, MS.EQ.5) GO TO 500	PARG	067
	1 = 1+2	PARG	068
	LS = L3+1	PARG	0690
	IF (IS.EQ.1.AND.FLG16.GT.0) LEL-2	PARG	670

PAKG

091C 1000 102 073 074 075 0760779 078 640 000 084 002 086 087 088 089 093 094 560 960 100 000 099 100 103 2 A 2 001 104 101 140 50 PARU PARU PARU PARU PARU PARG PARU PAR4 Par4 PARG PAR4 PAR4 PAR4 Par4 P & R 4 PAR4 PAR4 PARG PARQ PARU PARU PARG PARU PARG PAR4 PAR4 PARQ PARG READ(4)(RB(I,L),I=1,NT),(RB(I,L+1),III,NT) *** MULTIPLY NOTS COLUMN BY LAST INPUT PV ON THAT BODY MS.EG.0.0R.MS.EG.2.0R.MS.FG.4) GU TO 1500 READ (4) MS, (A(I), I=1, NT), (B(I), I=1, NT) READ (4) (A(1), IE1, NT), (B(1), IE1, NT) IF (FLG23 .67. 0)NSIG # 2.0 # NSIG = CALL AXIS CALL OVERLAY (4HAX8Y,4,1,6HRECALL) $PB(I_{0}L) = RB(I_{0}L) \times Z(NN)$ $RR(I_{0}L+1) = RB(I_{0}L+1) \times Z(NN)$ *** READ NOTS COLUMNS OF RHS IF (FLG04.LE.0) GO TO 2000 IF (FLG03.LE.0) GO TO 1050 IF (FLG17, NE.0) GU TU 1200 Dn 1100 I = 1, NT TF(FLG23 .LE. 0)G0 T0 600 TF (NNU) 1600,1600,1300 NN # NN + ND(KCNT) - 1 IPV = NB - FLG14 + 1 DI 550 KCNT = IPV,NB DU 1500 J = 1 . NNU RB(I,L+1) = B(I)DU 400 I = 1, NT RB(I,L+1) = B(I) $RB(I_{s}l) = A(I)$ RB(I,L) = A(I)DO 550 1=1,NT NSTG = NSIGA C + 5 REWIND 4 NN N NW CONTINUE ~+ - = -LSEO 1F 007 500 1000 С С С С С С 1200 1050 1300 009 1100 U $\boldsymbol{\omega}$ J

PARG

PARQ

1351 5 140 3 340 6 137 601 124 20 02 N **1** 000 23 2 5 80 50 N N N 90 07 00 0) () ~ 2 2 PARG PARU PARG PARQ PARG PARU PARG PARG PARM PARG PARU PARU PARG PAR4 Par4 PARU PARU PARG PARU PARG PARG PARU PARG PARU PARG PARG PARU PAR4 PARG PARG PARG ***CALL TO EXCROS FOR GENERATED (RESEP) BOUNDARY CONDITIONS ***IF CONTROL REACHES THIS POINT, THERE IS AT LEAST 1 NNU MS, (A(I), LEI, NT), (B(I), IEI, NT CALL DVERLAY (4MAXSY,4,3,6MRECALL IF (LS.EQ.1.AND.FLG17.GT.0) L=L=2 DVERLAY (4HAXSY,4,2,6HRECALL ***SKIP RECORD WITH SIN AND COS 60 70 2500 IF(FLG22.67.0) GO TO 2400 IF (FLG21, LE.O) RETURN I 1, NT DO 2200 J = 1, NNU z 8(1) IN I H = 8(1) IF (FLG21, LE, 0) A(T) A(I) NSIG = NSIGEC NSTG = NSIGC CALL EXCROS CROSS RB(1,L+1) RB(I,L) = RB(I,L+1) 1 0071 UU REWIND 4 REWIND 4 CONTINUE REWIND 4 READ (4) 002200 CONTINUE READ(4) RB(1,L) * ر ¤ ر LSELS+1 RETURN 0 2 1 CALL CALL END 000 2000 2500 1400 000000 2050 2200 2400 C 会学 敛 C & & & C & & & &

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OVERLAY	(IAXSY, 4, 1)					AXIS	001C
PRICRAM	AXIS					8 I X V	0020
SUBROUT	INF AXIS					AXIS	0031
						AXIS	000
	* COMPUTE &	XISYMMETRI	C VELOCITY CON	APONENTS	AND PRINT	AXIS	002
						AXIS	000
COMMON	/COMBIN/CHAY(2)				AXIS	001
COMMON	/IPSF/ PSF					AXIS	800
COMMON	MEDR(10)	, CASF	10 2 8	UNC.		AXIS	600
¢	, FLGO3	PLG04	FLGOS	FLGOO	, FLGOT	SIXV	010
2	, FLGOB	PLG09	FLGIO	FLG11	, FLG12	SIXV	5 ° 0
M	, FLG13	, FLG14	FLG15	PLG16	, FLG17	AXIS	210
5	,FLG18	° FI. G19	FLGZO	FLG21	, FLG22	AXIS	013
ທ	, FLG23	, FL G74	FLG25	, FLG26	, FLG27	AXIS	014
COMMON	NT.	D(11), MI	N. NUNA	(S), TYP	EA(S),	SIXV	015
¢~3	NERI	ER2 NI	MA, NSIG	No. No.	ec,	SIXV	016
ŝ	NUNC(5), T	YPEC(5) NI	LF(11), IFC.	ISN	GEC	SIX V	110
*	TYPFEC(5),N	UNEC (5)				AXIS	018
DOUBLE	PRECISION ME	DR, CASE				SIXV	1010
INTFGER	FLGO3	0 FLG04	, FLGOS	,FLG06	, FLG07	SIX8	020
	, FLGOR	erens,	FLGIA	FLG11	, FLG12	SIXe	021
2	,FLG13	eFLG14	FLG15	eFLG16	6FLG17	AXIS	022
M	FLG18	PLG19	FLGZO	, FLG21	, FLG22	AXIS	023
17	, FLG23	, FLG24	FLGZS	FLG26	, FLG27	SIX	028
REAL	Z					AXIS	025
						AXIS	026
COMMON	/C4/ X1(100	7 ×1(100) * X2(100) *	V2(100) 0	DELSCIOOD	AXIS	027
رسي ا	SINACI	00) , COSA(1-	00),XP(100),	YP(100)		S I X V	020
COMMON	/TC/ RB(100	,10), S	TG(100,5),	A(100) «	B(100),	SIXV	620
	Z(100)	0.	MI(100,5),	XN(100,5),T(100,5),	AXIS	030
N	T3(100	,5), N	sle,	° d. Z.	PI o	SIXW	120
N	SUMVS	ی ک	UMM(S)			S I X W	032
COMMON/	TTERF / ITER					AXIS	N N C
						SIXV	034
DIMENSI	UN UB(IOO),YB	(100) × XB(1	(00			AXIS	520

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	DIMENSION	VX(100,5),	VY(100,5)	VT(100,5),	AXIS	036
	4244	TH(100,5),	CP(100.5)	SUMTDS (5)	AXIS	120
٢		• • •			SIX X	880
	DATA FOURPI	/12.5665706/			AXIS	030
	EQUIVALENCE	(VX(1,1) , XN(1.01)) · (VY(1.0	, 1), Υ(1, 1)) ,	AXIS	040
	1 (VT(1.01) 0	T3(1,01)) 0 (TH	(1,1),SIG(1,1)) ((CP(1, 1), T3(1, 1))	SIXV	041
ပ ပ					SIXV	042
υ	භ අ	TART			a x 1 s	043
	NCENT				axis	000
	IF (FLG19,GT	. O) NCENMA			8 I X V	045
	IF (FLGOR,EQ	• 0) GO TD 10			sixa	940
ບ ບ		ITLE FUR MATRIX	PRINT		AXIS	0.07
	WRITF(6,150)	HEDR, CASE, PSF			o I X V	000
	WRITE (6,8)				s I X V	0.0
eC.	FORMAT (11 4	3H MATRICES A, A,	Z BY ROWS & AXT	SYMMETRIC FLOW //)	AXIS	020
с U	8 0x	FAD AXIS SIGMAS			sixe	350
07	00 20 Na1, NS	16			s I X V	20
					sixe Axis	220
	ONCLADO(N)HO.	c			six V	020
0 N	READ (3) (SI	G(I,N), Imi,NC)			sixv	550
	IF (FLG19°LE	.0) 60 70 25			0 I X V	020
	READ (4)				axis	057
	NR N NMAAL				axis	020
	IF (FLG23 67	. 0)GO TO 21			o I X V	050
	READ (4) (SI	G(I, I), LENR, NT)			sixe	000
	REWIND 4				ax13	061
	60 TO 25				axis	062
с U					9 I X 4	063
ں ا					o I X V	064
0 & & & & & & & & & & & & & & & & & & &	A DING WING				8 I X V	665
υ	:				SIXV	990
~	LIFBNO w 0				sixe	067
					sixv	068
	IF (NLF (K) .	5T. 0)60 TO 22			a X I S	0.69
	LIFBOD = LIF	BOD + 1			S X X	010

six

171

sixe

	22 CONTINUE	AXIS	171
		A A B	- P - C
			11
	DO 25 NET/LHPI	nixe	5 4 0
	DO 23 IHVR/NT	SIXV	074
	23 SIG(I,N) = 0.0	AXIS	075
	LBP2 = LBP1 + 1	AXIS	076
	DD 24 N = LBP2,NSIG	AXIS	077
	24 READ(4) (SIG(I,N),ISNR,NT)	AXIS	078
•	*** SIGMAS HERE HAVE BECOME THE INPUT PV	AXIS	610
	DU 26 N = LAP2,NSIG	AXIS	080
	DO ZA IENRANT	SIXV	180
	26 SIG(I,N) ≖ SIG(I,N) /(⇔FΩURPI)	SIXV	082
	REWIND 4	SIXV	083
د د	* NN, OF MIDPOINTS LONP	SIXV	0.64
	25 DU 100 I=1,NT	AXIS	580
6.)	* RFAD MATRICES A, B, Z	AXIS	086
	READ (9) (A(J),J=1,NT),(R(J),J=1,NT),(7(J),J=1,NT)	AXIS	087
e >	* NO, OF FLOWS LOOP	AXIS	000
	N [# 0	SIXV	0.00
	DO 70 Nel, NSIG	AXIS	060
	N1 = N1 + 2	SLXV	160
	SN¢0°0	AXIS	092
	STEC.O	AXIS	500
	SP=0.0	SIXV	094
• >	* NO OF ELEMENTS LOOP	AXIS	560
	DD 30 J=1,NT	AXIS	960
	SN#SN+A(J)*SIG(J,N)	AXIS	100
	ST=ST+R(J)*STG(J,N)	AXIS	098
	TF(FLG23 。GT。 0)Z(J) = 0。0	AXIS	660
	30 SP=SP+Z(J)*SIG(J,N)	AXIS	001
	IF(FLG22,GT_0) GN TU 68	AXIS	101
	IF (FLG12,FQ,0) GU TO 40	AXIS	102
	NOH(2°I)ZX	AXIS	103
	PH1(I, N)=SP=PB(I,N1=1)	AXIS	104
	GD T() 50	AXIS	105

axis

ومع همه اورا 123 120 621 08 60 0 25 5 9 7 7 <u>ک</u> چ 110 NNNNNNNN NNNNNNNN 130 222 135 136 130 62 90 رینی میں جن 07 0 a x I S A X I S A X I S A X I S A X I S e X I S A X I S S X X S AXIS 8 I X V AXIS AXIS 67) Ø ഗ AXT AXIS AXI A X I SUMM(N)=SUMM(N)+PHI(1,N)+Y2(1)+AB(1,N1-1)+DELS(1) (1H 10F10.5)) (1H 10F10.5)) (1H 10F10.5)) CP(I,N)=((1,+05*(1."T(I,N)**2))**3.5=1])/D4 16/ 16/ 191 * MACH NO. ADJUSTMENT 103 FORMAT (1H0 13H MATRIX A ROW FORMAT (1HO 13H MATRIX B ROW FORMAT (1HO 13H MATRIX Z ROW I, (Z(J), J=1, NT) WRITE (6,80) I, (A(J), J=1,NT) WRITE (6,85) I, (8(J), J=1,NT) TX=(I(I,N)*CUSA(I)=1,)/D2+1 TY = (T(I,N) * SINA(I)) CP(I,N) = 1.0 - T(I,N)**2 09 IF (MN.EQ.0.0) GU TO 130 IF(FLG08,EQ.0) GO TO 100 (ALAYTAXT) TAGOM (A LI) T G0 10 XX(I,N)HSNERR(I,N)=1) CP(I . N)=1. - T(I . N) + + 2 T(I,N)=ST+HB(I,N!) IF (FLG11.EQ.0) 00 120 NEL NSIG PHI(J,N) = SP DU 120 1=1.NT WRITE (6,90) XN(I N) H ON PHI(I,N)=SP T(I.N) = ST D3=S0RT(D2) T(1,N)=ST 60 10 65 GO TO 70 CONTINUE CONTINUE O S S M N & M N D4s 7*D1 D2=1.-D1 D5= 2*01 0 7 100 0 <2 T c S ¢ 9 5 0 9 6 60 00 00 C -

C

AXIS

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SIXV

167 ŝ 242 **8 8 \$** 5 5 0 0 3 5 7 7 5 7 164 165 166 168 169 170 203 200 2 9 7 29 J 17 A 2 90 101 0 7 22 161 (300) (200) (200) 572 513 5 * AXIS AXIS AXIS AXIS AXIS AXIS SI X V AXIS AXIS AXIS AXIS AXIS SIXV AXIS SIXV * ELIMINATE MACH NO EFFECT FOR PRINTOUT * PRINT AXIS FLOW (ON-BODY) OUTPUT 64 IF(FLG22.6T.0 .UR. FLG23.6T.0)KA IF(FLG22.6T.0)GD TD 136 SUMTOS(L) # SUMTOS(L) + T(J,L)*DFLS(J) SUMM(L)==6,2831853*SUMM(L) X2(J)=(X1(J1+1)+X1(J1))Z DELS(J)=SGRT(T1+T1+T2+T2) IF (FLG16,LE,0) KA=L=1 T2=Y1(J1+1)=Y1(J1) COSA(J)=11/DFLS(J) SINA(J)=TZ/DELS(J) (17)1X=(1+17)1X=1 DD 135 J = 1, NT DO 250 L=1,NSIG X1(1)=X1(1)*D3 DD 122 I=1.NT 00 126 KH1, NR DO 124 JEM.N NBN+ND(K)-1 XB(1)=X1(1) J=1-1 J18J141 (W) GN=N NINNUN REWIND REWIND لـــ () MUNAI J1#0 u N N O N N N 1 a X 136 <u>ላ</u> የ ଏ ମ ମ 130 ີ 124 \mathbf{C} C

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AXIS

	YB(1)=Y1(1)	AXIS	176
	DO 138 XX#1, NSM	AXIS	123
	X B (X K + 1) # X B (X X)	AXIS	178
	YB(KK+1)#Y2(KK)	SIXV	179
80 M		SIXV	130
	WRITE(3) N	SIXV	101
	WRTFF(5) (X8(K),K81,N)	axis	N 9 7
	MRJTF(3) (YB(K), KG1, N)	SIXY	183
	WRITE(3) (UB(K), K#1, N)	AXIS	198
	IF(ITER °GE, 1) GU TA 139	AXIS	50
	WRITE(15) N	AXIS	186
	ZCILE(10) (X1(X), XH1, N)	AXIS	107
	ZCIPE(1.2) (Y.(K),KH1,N)	AXIS	188
6 M	CONTINUE	AXIS	189
		AXIS	100
0 17 I	WRITE(6,150)HEDR,CASE,PSF	oix4	101
50	FORMAT (1H1 25%, 26MDOUGLAS AIRCRAFT COMPANY /	bixa	201
	ZAX, ZIHLONG BEACH DIVISION ///	AXIS	203
• •2	<pre>C 6X,10A6,4X,10HCASE NO A6,10M PSF = A4 //)</pre>	AXIS	194
	IF (FLG22,6T,0) GO TO 178	AXIS	501
	IF (L.GT.1.OR.FLG16.NE.0) GO TO 170	AXIS	196
	WRITE (6,160)	AXIS	101
60	FORMAT (1H 34H ON-BODY UNIFORM AXISYMMETRIC FLOW)	AXIS	198
		AXIS	66
170	IF (TYPEA(MA),GE,0,0) GU TU 175	SIX	200
1	WRITE (6,172)	NXIS	202
2	FORMAT (1H 44H FLOW GENERATOR & RUTATING BODY & TYPE ERROR)	AXIS	202
5	IF (NUNA(KA) EQ. 123456) WRITE (6,177)	AXIS	203
177	FURMAT (27H UN-BUDY STRIP VURTEX FLOW)	AXIS	204
	IF (NUNA(KA) NE 123456) WRITF(6/180)NUNA(KA)	AXIS	202
	FORMAT (IM 42H ON-BODY NON-UNIFORM AXISYMMETRIC FLOW NO 18)	AXIS	206
6		SIXV	207
00 20 2	FORMAT (IH 5X 24M TRANSFORMED COORDINATES //	SIXV	208
~ (12X 1HX 13X 1HY 13X 2HT1 12X 2HCP 9X 5HSIN A	AXIS	209
9	5 6X 5HCOS A 7X 5HSIGMA 11X 1MN 13X 3MPHI //)	AXIS	210

AXIS

AXIS
210	WRITE (6,220) I,XI(I),YI(I),X2(J),Y2(J), T(J,L),CP(J,L),	8 I X V	21
	1 SINA(J), COBA(J), SIG(J,L), XN(J,L), PHI(J,L)	AXIS	212
220	FORMAT (1H I3,2F14,7/ 4X 4F14,7,2F11,5,3F14,7)	AXIS	213
	[#]+]	AXIS	214
	J # J + J	AXIS	215
	IF (I.EQ.N) GO TO 230	AXIS	216
	TF (T.LE.LCTR) GO TU 210	8 I X V	217
	I.CTR=LCTR+22	AXIS	812
	Gn Tn 140	AXIS	219
230		AXIS	220
	(w) (w) * * * *	AXIS	221
	WRITE (6,240) [,X1(1),Y1(1)	AXIS	222
240	FORMAT (1M IS, 2F14,7 //)	AXIS	223
		AXIS	224
	IF (J = NT) 210, 242, 242	SIXV	225
202	IF(FLG22_GT_0) GN TU 250	AXIS	226
	WRTTE(6,244) SUMM(L), SUMV, SUMTOS(L)	AXIS	227
244	FURMAT (IMO 10X 13M ADDED MASS =F12.7, 4X 9H VOLUME = F12.7	AXIS	228
-	A 5X 18HSUM (7) (DEI TA S) # F12.7)	8XX8	229
250	CONTINUE	AXIS	230
252		AXIS	21
	IF(FIG23 ,GT O)CALL COMBU(LL)	AXIS	232
	JF(FLGOS "EQ" O)RETURN	AXIS	2331
	TF(FLG05 "EQ. 0) GO TO 700	SIXV	234C
	* ()FF=RNDY PDINT	SIXV	235
253	IF (FLG15,LE.0) GO IN 258	AXIS	236
		AXIS	237
	D() 254 I = 1, NB	AXIS	238
254	TF (NLF(T) [E, 0) M H M + 1	AXIS	239
	IF (M .EQ. 0) GU TU 258	AXIS	240
	MM II NNI + 1 · 1	S X V	241

IZZ + EE H 10 258 * ()FF=RUUY POINT 253 IF (FLG15, LE. 0) 60 IN 258 Z H Z «EQ. 0) GO TO IF (J = NT) 210, 242 242 [F(FLG22.6T.0) 60 TU 2 0) RETURN WRITE (6,240) I,X1(I), 5x 18HSUM (T) 0)CALL (244 FURMAT (INO 10X 13H A WRTTE(6,244) SUMM(L). FORMAT (IM IS, 2F14.7 09 0 HX CC A Z MM · U ور بر E O . .61. IF (FI G23 .GT. c ----11 , EQ, + finn = (NLF(T) (W) UN ANUN YF (FLG05 D() 254 I DO 255 1 **TF(FLG05 TF (FI 623** 250 CONTINUE READ (4) Σ ר וו וו ¢ N UN A [4] =] 29 is L 1 y Y Z 252 254 230 240 ららん $\boldsymbol{\omega}$ U

242 243

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IF (F[622.GT.0)HFAD(4)

176

	00 256 J = 1, M	AXIS	246
256	READ(4) (RB(1,J),I = 1,NP), (T3(1,J),I = 1,NP)	AXIS	747
	REWIND 4	AXIS	248
258	DO 300 I = 1, NP	SIXV	249
		AXIS	250
υ	* READ MATRICES X, Y, Z	AXIS	1 S N
	READ (9) (A(J),JZ1,NT),(B(J),JZ1,NT),(7(J),JE1,NT)	AXIS	252
ပ ပ	* NN OF FLOW	SIXV	253
	PO 300 N=1,NSIG	8 I X V	254
	KAIN	AXIS	252
	IF (FLG16,LF,0) KA#N=1	AXIS	25.6
	SXEO.O	SIXV	257
	SY#0.0	sixy	250
	SPB0 ° O	axis	259
ບ	* NO OF FLEMENTS LOOP	AXIS	260
	DD 260 J=1,NT	SIXV	201
	SX H SX + A (]) * SIG(] * N)	o I X V	262
	SYESY+B(J)+SIG(J,N)	AXIS	263
	IF(FLG23 ,GT, 0)Z(J) = 0,0	SIXV	202
260	SP=SP+Z(J) *SIG(J * N)	AXIS	265
	PHI(I, N) HOP	AXIS	266
	IF (FLG22,67,0) GO TO 270	AXIS	267
	IF (FLG11,GT,0) GO TO 270	AXIS	26.8
	IF (N.NE.1.OR.FLG16.GT.0) GU TU 262	AXIS	269
	VX(I,N) = SX+1,	AXIS	270
	GO TO 280	AXIS	271
267	IF (NUNA(KA) NE 123456) GU TN 270	AXIS	272
	L #L + 1	oixa	273
	VX(I,N)=SX+RB(I,L)	AXIS	274
	VY(I,N)=SY+T3(I,L)	AXIS	275
	GD TO 300	SIXV	276
270	VX(I,N) = SX	AXIS	277
280	VY(I,N) Z SY	8 I X V	270
300	CONTINUE	SIXV	279
	IF (MN EQ,0,0) GO TO 330	AXIS	280

AXIS

305 307 309 N N N N N N 306 308 310 303 304 283 296 298 299 200 305 205 202 284 285 286 207 2 8 8 0 0 0 0 0 0 0 2 9 0 201 202 293 294 295 297 202 ഗ AXIS AXIS AXIS AXIS AXIS SIXV AXIS SIXV AXIS AXIS AXIS AX IS AX IS AXIS SIXA NX N 12X ZHVY 12X ZHVT 10X [8] FLOW NO. ~ FORMAT (1H 35H OFF=BODY UNIFORM AXISYMMETRIC FLOW FORMAT (1H 43H OFF-BODY NON-UNIFORM AXTSYMMETRIC IF (NUNA(KA), NE, 123456) WRITE (6, 380) NUNA(KA) _ (1H 5X, 24H TRANSFORMED COORDINATES // (I * PRINT AXIS FLOW (OFF-BODY) NUTPUT ZHVX A X TH(I_N)=ATAN2(VY(I_N),VX(I_N)) * 57,29578 FORMAT (284 OFF-BODY STRIP VORTEX FLOW) 6 IF (NUNA(KA).EQ.123456) WRITE (6,377) FLG23 .67. VT(I,N)=SQRT(VX(I,N)**2+VY(I,N)**2) GO TO 370 * COMPUTE VT AND THETA IF (TYPEA(KA),GE.0.) GO TO 375 NO. ADJUSTMENT 12X 1HX 13X 1HY 13X VX(I,N)=(VX(I,N)=1,)/D2+1. IF (L.GT.1.0R.FLG16.NE.0) IF(FLG22.GT.0) GO TO 378 WRITE(6,150)HEDR,CASE,PSF C 0)KA = L 0 _ DR. VY(I,N)=VY(I,N)/D3 00 322 I = 1, NP MACH 00 335 N=1, NSIG DO 450 LE1,NSIG DI 320 NEL NSIG XP(])=XP(])*D3 IF(FLG16 .LE. IF(FLG22 .GT. 00 335 I=1,NP WRITE (6.172) WRITE (6,400) 00 320 I=1,NP WRITE (6,360) 乍 60 70 390 LCTR=45 FORMAT نــ 11 ₹ ¥ N - N 380 360 370 375 377 37.8 0007 335 320 でも 022 340

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SHTHFTA 11X 3HPHI //)

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VX(I,L),VY(I,L),VY(I,L),

WRITE (6.420) I,XP(I),YP(I),	TH(I,L), PHI(I,L)	FORMAT (1H I3, 7F14.7)	[2] 4]	IF (I.,GT,NP) GO TO 450	IF (I,LE,LCTR) GO TO 410	LCTR=LCTR+45	GO TN 340	CONTINUE	LL = 0	IF(FLG23 ,GT, 0)CALL COMBU(LL)	RETURN	CONTINUE	END
010	Qui	420						450	500			700	

C

SURROUI	INE COMBO	(11)				COMB	003
						COMB	005
NUMMOU	/ IPSF /	PSF				COMB	003
COMMON	/COMBIN/C	(2) HAY (2)				COMB	004
COMMON	HEDR	R(10) CASE	s NB	NNN		COMB	002
	, FLG0	13 PLC04	FLGOS	, FLG06	, FLG07	COWB	000
ŝ	097 <i>4</i> '	08 FLG09	, FLG10	FLG11	, FLG12	COMB	007
فري	FLG1	3 FLG14	, FLG15	, FLG16	, FLG17	COMB	000
3	ELG17	18 FLG19	, FLG20	FLG21	, FLG22	COMB	600
<u>ار</u>	FLG2	23 FLG24	, FLG25	, FLG26	, FLG27	COMB	010
COMMON	NT.	ND(11) "	MN. NUN	A(S), TYPE	A(5),	COMB	011
	NER!	NER2.	NMA NSIC	GA, NSIG	ر ،	COMB	012
ι Λι	NUNC (S)	, TYPEC(S),	NLF(11), IEC,	NSIG NSIG	EC,	COMB	013
۲۹	TYPEEC((S) NUNFC(S)				COMB	014
DOUBLE	PRECISION	W HEDR, CASE				COMB	1510
INTEGEF	R FLGO	13 FLG04	, FLGOS	, FLG06	, FLG07	COMB	016
ę	, FLGO)8 FLG09	FLGIO	, FLG11	, FLG12	COMB	017
~	19730	13 FLG14	FLG15	, FLG16	,FLG17	COMB	010
~	"FLG1	IB FLGI9	, FLG20	FLG21	, FLG22	COMB	010
17	° F L G 2	23 FLG24	FLG25	, FLG26	, FLG27	COMB	020
RFAL	Z					COMB	7 N N O
!						COMB	022
COMMOD	1C4/ X1	1(100), VI(1	00), X2(100),	Y2(100) "	DELS(100),	COMB	023
	5	[NA(100), CUSA	(100) XP(100)	YP(100)		COMB	024
NOMMOU	/TC/ RB	3(100,10),	SIG(100,5),	A(100) «	B(100)。	COMB	020
-	2	(100),	PHI(100,5),	XN(100.5)	eT(100.5)	COMB	020
N	9	5(100,5),	NSIG	, dN	° I N	COMB	227
~1	SL	JMV ,	SUMM(5)	I		COM8	028
DIMENS	(2,2) J NO1	, DV(2),	TFIRST(2,"	5) , TLAST (2,	5), TSUM(2,5)	COMB	029
DIMENS	ION CP(10	(00				COMB	0 X O
FOUTVAL	ENCE (CF	>(1), A(1))				COMB	031
EQUIVAL	ENCE (C	OV(1) CHAY(1)	~			COMB	032
SNJWIG	IDN VX(100	0,5),VY(100,5), VT(100,5)			COMB	S CO
FOUTVAL	ENCE (V)	K(1,1),XN(1,1)))。(VY(1,1),T(101))0		COMB	034
1 (17	(1.1), 73(1	((1,1))				CUMB	50

U

C

COMB

180

C

6 M M M M O M	0 2 G	030	040	120	042	500	044	045	900	047	048	670	020	051	052	053	930	055	020	057	020	050	090	061	062	063	064	0.65	066	067	068	069	010
	COMB	COMB	COMB	COMB	COMB	COMB	COMB	COMB	COMB	COMB	COMB	COMB	COMB	COMB	COMB	COMB	COMB	COM BO	COMB	COMB	COMB	CUMB	COMB	COM B	COMB	COMB	COMB	COMB	COMB	COMB	COMB	COMB	COMB
C C ** ICNT WILL BE THE NUMBER OF LIFTING BODIES	C * NFLOW WILL BE THE NUMBER OF FLOWS				IN IFC NLF(K) »LE, 0)ICNT#ICNT+1		IF(LL , EQ, 0)GD TU 1000	READ(5,4)(DV(1),1=1,1CNT)	4 FORMAT (6F10,0)	WRITE(6,6) (DV(I),IS1,ICNT)	6 FORMATCIM1,42M THE INPUT DV FOR COMBINATION SOLUTION ARE /			C *** IPICNI WILL BE THE LAST MIDPOINT ON BODY K			C * ILLFT WILL RE THE LIFTING BODY NUMBER				IFIRST = IFICNT = ND(R) + 2	IF (NLF(K) , GT , 0)GO TO 100					TLAST(ILIFI,J) = T(IPTCNT,J)	50 ISUM(ILIFI,J) = TFIRST(ILIFT,J) + TLAST(ILIFT,J)	100 CONTINUE		C ** IPVBUD WILL BE IST PRESCRIBED VORTICITY FLOW	LANDA WITT DE LAND VIKIF VURTEX FLOW	
	_ •																														~~ Q		2

COMB

IPVRUD = 24ICN		COMB	140
ASTSV = IPVRD)) - 1	COMB	072
DU 300 [#1, TCN		S S S S S S S S S S S S S S S S S S S	073
		COMB	074
PV(I) = DV(I) =	• TSUM(I,1)	COMB	075
а А.)		COMB	076
DO 200 JEIPVBO	DD, NFLOW	COMB	077
(I) A = (I) A = 0 A (I)	« TSUM(I,J)	COMB	078
a		COMB	079
DO 250 J=2, LAS	37SV	COMB	080
JCNT # JCNT +		COMB	081
250 C(I, JCNT) # TS	5UM([,J)	COMB	200
300 CONTINUE		COMB	003
		COMB	080
		COMB	002
CALL SOLCOME D	DV, C, ICNT)	COMB	096
00 500 I = 1°N	47	COMB	087
C *** ADD PV FID	DWS TO AXIS FLOW FOR COMBINATION SOLUTION ON BUDY	COMB	088
JCNT = 0		COMB	080
DO 350 JaIPVBO	JD "NFLQW	COMB	000
XN(I,1) = XN(I	[,]) + XN(I,J)	COMB	160
350 T(1,1) = T(1,1	$() \leftarrow T(T,J)$	COMB	200
C *** ADD K * ST	RRIP VORTEX BODY VELOCITY FOR COMBINATION SOLUTION	COMB	093
DO 400 J = 5°C	ASTSV	COMB	10 C
JCNT = JCNT +	Series	COMB	0.95
XN(I ° I) = XN(I	I, 1) & CMAY(JCNT) & XN(I,J)	COMB	096
400 T(I,1) = T(I,1	<pre>[] + CHAY(JCNT)*T(I,J)</pre>	COMB	197
CP(I) # 1,0 m	e T(I,1)**2	CUMB	990
500 CONTINUE		COMB	660
		COMB	100
5 87		COMB	101
Mus		COMB	102
N WND (W)		CUMB	103
LCTR = 22		COMB	104
540 WRTTE(6,550)HE	EDR, CASF, PSF	CUMB	105

182

550	FORMAT(141,25%, 26HDOUGLAS AIRCRAFT FOMPANY /	COMB	106
	1 28X, 21HLUNG BEACH DIVISION ///	COMB	107
-	2 6X,10A6, 4X,10HCASE NO. A6, 9H PSF = ,44 //)	COMB	108
	WRITE(6,560)	COMB	109
560	FORMAT(1H , 21H COMBINATION SOLUTION)	CUMB	110
	WRTTF(6,700)	COMB	
700	FURMATCIH 5X 24H TRANSFORMED COURDINATES //	COMB	N ~
	1 12X014X 13X 14Y 13X 24T1 12X 24CP 9X 54SIN A 6X 54COS A 11X 14N	COMB	2 2 2 3
-		COMB	124
710	WRITF(6,720)I,X1(I),Y1(I),X2(J),Y2(J),T(J,1),CP(J),SINA(J),COSA(J)	COMB	5
-	$\sim 10^{10}$ $\sim 10^{10}$ $\sim 10^{10}$	COMB	913
720	FORMATCIH I3,2F14,7 / 4X 4F14,7+2F11,5,F14,7)	COMB	2 3 3
		COMB	817
		COMB	673
	IF(I "EQ" N) GO TO 730	COMB	120
	IF(I , LE, LCTR) GO TO 710	COMB	2
	LCTR = LCTR + 22	COMB	122
	GO TO 540	COMB	521
730		CUMB	120
		COMB	5
	WRITE(6,740)I,X1(1),Y1(1)	COMB	126
740	FORMAT(IM , I3, 2FI4, 7 //)	COMB	127
	[6] 4 [COMB	128
	IFC J LT NTGO TO 710	COMB	621
	M 🕽 🕿 ()	COMB	021
		COMB	
	DID 800 K H 1 . NB	COMB	132
		COMB	[67] [67]
		COMB	130
	CIRC # 0.0	COMB	135
		COMB	136
		COMB	137
	CIRC = CIRC + (T(I,1) + DFLS(I))	COMB	138
790	THRUST = THRUST + (YZ(I) * CP(I) * SINA(I) * DELS(I))	COMB	139
	THRUST = = 6,283186 * TMRUST	COMB	140

COMB

CUMB 141	COMB 142	COMB 143	COME 140	COMB 145	COMB 146	COMB 147	COMB 148	CUMB 149	COMB 150	300Y COMB 151	COMB 152	COMB	COMB 150	COMB 155	COMB 156	COMB 157	COMB 158	COMB 159	COMB 160	COMB 161	COMB 162	COMB 163	COMB 164	CUMB 165	CUMB 166	COMB 167	CUMB 168	COMB 169	COMB 170	COMB 171	COMB 172	COMB 173	COMB 174	COMB 175	
WRTTF(6,795)K,CIRC,THRUST	795 FURMAT(///13H BODY NO, JUSX/JAHCIRCULATTON = /F14 7/5%	1 9HTHRUST = 0F14.7)	ROD CONTINUE	RFTURN	C *** DFF BODY COMBINATION SOLUTION	1000 [PVBAD = 2 + ICNT	LASTSV = IPVRID - 1	DU 1500 I=1,NP	JCNT = 0	C *** AUD PV FLOWS TO AXTS FLOW FOR CUMBINATION SOLUTION OFF E	DO 1350 J = IPVBOD,NFLOW	$VX(I_{\rho}I) = VX(I_{\rho}I) + VX(I_{\rho}J)$	$1350. VY(I_{\rho}I) = VY(I_{\rho}I) + VY(I_{\rho}J)$	C *** ADD K * STRIP VURTEX UFF BODY VELOCITY	DD 1400 J=2,LASTSV	JCNT # JCNT + 1	VX(I,1) = VX(I,1) + CHAY(JCNT) * VX(I,J)	1400 VY(I,1) = VY(I,1) + CHAY(JCNT) * VY(I,J)	VT(I,1) = SGRT(VX(I,1)**2 + VY(I,1)**2)	ISOO CONTINUE	58 2	LCTR # 45	1540 WRITE(6,550)HEDR,CASE,PSF	WRITF(6,1560)	IS60 FORMATCIM "31M COMBINATION SOLUTION OFF BODY)	WRITF(6,1700)	1700 FURMATCIH "5%,24H TRANSFURMED COORDINATES //	1 12X+14X+13X+14Y+13X+24VX+12X+24VY+12X+24VY+12X+24VY-17	1710 WRITF(6,1720)1,XP(I),YP(I),VX(T,1),VY(T,1),VT(I,1)	1720 FORMAT(1H ,I3,5F14,7)		TFIL STT, NPIGN TO 1750	IF(I ,LE, LCTR)GU TO 1710		

СОМВ

COMB 176 COMB 177 COMB 177 COMB 178

GO TO 1540 1750 CONTINUE Return End

005 000 002 900 700 8000 010 **21**0 013 014 5 1 0 010010 100 003 011 SOLC solc solc SOLC solc solc sulc SULC SOLC SOLC solc solc SULC SOLC SOLC SOLC THF MATRICES HAVE BEEN FORMED GENERALLY NUTE THAT THIS SUBROUTINE SOLVES UNLY A 1X1 OR 2X2 MATRIX It is separated so that if prugram is ever inlarged, this is where the matrix solution for the combination part of 0V (2) A(202) e ICNT) A(1,2)*A(2" A(2,1)*DV(1)) (A(1,2)/A(2,2) ≪ IF(ICNT "EQ" 2) GU TU 20 DIMENSION DV(2), A(2,2) THE PROGRAM WILL GO. SURROUTINE SULCOM(DV, IN SUBROUTINE COMBO. A(1,1) ¢ B 0V(2) -A(1,1) V(1) = DV(1) /= (DV(1))DV(2) =(RETURN RETURN CI)AQ END 20 偶似 金金 或或 会会 我

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UVFRLAY (PROGRAM	AXSY,4,2) CRUSS					C R O S C R O S	00100020
SURRNUT	NE CROSS					CROS	0031
						CROS	000
	* COMPUTE	CRUSS FLUW	VELOCITY COMP	ONENTS AND	PRINT	CROS	002
						CKOS	000
COMMON /	TPSF/ PSF					CROS	007
NUMMOL	HEDRCI	O) CASE	8 2 8 2	DNN.		CROS	000
6 4	, FLG03	0 FL G04	, FLGOS	FLGO6	, FLG07	CROS	600
~	, FLG08	FLG09	FLGIO	FLG11	FLG12	CROS	010
M	, FLG13	FLG14	FLG15	FLG16	, FLG17	CROS	110
4	°FL618	0FLG19	FLG20	FLG21	, FLG22	CR03	210
ۍ ا	, FLG23	, FLG24	FLG25	FLG26	, FLG27	CROS	010
NCM NCO	N T .	(11)ON	MN. NUNA	(5), TYPE	A(5),	CROS	010
1	NERIS	NERZO	NMA, NSIG	A. NSIG		CROS	015
~	NUNC (S)	TYPEC(5),	NIF(11), TEC,	ISISN	C S	CROS	016
M	TYPEEC(5)	, NUNEC (5)				CROS	110
DOUBLE P	RECISION	HEDR, CASE				CROS	1910
INTEGER	FLG03	, FL G04	, FLGOS	, FLG06	, FLG07	CROS	610
	, FLG08	PFL609	FLGIO	FLGII	0 FLG12	CROS	020
N	, FLG13	PLG14	, FLG15	PLG16	,FLG17	CROS	120
ν.	"FLG18	0 FLG19	FLGZO	, FLG21	, FLG22	CROS	220
17	, FLG23		, FLG25	, FLG26	, FLG27	CROS	N N O
REAL	Z					CROS	024
						CROS	025
COMMON	C4/ XICI	00) × 1110	0), X2(100),	YZ(100),	DELS(100),	CROS	026
490 0	SINA	(100), CUSA(100) xP(100)	YP(100)		CROS	227
CDMMON /	TC/ RBCI	00,10),	SIG(100,5),	A(100),	B(100) /	CROS	028
6 2-4	Z(10	0),	PHI(100,5%	XN(100.5)	, T(100,5),	CROS	029
ŝ	T3(1	00,5),	NSIG,	N D S	NI e	CROS	030
~	AMOS		SUMM(5)			CROS	180
						CROS	032
DIMENSIO	C. OOIJXA N) , VY(100,5)	, VZ(100,51, TZ(100,5)		CROS	033
						CROS	920
EGUIVALE	NCE C VX(1	ollo XN(101)) o (VY(101)	· *(1.1) >	•	CROS	SS 0 2 2

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037 030 039 070 042 043 3333 048 6 10 0 050 250 058 059 090 061 0.62 063 0.64 005 000 0.67 068 030 041 CROS CROS CROS CROS CROS CROS CROS CROS C R O S C R O S CROS CROS CROS CROS CROS CROS CR0S CR0S CROS * INITIALIZE UNIFORM OR NON-UNIFORM PARAMETERS BY ROWS * CROSS FLOW //) READ (10) (A(J), J=1, NT), (B(J), J=1, NT), (Z(J), J=1, NT) (T2(1,1), T(1,1)) 5 * TITLE FOR MATRIX PRINT TF (FLG21,67,0) 60 TO 38 IF (N.FQ.1.AND.FL617.LE.0) 60 TU * NO. OF MINPOINTS LOOP * NO. OF ELEMENTS LOOP * READ MATRICES A, 8, 2, 2 FORMAT (1H 36M MATRICES A, 8, 2 * RFAD CRUSS SIGMAS * NO. OF FLOWS LOOP READ (3) (SIG(I,N), I=1,NT) WRITF(6,150)HEDR,CASE,PSF IF (FLG08,EQ.0) GU TN 10 (VZ(1,1), T3(1,1)), SA=SA + A (J) * SIG(J, N) S8=S8+R(J)*SIG(J,N) SZ=SZ+7(J)*STG(J,N) START C2 = -RB(I, M-1)DO 20 N=1, NSTG 00 70 N=1, NSIG DO 100 I=1,NT DO 30 J=1 NT WRITE (6,8) SUMM(N)=0°0 個 C1=RR(I,M) 60 Th 40 C3=0.0 SAE0.0 SB=0.0 SZ=0°0 N ♦ X II X C N N 202 C 30 ¢ C C ${\boldsymbol{\omega}}$ C $\boldsymbol{\omega}$ - - -G ູ

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5 M		C K U S	100
		CKUS	2
	C3=1.	CROS	073
	GO TO 40	CROS	074
80 20	C1 = 0.0	CROS	075
	C2 = 0.0	CROS	076
		CROS	077
017	IF (FLG12,EQ.0) GO TO 45	CROS	078
	* UPTION FOR Z (PHI) MATRIX SALUTION	CROS	019
	XN(I,N) # SA	CROS	080
	$PHI(I,N) = Y2(I) \times SZ$	CROS	081
		CROS	082
	* REGULAR A MATRIX SOLUTION	CROS	083
5	PHI(I,N)=Y2(I)=S2	CRUS	084
		CROS	085
20	IF (FLG11,EQ.0) GO TO 55	CROS	086
	CPTION PERTURBATIONS	CROS	087
	T2(I,N)=5B	CROS	088
	T3(I,N)=52	CROS	089
		CROS	060
ហ ហ	15(I°N)=284C1	CKOS	160
	T3(I ^k N)=92+C3	CR08	092
¢ 9	JF(FL.G21,61,0) 60 TO 70	CROS	093
	SUMM(N) # SUMM(N) + PHI(I,N) + Y2(I) + C2 + DELS(I)	CRDS	17 6 0
70		CROS	095
	IF (FLG08 EQ00) GUTTO 100 CONTRACTOR IN THE CONTRACTOR OF THE CONTRACTOR OF THE CONTRACTOR OF THE CONTRACTOR OF	CRUS	960
	WRITE (6,80) I. (A(J), J=1, NT)	CROS	097
08	FORMAT (1HO 13H MATRIX A ROW 16/ (1H 10F10_5))	CROS	098
	WRITE (6,85) I, (8(J), J=1,NT)	CRUS	000
с С	FORMAT (1HO 13H MATRIX B ROW 16/ (1H 10F10_5))	CROS	100
	WRITF (6,90) I,(2(J),J#1,NT)	CROS	101
60	FORMAT (1HO 13H MATRIX Z ROW 16/ (1H 10F10_5))	CRDS	102
100	CONTINUE	CROS	103
	* PRINT CROSS FLOW (ON RODY) OUTPUT	CROS	104
130	CO 250 LetiNSIG	CRUS	102

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CROS

		CRUS	106
	IF (FLG17,LE,0) KC=L=1	CROS	101
	JF(FLG21,GT,0) GO TO 138	CROS	108
	SUMM(L) = 3,141593 *SUMM(L)	CRUS	601
339		CROS	011
		CROS	() () () () () () () () () () () () () (
		CROS	112
		CRUS	202
	LCTRS22 Structure and	CROS	17 3 3
140	WRITE(6,150)HEDR,CASE,PSF	CROS	5
051	FORMAT (1H1 25%, 26MDOUGLAS AIRCRAFT COMPANY /	CROS	116
(and	1 28X, 21HLONG BEACH DIVISION ///	CROS	111
i U	2 6X,10A6,4X,10HCASE NO, A6,10H PSF = ,44 //)	CROS	118
	JF (FLG22_GT_0) GO TO 175	CROS	119
	IF (L.GT.1.0R.FLG17.NE.0) GO TO 170	CROS	120
	WRITE (6,160)	CROS	121
160	FORMAT (1H 27H UN-BUDY UNIFORM CROSS FLOW)	CROS	122
	60 LU 160	CROS	123
170	IF (TYPEC(KC),GF,0,) GO TU 175	CROS	120
	WRITE (6,172)	CROS	125
172	FORMAT (1H 31H FLOW GENERATOR & ROTATING BODY)	CROS	126
513	WRITE (6,180) NUNC(KC)	CROS	127
000	FORMAT (1H 35H ON-BODY NON-UNIFORM CROSS FLOW NO_ I8)	CROS	120
061	WRITE (6,200) P	CROS	621
200	FURMAT (1H 5X 24H TRANSFORMED CUORDINATES //	CROS	130
фац.	I I 2X 1HX 15X 1HY 13X 2HT2 12X 2HT3 9X 5HSIN A	CROS	131
. U	2 CALLER OF SHCOS A 7X SHSIGHA 11X 1HN 13X 3HPHI //)	CROS	23
012 S	WRITE (6,220) I,X1(I),Y1(I),X2(J),Y2(J), 72(J), 72(J,L),73(J,L),	CROS	133
	L SINA(J), COSA(J), SIG(J, L), XN(J, L), PHI(J, L)	CROS	130
0	FORMAT (1H I3,2F14,7/ 4X 4P14,702P11,5,3F14,7)	CRDS	1 3 S
		CROS	136
	በቱ ይቀ 1 	CROS	153
	IF (1,EQ.N) GU 70 230	CROS	130
	IF (I, LE, LCTR) GD TU 210	CROS	139
	LCTR=LCTR+22	CRUS	140

156 091 502 166 69 141 243 05 0 NN 99 1993 0 691 043 N 5 46 8 949 121 2 175 542 107 150 161 2 2 4 CROS FORMAT (1H0 10%,14H ADDED MASS = F12.7, 4%,10H VOLUME = F12.7) READ (10) (A(J), J=1,NT), (B(J), JE1,NT), (Z(J), JE1,NT) 270 (FLG22,67,0) GO TO 270 (FLG11,67,0,0R,N,NE,1,0R,FLG17,61,0) GO TO PERTURBATION ON NON-UNIFORM VY, VZ * NO. OF FLEMENTS LOOP * READ MATRICES X, Y, Z WRITE (6,240) I,X1(I),Y1(I) IF(FLG22.61.0)60 T0 250 WRITE(6,244) SUMM(L), SUMV FORMAT (14 13, 2F14.7 //) * OFF-BODY POINT * NU, OF FLOW N#1, NSIG IF (FLG05,EQ.0) RETURN IF(J_GT_NT)GO TO 242 Go to 210 (N°C)SX + V(C) × AIC(C) × XS SYBSY+B(J)*SIG(J,N) Sp=SP+Z(J)*SIG(J,N) PHI(I,N)=YP(I)*SP ON 300 ITINP DO 260 J=1,NT VY(I,N)=SY+1. VZ(1,N)=SP+1. 叡 XS=(NºI)XA TO 300 GO TO 140 (W) (N + N#N CONTINUE 00 300 Sym0.0 Sps0.0 SXE0.0 2 + X || X 4 4 1 14 0 240 260 530 242 0 N 15 N N N 244

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CROS

	TO VYET.	Z)=SY	CRUS	176
	VZCIO	N) # SP	CRUS	177
	100 CONTI	NUE	CRUS	178
ن		* PPINT CRUSS FLUW (DFF=ROUV) OUTPUT	CROS	179
	130 00 45	0 L=1,NSIG	CROS	180
	π Σ		CROS	181
	TF (F	LG17,LE.0) KC=L-1	CROS	182
]=]		CROS	183
	LCTR=	45	CROS	184
	S40 WRTTE	(6,150)HEDR,CASF,PSF	CROS	10S
	IF (F	LG22,67,0) GO TO 375	CRDS	186
	IF (I	.GT.1.0P.FLG17,NE.0) GU TU 370	CROS	167
	WRITE	(4,360)	CROS	188
	160 FURMA	T (IH ZAH OFF-BODY UNIFORM CROSS FLOW)	CROS	189
	60 10	390	CROS	061
	570 IF (7	YPEC(KC),GE.0,) GN TU 375	CROS	191
	AR T FE	(6,172)	CROS	202
	STS WHITE	(6,580) NUNC(KC)	CROS	201
	SO FURMA	T (1H 36H OFF-BODY NUN-UNIFORM CROSS FLOW NO. 18)	CROS	194
	390 WRITE	(0)	CROS	503
	IOO FURMA	T (IH SX, 24H TRANSFURMED COURDINATES //	CROS	196
	1 12X	(// IAX IZX IHY IZX ZHVY IZX ZHVZ IZX 3HPHI //)	CROS	197
	110 WRITE	(6,420) I,XP(I),YP(I),VX(I,L),VY(I,L),VZ(I,L),PHI(I,L)	CROS	198
	120 FORMA	T (1H I3, 6F14.7)	CROS	999
	I = I = I		CROS	200
	TF (1	"61.°NP) 60 T0 450 .	CROS	201
	TF (T	LE.LCTP) GO TO 410	CROS	202
	LCTR=	LCTR+45	CROS	203
	GO TC	340	CKOS	204
	150 CONTI	NUJE	CROS	205
	500 CONTI	NUF	CROS	206
L	RFTUR		CROS	2071
	FND		CROS	208

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	UVFRLAY (4	XSY . 4 . 3)					EXCR	0010
	PRIGRAM F	EXCRUS					FXCR	0020
ు	SURROUTIA	JE EXCROS					EXCR	1200
のななな	***CUWD(JTE EXTRA	CROSS FLOW	VFLOCITY COMPO	NENTS AND	PRINT	FXCR	004
	COMMUN /1	(PSF/ PSF					EXCR	002
	COMMUN	HEDR(1	0) "CASE	PZ °	DNN °		F X C R	000
	~**	, FLG03	, FL GO4	FLGOS	, FLG06	, FLG07	FXCR	001
	5	, FLG08	, FLG09	FLGIO	FLG11	, FLG12	EXCR	000
	M	, FLG13	0 FLG14	FLG15	, FLG16	FLG17	FXCR	600
	17	FLG18	, FLG19	FLG20	• FLG21	,FLG22	EXCR	010
	ŝ	, FLG23	JFLG24	, FLG25	rrg20	, FLG27	EXCR	110
	COMMON	NT .	ND(11) v	MNP NUNA	(S), TYPE	A(5),	EXCR	012
	~1	NERI	NERZ	NMA, NSIG	A. NSIG	c,	EXCR	013
	ſ.	NUNC(5),	TYPEC(5),	NLF(11), IFC,	NSIG	EC,	EXCR	014
	M	TYPEEC (5)	, NUNEC (S)				EXCR	s i c
ပ ပ	DOUBLE PF	RECISION	HEDR, CASE				EXCR	1910
	INTEGER	FLG03	05LG04	FLGOS	, FLG06	, FLG07	FXCR	017
	~~4	FLGOB	rLG09	, FLG10	, FLG11	FLG12	EXCR	018
	2	, FLG13	PLG14	, FLG15	FLG16	, FLG17	EXCR	610
	٠ ۲	, FLG18	FLG19	FLGZO	, FLG21	, FLG22	EXCR	020
	17	FLG23	, FLG24	, FLG25	, FLG26	, FLG27	E X C R	021
	REAL	Σ					E X C R	022
ပ ပ							R X C R	023
	COMMON /C	24/ X1(1	00), VI(10	10) × × × (100) .	V2(100) "	DELS(100),	EXCR	020
	4	SINA	(100) , CUSA (100) , XP (100) ,	YP(100)		EXC R	50
	COMMON /1	C/ RB(1	.00,10),	SIG(100,5),	a(100) ø	B(100) "	FXCR	026
	~	01)Z	0).	PHI(100,5),	XN(100,5)	• T(100,5),	EXCR	027
	ŝ	T3(1	00,5),	NSIG,	s d N	N I V	EXCR	028
	M	SUMV	•	SUMM(5)			FXCR	029
C							EXCR	030
	DIMENSIO	4 VX(100 5	(S°001) AA (!	, v2(100,5), 72(100.5)		EXCR	031
C							EXCR	032
	FOUIVALEN	VCE C VXCI	· I) · XN(1,1)) , (VY(1,1)	e T(1.01))		EXCR	033
	1 (VZ(1,	1), 73(1,	1)), (72([101) r(101))			F X C R	034
e							EXCR	035

EXCR

037 007 040 020 0 2 1 0 2 1 £ €0 054 0550 056 057 058 059 0.00 0.0 0.62 0.63 0.04 0.65 000 067 068 0.69 010 043 045 046 000 042 044 036 038 039 040 041 EXCR F.XCR EXCR EXCR EXCR EXCR FXCR EXCR EXCR XCK EXCR EXCR EXCR FXCR EXCR FXCR ጦ READ (8) (A(J), J = 1, NT), (8 (J), J = 1, NT), (2(J), J = 1, NT * EXTRA CROSS FLOW //) (1H 10F10,5) ***YOU MUST SOLVE POTENTIAL MATRIX FOR EXCROS RY ROWS FORMAT (1H0 13H MATRIX A RNW 16/ (A(J), J = 1, NT) $(B(J)_{J} = 1, NT)$ FURMAT (1H 42H MATRICES A, B, Z READ (3) (SIG(I,N),I = 1,NT ***NO, OF MIDPOINTS LOOP ***READ EXTRA CRUSS SIGMAS PHI(I,N) = Y2(I) * SZ / 2.0 ***TITLE FOR MATRIX PRINT TF (FLG0A.EQ.0) 60 TO 100 SIG(J,N) WRITE(6,150)HEDR,CASF,PSF SIG(J,N) STGCJ,N) ***NO. OF ELEMENTS LOOP IF (FLG08,EQ.0) GU IN 10 ***READ MATRICES A. B. Z ***NO. OF FLOWS LOOP DO 20 N = 1 NSIG 傢 D() 70 N H 1, NSTG M W M + 2 WRITE (6,80) I. WRITE (6,85) I. TN.1 = 1 001 00 + B(J) + Z(J) A (J) PO 30 J # 1.NT = 89 11 XN(I,N) = SA 73(1, N) = 52MRTTE (6,8) 4 CONTINUE e 0°0 58 = 58 52 = 57 SA = 0.0 SZ = 0.0 REWIND 8 N SA TZ(L.N) 0 11 1 <u>م</u> **8**8 60 01 0 3 0 202 30 ¢ Caaa Cooo Ceek C & & & & Caba C & & & (* * * *

EXCR

EXCR

85 FURMAT (1H0 13H MATRIX B ROW 16/ (1H 10F10,5))	FXCR	071
WRTTF (6,90) 1, (7(J),J = 1,NT)	EXCR	072
90 FORMAT (IMO 13H MATRIX Z ROW I6/ (IH 10F10,5))	FXCR	510
100 CONTINUE	EXCK	074
C*** ***PRINT EXTRA CROSS FLOW (ON BODY) OUTPUT	EXCR	075
130 D() 250 L = 1,NSIG	EXCR	076
	E X C R	077
	Excr	078
	EXCR	640
	EXCR	080
	EXCR	081
CAAA AAAM IS THE BODY NUMBER	EXCR	082
C*** ***N IS THE NUMBER OF POINTS ON BODY M	EXCR	083
LCTR = 22	EXCR	084
140 WRITE(6,150)HEDR,CASE,PSF	EXCR	085
150 FURMAT (1M1 25%, 26HDUUGLAS AIRCRAFT COMPANY /	EXCR	086
1 ZBX/ ZIMLONG BEACH DIVISION ///	EXCR	087
Z 6X,10A6,4X,10HCASE NO, A6,10H PSF = ,A4 //)	EXCR	0.8.8
IF (FLG22,GT_0) 60 TO 160	EXCR	060
RRITE (6,155)NUNEC(KEC)	EXCR	000
155 FORMAT(41M QN=RUDY NON=UNIFORM EXTRA CROSS FLOW NO_ 18)	F X C R	360
GU TD 190	EXCR	092
160 WRITE (6,162)	EXCR	093
162 FURMAT(68H UN BODY GENERATED (RESEP) BOUNDARY CONDITIONS EXTR	EXCR	17 6 0
LA CROSS FLOW)	EXCR	56 0
190 WRITE (6,200)	EXCR	0960
200 FORMAT (IM 5% 24H TRANSFORMED COORDINATES //	EXCR	101
1 12X 1HX 13X 1HY 13X 2HT2 12X 2HT3 9X 5HSIN A	EXCR	098
Z 6X SHCAS A 7X SHSIGMA 11X 1MN 13X 3HPHI //)	EXCR	660
210 WRITE (6,220) I,X1(I),Y1(I),X2(J),Y2(J), 72(J), 72(J,L),	EXCR	001
1 SINA(J),COSA(J),SIG(J,L),XN(J,L),PMI(J,L)	EXCR	202
220 FORMAT (1M I3,2F14,7/ 4X 4F14,702F11,5,3F14,7)	EXCR	201
	EXCR	103
	K C K C K	104
IF (I EQ.N) GO TO 230	EXCR	50

	IF (I_LF_LCTR) GO TU 210	5 5 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7	106
	LCTR = LCTR + 22	EXCR	107
	GU TO 140	FXCH	108
с М Л		EXCR	109
	(H) ON + N = K	EXCR	10
	WRTTF (6,240)I , X1(T), Y1(I)	E X C R	4004 6004 6004
540	FORMAT (IM I3, 2FI4 "7 //)	F X C R	2
`		EXCR	12 2 2 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3
	IF (J_GE_NT) GO TU 250	F X C R	12 1
	Gn Tn 210	EXCR	1
250	CONTINUE	R X C R	116
C 252	IF (FLG05°EQ.0) RETURN	EXCR	
223	TF (FLGO5,EQ.0) CONTINUE	R X C R	1180
Caaa	***OFF RODY POINTS	R X C R	119
	PID 300 I = 1,NP	EXCR	021
CARA	***READ MATRICES X,Y,Z	EXC B	s N
	READ (R) (A(J), J=1, NT), (B(J), J = 1, NT), (Z(J), J = 1, NT)	FXCR	122
	DO 300 N # 1 NSIG	EXCR	2
	SX = 0°0	E X C R	124
	SY = 0.0	EXCR	S N N
		EXCR	126
Csea	***NUMBER OF ELEMENTS LOUP	E X C R	127
	DO 260 J H 1,NT	E XCN	120
	SX # SX + A(J) # SIG (J,N)	E X C B	200
	SY H SY + B(J) + SIG (J,N)	¢ ∪ × ⊔	130
260	SP = SP + Z(J) + SIG(J,N)	EXCR	131
	VX(IPN) = SX	EXCR	132
	VY(I,V) = SY	F XCR	n M
	VZ(I, N) Z SP	EXCR	130
	$PHT(T_{N}) = YP(I) \approx SP / 2.0$	EXCR	5 M M
300	CONTINUE	E X C R	136
CANA	***PHINT EXTRA CHOSS FLOW (NFF-BADY) AUTPUT	E X C B	137
330	DU 450 L = 1, NSTG	EXCR	138
	KFC # L	EXCR	139
		EXCK	140

EXCR

PSF 355 NON-LINIFORM EXTRA CROSS FLOW NO. 18) GENERATED (RFSEP) BOUNDARY CONDITIONS FXTR NSFORMFD COORDINATES // HVX 12X 2HVY 12X 2HVY 12X 3HPHI //) YP(1),VX(1,L),VY(1,L),VZ(1,L),PHI(1,L) 10	EDR.CASE.PSF 0) GU TD 355 NUNFC(KEC) 0FF BODY NON-UNIFORM EXTRA CROSS FLOW NO. 18) F BODY GENERATED (RFSEP) BOUNDARY CONDITIONS FXTR 24H TRANSFORMED COORDINATES // 1HY 13X 2HVX 12X 2HVY 12X 2HVZ 12X 3HPHI //) 1HY 13X 2HVX 12X 2HVY 12X 2HVZ 12X 3HPHI //) 1HY 13X 2HVX 12X 2HVY 12X 2HVZ 12X 3HPHI //) 1HY 13X 2HVX 12X 2HVY 12X 2HVZ 12X 3HPHI //) 1HY 13X 2HVX 12X 2HVY 12X 2HVZ 12X 3HPHI //) 1HY 13X 2HVX 12X 2HVY 12X 2HVZ 12X 12X 12H //) 1HY 13X 2HVX 12X 2HVZ 12X 2HVZ 12X 12X 12H //) 1HY 13X 2HVX 12X 2HVZ 12X 2HVZ 12X	= 45 F(6,150)HEDR.CASE,PSF F(52,61.0) GO TD 355 F(5,530) NUNEC(KEC) T (43H DFF BODY NON-UNIFORM EXTRA CROSS FLOW NO. 10) 0 390 T (43H DFF BODY NON-UNIFORM EXTRA CROSS FLOW NO. 10) F(6,357) F(6,357) T (1H 5x, 24H TRANSFURMED COORDINATES // AT (1H 5x, 54H TRANSFURMED COORDIN	EXCR 141 Excr 142	EXCR 143	EXCH 144	EXCA 145	EXCR 146	EXCR 147	EXCH 148	EXCR 149	EXCR 150	EXCR 151	EXCR 152	EXCR 153	EXCH 154	EXCR 155	EXCR 156	EXCR 157	EXCR 158	EXCR 159	EXCR 160	EXCR 1611	FXCR 162C	EXCR 163					
PSF 355) NON-UNIFORM EXTRA CROSS FLOW NO. 18) GENERATED (RFSEP) BOUNDARY CONDITIONS GENERATED (RFSEP) BOUNDARY CONDITIONS HVX 12X 2HVY 12X 2HVZ 12X 3HPHI (/), YP(I),VX(I,L),VY(I,L),VZ(I,L),PHI(I,L 10	EDR,CASE,PSF 0) GU TU 355 NUNEC(KEC) NUNEC(KEC) 0FF BODY NON-UNIFORM EXTRA CROSS FLOW NO. 18) 0FF BODY NON-UNIFORM EXTRA CROSS FLOW NO. 18) 24H TRANSFURMED COORDINATES // 14Y 13X 2HVX 12X 2HVY 12X 2HVZ 12X 3HPHI //) 1,YP(1),YP(1),VX(1,L),VY(1,L),VZ(1,L),PHI(1,L) 1,XP(1),YP(1),VX(1,L),VY(1,L),VZ(1,L),PHI(1,L) 1,XP(1),YP(1),VX(1,L),VY(1,L),VZ(1,L),PHI(1,L) 1,YP(1),YP(1),VX(1,L),VY(1,L),VZ(1,L),PHI(1,L) 0 TO 450 1 TO 450 1 GO TO 410	= 45 F(6,150)HEDR,CASE,PSF F(62361.0) G0 T0 355 F(6,350) NUNEC(KEC) 0 390 1 390 F(6,357) AT (43H OFF BODY NON-UNIFORM EXTRA CROSS FLOW NO. 18) 0 590 F(6,357) AT (68H OFF BODY GENERATED (RFSEP) BOUNDARY CONDITIONS F(6,450) 0 55 FLOW) F (6,400) F (6,400) F (1H 5X, 24H TRANSFORMED COORDINATES // AT (1H 15X, 6F14.7) AT (1H 15X, 6F14.7) AT (1H 15, 6F14.7) A							FXTR					~															
PSF 355 NON-LINIFORM EXTRA CROSS FLOW NGN-LINIFORM EXTRA CROSS FLOW NSFURMED COORDINATES // HVX 12X 2HVV 12X 2HVZ 12X 3 HVX 12X 2HVV 12X 2HVZ 12X 3 10 10	EDR.CASE, PSF 0) GO TO 355 NUNEC(KEC) 00F BODY NON-UNIFORM EXTRA CROSS FLOW 0FF BODY NON-UNIFORM EXTRA CROSS FLOW 24H TRANSFURMED COORDINATES // 24H TRANSFURMED COORDINATES // 260 TO 410 0 TO 450 0 TO 45	= 45 F(6,150)HEDR,CASE,PSF F(6,350) NUNFC(KEC) AT (43H OFF BODY NON-INTFORM EXTRA CROSS FLOW 0.390 0.390 0.590 0.590 0.590 0.590 0.590 0.590 0.590 0.590 0.590 0.590 1.6400 1.41 1.52 1.42 1.52 1.42 1.52 1.42 1.52 1.42 1.52 1.42 1.52 1.42 1.52 1.42 1.52 1.42 1.5				4 NU. 18)	• • •		CONDITIONS	4			4PHT //)	J. PHI (I,L															
PSF 355 MON-LINIFORM EXTRA GENERATED (RFSEP) NDN-LINIFORM EXTRA NSFURMFD COORDINAT HVX 12X 2HVV 12X 2 YP(I),VX(I,L),VY(I 10	EDR, CASE, PSF 0) GU TU 355 NUNEC(KEC) 0FF BUDY NON-IINIFOHM EXTRA 0FF BUDY NON-IINIFOHM EXTRA 1 HY 13X 2HYX 12X 2HYY 12X 2 1, XP(I), YP(I), VX(I,L), VY(I 6 F14,7) 0 TO 450 0 TO	<pre>= 45 = 45 F(6,150)HEDR,CASE,PSF F(6,350)HEDR,CASE,PSF F(6,350)NUNFC(KEC) at (43H 0FF B0DY NON-UNIFOHM EXTHA 0 390 0 390 0 390 f(6,357) at(68H 0FF B0DY GENERATED (RFSEP) 05S FLOW) f (1H 13X 1HY 13X 2HYX 12X 2HYY 12X 2 1HX 13X 1HY 13X 2HYX 12X 2HYY 12X 2 1HX 13X 1HY 13X 2HYY 12X 2HYY 12X 2 1HX 13X 1HY 13X 2HYY 12X 2HYY 12X 2 1HX 13X 1HY 13X 2HYY 12X 2HYY 12X 2 1HX 13X 1HY 13X 2HY 12X 2HYY 12X 2HYY 12X 2 1HX 13X 1HY 13X 2HY 12X 2HYY 11Y 11X 11X 11X 11X 11X 11X 11X 11X 1</pre>				CRUSS FLOW						FS //	42 XCI 471																
PSF 355 1 NON-UNIFO NSFURMFD AVX 12X 2 YP(I), VX(EDR, CASE, PSF 0) GU TU 355 NUNEC(KEC) 0FF BODY NON-UNIFO 0F BODY NON-UNIFO 24H TRANSFORMFD 1HY 13X 2HVX 12X 2 1, XP(1), YP(1), VX(6 F14, 7) 6 G TU 410 0 G TU 410 0 G TU 410	= 45 FLG22,67,0) GU TD 355 FLG22,67,0) GU TD 355 FLG22,67,0) GU TD 355 FLG22,67,0) GU TD 355 AT (43H 0FF B0DY 06N-UNIFO 0 390 0 390 0 590 1 41 AT (1H 5X, 24H TRANSFURMFD AT (1H 13, 6F14,7) AT (1H 13, 75,7) AT (1H 13, 75				AM FXTWA			(DE SED)			COURDINAT		Tavara															
	EDR.CASE 0) GU TU NUNFC(KEC NUNFC(KEC 0F BUDY 1, 24H TRA 1, 24H TRA 1, 24H TRA 1, 24H TRA 1, 450 1,	= 45 = 45 FLG22,67.0) GU TD FLG22,67.0) GU TD FLG22,67.0) GU TD A (43H DF BDV 0 390 0 390 1 43H DF BDV 0 390 0 591 0 70 1 491 1 491 1 451 1 461 1 450 1 450 1 450 1 0 450 1 0 450 1 0 450 1 0 540 1 0 540 1 0 450 1 0 10 1 0 540 1 0 10 1		1 1 1 1 1 1		V NON-INTEO			CCMEDA TEN	GENERAL		NCEDDMED		AVA ICA C	~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~														

EXCR

	OVERLAY (AXSY, 5, 0)	BOUN	0010
Ľ	SURROUTINE BOUNDL	BOUN	0021
	PROGRAM BOUNDL	BOUN	0030
J	***************************************	BOUN	000
J		BOUN	0.05
U	SOLUTION OF THE 2-D , YAWED WING, AND AXTSYMMETRIC, COMPRESSIBLE	BOUN	006
υ υ	BOHNDARY LAYER EQUATIONS USING KELLERES BOX METHOD	BOUN	007
L		BOUN	000
J	●金索索会比例的代表的比例的比例的的的比例的的的的的的的。 ● · · · · · · · · · · · · · · · · · · ·	BOUN	000
ں		BOUN	010
J	AAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAA	BOUN	011
u U	**************** AFRODYNAMICS RESLARCH GROUP ****************	BOUN	012
υ υ	***** DOUGLAS AIRCRAFT DIVISION , MCDONNFLL-DOUGLAS CORP, *****	BOUN	013
U	AAAAAAAAAAAAAAAA LONG BEACH CALIFORNIA AAAAAAAAAAAAAA	BUUN	010
υ		BOUN	015
Ľ		BOUN	016
U		BOUN	110
	CUMMON NX, NP, NPPR, JI, IT, NRVP, LSP, NPM1, JI1, JIM1, NTC, NXT, NXW, NXM	BOUN	010
	1 "TTLE(15)	BOUN	610
	COMMON LG16,LG17,LG18,LG32,LG40	BOUN	020
	1 , IGOL, IGOT, IGOW, IGON, IGCV, IGEG, IGNP, IGRC, IGTR	BOUN	021
	COMMON /HEADR/ CASE, IPAGE	BOUN	022
	COMMON/BLC1/F(100,2),U(100,2),V(100,2),ETA(100),DELETA(100)	BOUN	023
	COMMON/ALC3/XI(100), XS (100), ETAINF(100), BETA(100)	BOUN	024
	COMMON/BL11/VWPRI,UWPRI,DELV1	BOUN	025
	COMMON/BL13/FPSLN	BOUN	026
	COMMON /BL16/ NTYPE, TOUT	BOUN	027
	COMMON/ALC5/EM(100,2),EDV(100,2),E(100,2),EB(100,2),VPRT(100)	BOUN	028
	COMMON/BLC7/VGP ", DETAI " THE REAL OF	BOUN	020
	COMMUN/BLCB/A(100), CEL(100)	BOUN	020
	COMMON/RL10/SWP, TANL, WE, W(100,2) , WP(100,2)	BOUN	120
	COMMON/BLIZ/TI, RMI, UI, RI, PR, PRT, FK, RL, RMUI, RHOI, PSI, HE	BOUN	250
	1 ,UE(100),R0(100),TW(100),GW(100),RP(100),FW(100)	BOUN	233
	2 , RR(100), TE(100), RHNE(100), RMNE(100), GW(100), GPW(100)	BOUN	034
	3 , RFI(100), RF2(100), YS (100), IGX1(100), FPW(100), RUL(100)	BOUN	035

ROUN

	COMMUN /BL	14/ RX1, RTH1, CF0, CF1, CF2, CFSUM0, CFSUM,	BOUN	9 P M M C (
	L L L L L L L L L L L L L L L L L L L	IA(100),DELS(100),PPPM(100) 15/ NXV	NUDA	- 60 - 10 - 0	
	COMMON /BL	17/ RX(100) CFA(100) CF(100) ETAE(100) CDI(100) ST(100)	BOUN	039	
		VP (100)	BOUN	040	
	COMMUN/BL 1	19/C(100,2),G(100,2),GP(100,2),	BOUN	1001	
		RHD(100), RMU(100), TVCT(100)	BOUN	240	
	COMMON/BL2	20/ RTHTR, UEIN, KOIN, GAMAT	BOUN	043	
	COMMON/BL2	21/ A1(100,2), A2(100,2)	BOUN	040	
	COMMON/RAD	DIUS/ ROMAX	BOUN	500	
C			BOUN	046	
υ	8 8 8 9		BOUN	790	
e				0 0 0 0 0 0	
	NEWINO A				
	REWIND 3				
			BOUN	2 2 2 0	
a.	O NTCENTC+1		BOUN	50	
•	1GNP≈0		BOUN	0.54	
	IGTREO		80UN	023	
	O 篇 X N		NOOS	910	
	11 = 0			200	
i			BOUN	690	
;	CALL INPT		BOUN	190	
				N M 9 Q 0 C	
i C			BOUN	00	
))	JO NXENX+1		BOUN	065	
່. ເບ	9		NUDO	066	
	TTCED		NNOG	200	
Ŧ	IGRC=0		BOUN	000	
- -	160T = 0		BOUN	640	

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BOUN

	i c	4
IF(NX "LT" NXT) IGOL = 1	RUUN	1/0
IF(NX _GF, NXT) [GOT = 1	2006	N NO
	BOUN	073
I G C V = 0	BUUN	074
CAILEFINE	BOUN	075
IF(LG37 "NF, 1 "OR, NX "EQ. 1) CALL HEAD	BUUN	076
TF(LG32,FQ,1) GO TO 130	BOUN	077
WRITF(6,6015) NX,BETA(NX),XI(NX),XS (NX),ETAINF(NX)	BOUN	078
GU TN 138	BOUN	610
130 IF(NY °F0, 1) WRITE(6,7000)	BOUN	080
1 C = LC+3	BOUN	081
JF(LC "LT, LCMAX) GO TO 135	BOUN	082
CALL HEAD	BOUN	083
	BOUN	000
135 WRITF(6,7015) NX,BETA(NX),XI(NX),XS (NX),ETAINF(NX)	BOUN	085
LC = LC+2	BUUN	086
138 IF(LSP.EQ.1) 60 TO 700	BOUN	087
	BUUN	0 8 8 8
IF(NX,EQ.1) CALL TVPF	BOUN	080
IFILSP.EQ.1) GN TU 700	BOUN	060
	BOUN	191
IF(NX,EQ.1) CALL FLPR	BOUN	092
IF(LSP "EQ" 1) GU TU 700	BOUN	093
	BOUN	094
IF (NX NE, 1 "OR, XS(NX), EQ.0.) GO TO 140	BOUN	500
CALL EDVS	BOUN	096
TF(LSP,EQ,1) GA TU 700	ROUN	097
6 8 5 6 6 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	BOUN	098
140 TF(NX_EQ.1) GO TO 145	BUUN	66C
Call. SHFT	BOUN	100
IF(LSP.EQ.1) G0 T0 700	BOUN	101
CALL FIPR	BOUN	102
JF(LSP "EU, 1) GU IN 700	BOUN	103
	BOUN	104
145 ITEO	BOUN	105

		ROUN	400
	IF(NX=NXT)150.142.150		200
142		BOUN	- 00 - 0
150		BOUN	00
	LC as LC+1 and a second s	BOUN	110
	IF (IT, LE, 9) 60 TO 220 ST	BOUN	111
	IF(ITC FEQ. 0) GO TU 200	BOUN	112
	WRTTF(6,6000)	BUUN	113
	[T r. ± 0	BOUN	1 4
	[BOUN	115
	GO TO 220	80UN	116
200	WRITE(6,6010)	BOUN	117
	LSPat	BOUN	118
	GO TO 700	BOUN	611
220	CALL FDVS	BOUN	120
	IF(LSP,E0,1) G0 T0 700	BOUN	121
	CALL MOMX	BOUN	222
300	IF(IGOL,EQ.1) GO TO 540	BOUN	123
	IF(IGOT,EQ.1) GD TO 550	BOUN	200
540	IF (ABS (DELV1) "LT, EPSLN) GN TU 600	BOUN	50
	IF(V(1,Z),LT,0, AND, LG16,NE,0) GO TO 670	BOUN	50
	GO TO 150	BOUN	127
550	EAG= DELV1/((V(1,2)+VWPRI)*,5)	BOUN	021
	IF (ABS (EAG) "LT" 0, 02) GN TO 600	BOUN	29
	IF(IGTR "LE" 1 "DR" V(1,2) "LE" 0.) GA TU 150	BOUN	0 M N
		NUCE	3
	CALL EINF	BOUN	132
	IF(NX .EQ. 1) GO TO 150	BOUN	2 2 2 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3
	IF(LSP "EQ 1) GO TO 700	BOUN	134
	IF(IGRC "EQ" 0) GU TO 150	BOUN	1 25
	CALL SHFT	BOUN	136
	CALL FLPR	BOUN	137
,	G0 TN 145	BOUN	138
		BOUN	6 X J
600	WRITE(6,6050) V(1,2)	BOUN	140

LC # LC+1	BOUN	2 C 2
IF(IGTR,GI,1) IGTH=0	BOUN	142
IGCVEL	BOUN	143
CALL EINF	BOUN	244
LC=LC+3	ROUN	145
IF(LSP,EQ,1) G() T() 700	BOUN	146
IF (JGRC "EG" O) GO TO 670	BUUN	147
CALL SHFT	BOUN	148
CALL FLPR	BOUN	149
IF(LSP «EQ" 1) GUTU 700	BOUN	1 N Q
LC = LC+2	BOUN	5
GO TO 145	NUOR	2
	BOUN	20
670 CALL NTPT	BOUN	150
IF(NX_EQ_NXM) GO TO 700	800N	2 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5
	BOUN	200
IF(1607 ,EQ, 1) GU TO 100	ROUN	151
IF(NX .GT, I .AND, LG16 .NE, 0) CALL TANS	NUOO	60
IF(IGTR GF, 1) IGRC=1	80UN	5
IF(LSP ₆ EQ ₆ 1) GO TO 700	BOUN	160
IF(IGTR,GT,1) GO TO 120	BOUN	161
	BOUN	162
GO TO 100	BOUN	163
700 IF(NX .EQ. 0) GO TO 800	BOUN	164
IOUTEI	BOUN	165
CALL OTPT	BOUN	166
800 IF(LSP 。EU。 1) write(6,9999)	BOUN	167
	BOUN	160
5010 FORMAT(I3 , 39X, I1)	BOUN	169
6000 FORMAT(1H "20%,43HCUNVFRGENCE IS SLOW - ITERATIONS CONTINUING,/)	BOUN	170
6010 FORMAT(14 ,15%,45H*** ITERATIONS EXCEED THE ALLOWABLF LIMIT *** /)	BOUN	172
6015 FURMAT(1H0,///5X,8HSTATION=,13,3X,5HBETA=,E16,9,2X,3HX1=,E16,9,2X,	BOUN	172
1 2HSF/E16,9,2X,8HETAINF = E16,9,////)	ROUN	173
6030 FORMAT(1H ,32X,E20,9)	80UN	174
7000 FORMAT(1H ,45%,20HOUTPUT IN SHORT FURM, /)	BOUN	5

12, F16.9,2X,8HETAINF =,F16.9) 12, F16.9,2X,8HETAINF =,F16.9) 9999 FORMAT(1H0/45X,37H************ CASE TERMINATED **************//)		178 178
C RETURN 1000 CONTINUE FND	BOUN	180
		BUUI

		SUBRAUTINE INPT	INPI	001
U			INPT	002
U	包包	SURROUTINE INPT	INPI	003
Ľ		THIS SUBROUTINE PROCESSES ALL THE INPUT DATA TO THE PROGRAM	INPT	000
U			INPT	002
		COMMON NX,NP,NPPR,JI,IT,NRVP,LSP,NPM1,JI1,JIM1,NTC,NXT,NXW,NXM	INPT	000
		, TITLE(15)	INPT	007
		COMMON LG16,LG17,LG18,LG32,LG40	Idui	000
		I / IGOL, IGOT, IGOM, JGON, IGCV, IGEG, IGNP, IGRC, IGTR	INPT	000
		COMMON /HEADP/ CASE, IPAGE	TUPT	010
		COMMON/BLC7/VGP ,DETAI	Idai	011
		COMMON/BLC3/XI(100),XS (100),ETAINF(100),BETA(100)	TANI	012
		COMMON/BL12/TI,RMI,UI,RI,PR,PRT,FK,RL,RMUI,RHOI,PSI,ME	INPT	210
		U UE(100),R0(100),TW(100),GW(100),RP(100),FW(100)	INPT	014
	-	2 "PR(100), TE(100), RHNE(100), RMUE(100), GW(100), GPW(100)	INPT	5°0
		5 , RF1(100), RF2(100), YS (100), IGX1(100), FPw(100), RDL(100)	TANI	016
		COMMON/BL13/EPSLN	INPT	017
		COMMON /BL15/ NXY	INPT	018
		COMMUN/RADIUS/ ROMAX	INPT	019
		DIMENSION S(301) "XR(301) "DUEDX(100) "PE(100)	INPT	020
		DATA DATA1/1°4/, DATA2/6035,0/	INPT	021
U			INPT	N N C
ပ		年自在 8 4 6 4 5 6 6 7 7 7 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9	INPT	023
ပ			INPT	020
		EPSLN z 005	INPT	520
		PR = ,72	INPT	026
ပီ	8 0 0	READ CASE DATA	INPT	027
		RFAD(5,5005) TITLE,CASE	INPI	028
		READ(5,5010) NXT,LG16,LG17,LG18,LG32,LG26,LG40,LG41	INPT	029
		READ(5,5020) TI,RMI,UI,FK,RL,RI	INPI	020
		READ(5,5025) ROMAX,DFTA1,VGP	INPT	031
		IF(LG40 。EQ 0) GU TN 7000	INPT	032
		READ(5,1013) NXM	INPY	033
		READ(5,1014) (XS(I),I=1,NXM)	INPT	034
		READ(5,1014) (VS(I),I=1,NXM)	INPT	520

TNPT

065 000000 0000 040 062 039 045 046 049 0 - N M 0 0 0 0 0 050 057 003 064 066 067 068 060 010 036 037 8 N O 000 042 043 040 047 040 061 041 I dn I TANI INPY INPT TONI INPT Ldvi NPT NPT INPT NPT INPT NPT NPT NPT INPT INPT INPT INPT INPY INPT INPT INP7 INPT NPT SDA1=(XS(I)=XS(I=I))**2+(YS(I)=YS(I=I))**2 READ(5,1014) (UE(I), I=1, NXM) READ(3) (XS(1),I=1,NXM) READ(3) (YS(I), I=1, NXM) READ(3) (UE(I), I=1, NXM) SDPESD1+ ABS(SQDA1) SODA1= SORT(SDA1) 10° DO 180 1=2,NXM SU2 00 50 I=1, NXM RO(1) = VS(1)01 11 READ(3) NXM RF2(1) = 0. FW(I) = 0. GO TO 7001 GW(I) = 0. IGX1(I)=0. ETAINF(1) ETAINF (2) CALL HEAD 0°0=(I)M0 RF1(I)=0. FPW(I)=0. GPW(I) H S(2#1+1) CONTINUE TW(I)=0. BR(I)=0. MXNHSNXN CONTINUE RP(I)=0, XS1=0.0 SD1=0.0 WXXHAXN 150 ວ ທ ເ 8 2 160 7000 7001

INPT

IdNI

ŝ	501=502	INPT	071
			• f • 1
			2/2
180 C	CONTINUE	INPT	073
Z	WRITE(2) NXM	INPT	074
3	4RTTE(2) (S(2*1+1),I=1,NXM)	INPT	075
ل		INPT	076
ل	-CMAX = 36	INPT	077
3	VRITE(6,2550)	INPT	070
C	DO IRS IEI/NXM	IVPI	610
	[F(LC .LT. LCMAX) GO TO 182	INPT	080
	CALL HEAD	INPT	001
Z	4RITE(6,2550)	INPI	082
ٹے		INPT	083
ب	-CMAX == 49	INPT	080
X	(BG ב XS(I) + אך	INPT	005
ŝ	38G = S(2*J+1) * RL	INPT	066
室	4RTTE(6,3100) I,XS(I),YS(I), XBG,SBG,Sf2☆I↓I)	TUPT	087
ب		Indi	089
(pand)	[F(FK "EQ, 1) RO(I) = YS(I)#RL	TNPT	080
*	/S(I)=XS(I)	TUPT	000
×	(S(I) = SBG	INPT	091
185 C	CONTINUE	INPT	092
8 1	IF (LCMAX EQ.36 & AND, LC.GT.18) CALL MEAD	INPT	093
(kanti	IF (LCMAX, EQ, 49 , AND, LC, GT, 45) CALL MEAD	INPT	094
61	LF(FK "EQ, O, "OR, LG18 "NE, 1) GO TO 203	INPT	095
U	CALL SLOPE(NXM,XS,YS,RF1,1)	INPT	0960
	[F(HL EQ. 1.0) 60 TO 203	INPT	097
0	MXN JEI JZ02 DC	INPT	098
202 R	<pre>₹FI(I) = RFI(I)*RL</pre>	INPT	000
		INPT	100
203 I	IF(UI,NE,0, OR, RMI,NE,0,) GO TO ZO4	INPT	101
M	VRITE(6,9030)	INPT	102
ل		Indi	103
9	50 TO 1800	INPT	104
704	[F(TT_NE_0_) G() T() 205	INPT	105

INPY

		4071	400
		- 0 - 2	
		L D L	
e r			
- - 		A Z Z	0 1 1
	WRITE(6,9040)	INPT	ुल्ल इन्हे दुल्ले
	TI = 519.0	INPT	21
205	IF(RMI "NF" n") UI # 0,	INPT	213
	IF(LG41 FEQ 1) GD TD 206	INPT	114
	TF(UI,NE,O,) RMI=UI/(SORT(TI)*49,1)	Idul	110
	IF(RMI_NE,0,) UI=RMI* SQRT(TI)*49_1	IdnI	116
	RMIII= 1,0E=06+(90311276E=034T141 238522= (56843634E=064T1#TI	TANI	6-1 (2-1
	<pre>l + 38312556E=03*TI+1,436156)**0.5)</pre>	INPT	
	RHOT=RMUT*RI/UT	INPT	119
	PSIERHDI*TI*1718.0	IdnI	120
	RMIZHRAIAH	INPT	121
	DK1 ZRMIZ*(DATA1=1,0)+0,5	INPT	122
	UEA4=DATA1*RMI2*0,5	INPT	123
	SHIEDATAZATI	INPT	124
207	HE # SHI + ,5*(UI**2)	INPT	5
	GO TO 209	INPT	126
206	TIRETI#9./5.	INPT	24
	UIIEUI/ S04B	LONI	128
	TF(UT "NE, O") RMI=UII/(SGRT(TIR)*49.1)	INPT	129
	IF(RMI "NE, O,) UI=(RMI×SGRT(TIR)*49.1)*.3048	I NP I	130
	RMIJII.0E=06*(.90511226E=03*TIR*1.238522=(.56843634E=06*TIR*TIR	INPT	131
~	[+。38312556E=n3*TIR+1。436156)**。5)	INPT	132
	RHUI=RMUI*RI/UII	INPT	133
	PST=RHOI*TIR+1718,0	INPT	134
	SHIEDATAZ*TIR	Idni	33
	MF=SHI+ _e 5*(UII**2)	LUPT	136
	RMUI=RMUI+47。88025	INPT	137
	RHDT=RH()1*515,379	TONI	10 10 10 10
	PSTEPSI*47.8A025	INPT	139
	HE#HFA。30484。3048	INPT	140

LdNI

207

INPT

3 5 99 69 169 170 22 2 43 37 5 90 47 8 65 0 . N N ณ เว 5 30 5 160 161 202 163 164 100 167 24 174 NPT NPT INPT INP1 INDI L d N] INPT LANI INP 1 TONI 1 a z NPY NPY NPT LON INPT I d'N J L d N] INPY NPY L d N] NPT INPT INPT INPT [NP] I d Z] NPT NPY [ND] NPT TONI INPT INPT INPT CALL SLOPE(NXM,XS,UE,DUEDX,MULT) UE(I)=UI* SQRT(1,0~UF(I)) 60 10 270 60 10 210 IF(I 6T 1) 60 TO 520 VT1=RH0I*RMUI IF(FK.NE.0.) GO TO 550 DO 1500 I=1,NXM IF(LG26.FG.2) (IF(LG26.EQ.3) (Writf(6,9050) 208 DO 220 I=1.NXM DO 280 I#1.NXM NU 320 141 NXW UE(I)=UE(I)*UI VT2=VT1*UE(I) VT3#VT2#UE(I) RHUE(I)=RHUI RMUE(I)=RMUI PF(1) × 0. GO TN 1800 TE(I) = 0.GO 70 300 CONTINUE CONTINUE CONTINUE CONTINUE 300 CONTINUE CONTINUE 0 V742=1.0 VT5=1.0 VT4=1.0 137 = 1 MULT = Lsp=1 270 200 6866 210 520 209 500 510 220 320

U

TUPT

TUPT

180 202 83 88 185 1 8 Å 60 6 66 90 0 66 200 203 204 205 206 202 208 410 613 178 675 181 6 2 0 6 50 07 86 202 2109 0 201 6 INPT IdNI INPT NPT INPT INPT INPY INPT INDY INPT INPT INPT INPT INPT INPT **VP** [NP7 INPT INPT INPT INPT TUPT TUPT INPT INPT INPT INPT Idul INPT NPT NPT INPT NPT TUPT INPT WRITE(6,2600) DETAL, RL, PR, VGP, RHUI, SWP, FK,RMUI, HE, FPSLN BETA(I)=2.0*XI(I)*(UE(I)-UE(I=1))/(VT3*VT42*(XS(I)=XS(I=1))) XI(I)¤XI(I=1)+(FX1+FX2)+(XS(I)=XS(I=1))+0.5 IF(FK .EQ. i.) BETA(1) = BETA(1)/2, GO TO 1500 IF(I .EQ. 2) GO TO 950 BETA(1)=2.*XI(1)/(VT3*VT42)*DUEDX(I) WRITE(6,9095) I 0, 00 TO 555 GO TO 1500 IF(I.EQ.1) XI(1)=FX2*XS(1) 60 10 930 GU TN 560 GU TO 680 IF(FK_NE_1_0) GU IF(R0(I) "NE_ 0_) IF(I 6T_ 1) WRI R0(I) = 0001*RL IF(I °NE° 1) G IF(IST °EQ° 0) 0 7 1 WRITE(6,9060) IF(I ¢EQ. 1) VT4=R0(I)/RL VT42=VT4*VT4 ROL(I) = VI4 FX2mVT2*VT42 V75=RL/R0(1) GU TO 1800 60 TO 1500 GO TO 600 GO TO 600 FX1 = FX2 CONTINUE RETA(1) Spa! 650 680 550 555 560 009 026 020 1500

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214 213 219 220 223 2 2 2 224 222 221 228 2 2 0 2 2 2 S M える 233 230 5 5 7 1 7 236 238

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INPT

INPT IdNI I NPT INPT I NP1 INPT NPT I da I NPT TQNI INPI INPT INPT INPT INPT N D A L d N J L d N] TONI INPT NPT NPT NDA LAZ NPT NPT INPT I NPT TONI L d Z INPT INPT TONI INPT INPT , RMUE(I), FPW(I) WRITE(6,3250) BETA(I), RF2(I), RP(I), RMACH, TE(I), XI(I) WRITE(6,3200) I, YS(I), RO(I), TW(I), UE(I), PE(I), BK(I) WRITE(6,3200) I,YS(I),ROL(I),TW(I), UE(I), PE(I), BR(I) å WRITE(6,3250) XS(I), RFL(I), QW(I), IF(XI(I).GT,XI(I-1)) GO TO 1700 IFULC .LT. LCMAX) GU TU 1520 GO TO 1530 GO TN 1620 GU TU 1600 CPs1 "=UE(I)*UE(I)/(UI*UI) RE TURN Г м X OLTO TIO RIO IF(XI(1)。GE。O。) WRITE(6,9070) IF(NXM °F4 1) D0 1700 I=2,NXM IF(XI(I),GT,0,) DU 1550 1=1,NXM WRITE(6,9090) I WRITE(6,9080) TF(FK .NE. 0.) WRITF(6,2900) WRTTF(6,3000) WRTTE(6, 3000) RMACH = 0. GO TO 1540 HEAD CALL HEAD LC = LC+4 LCMAX=49 LCMAX=45 CONTINUE CONTINUE IGXI=0 IGXIEI IGXIEI ISIISI CALL (C=1 LC & 1 1540 1520 1590 1600 1620 1700 1520 1530

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0 - N M 3 M 5 5 5 5 5 5 N N N N N N INPT

10 10 N 305 50 236 250 2 © 0 262 20 M 264 265 266 267 260 269 270 272 543 279 5 4 3 276 112 278 279 280 9 3 6 8 247 248 249 0 5 2 2 222 223 272 500 522 L N P L LANI INPT LANI LANI Lani LONI IdNI LANI LUNI INPT LNPT INPT INPT INPT N D NPT Z D Z NPT NPT INPT I N P 1 INPT INPT LANI Lavi INPT TONI NPT INPT a z I I N D I [N P 1 INPT I d N J (° 0 EIS.7, 10X,8HSWEEP = ,F9.4 / 140,16X, 6HKK = ,F9.5, 16X, 8 RHWUREF = ,E1S,7, 10X,8HHE = ,E1S,7 / 140,16X, 6HEPS1 = , F1S,7, 10X, 8HVRF = ,E1S,7, 10X, 8HTRF = ,F10,3/ 140,16X, 1 10%, BHSHORTP =, 11, //14 , 30%, 31HTRANSITION SPECIFIED AT STATION, 14 1HO ZIX, 1HK, 9X, 3HX/C , 15X, 3HY/C , 16X, 1HX, 17X, 1HS , 16X, 3HS/C /) 2600 FORMAT(1H0/1H0,40X,43HREFERENCE QUANTITIES AND CONTROL PARAMETERS, 3000 FORMAT(1H0,7X,1HN,12X,3HX/C,13X,4HRU/C,14X,2HTW,16X,2HUE,15X,2HPE, 14X, 2HFW, /1H , 20X, 4H S , 12X, 6HAL PHAI, 13X, 2HQW, 16X, 2HCP, 14X, 2050 FURMAT(1H "25%"1544"10%"6HCASE "A4"///1H "54%"10H CASE DATA "///) 2500 FURMAT(1H0"10%"8HTRFLAG ="I1"10%"7HTRINT ="I1"10%"5HTVC ="I1" 3HMUE,13X, 3HFPW,/1H 20X,4HBFTA,12X,6HALPHA2,13X,2HRR,16X, - INPUT SURFACF DISTANCF AT STATION 1 LT 4C = .E15.7.10%, = .F9.5, 16%,8HRHOREF = = 0E15.7/ FURMAT(2F8,0,F6,0,F5,0,F6,0,F7,0,2F6,0,F7,0,8X,F4,0,11) FURMAT(1H ,37H**ERRUR = INPUT REFERENCF LENGTH = 0 /) = "E15"7" 10% BHMREF 2550 FURMATC 1H , 50X, 19HBNDY GEOMETRY DATA / /140.16X. 6HH1 = ,F9.5. 16X.8HC 8HPR0 = "F9"5" / 1H0"16X" 6HK ZHME, 15X, 2HTE, 12X, 5HSQUIG,/) 2900 FORMAT(1M ,50X,12HSTATION DATA//) 3100 FURMAT(1H ,19X,13,5(3X,E15,7)) FORMAT(1H /1H .18,3X,6517.6) FORMATCIM "11X" 6E17.6) BHREY FORMATCIN SINA*EROR FORMAT(5F10.0,E12.6) FORMAT(3F10.0) IF(TGX1 EU.O) RETURN FIJRMAT(1544, 44) FDPMAT(3E14.9) FORMAT(14,711) 1014 FORMAT(6F10,0) 1013 FURMAT(14) 31X, RETURN SP=1 8 8 N M 3 3 3200 5005 5040 3250 5030 1800 5010 5025 ا ا ا 5020 9004 9005 L d N]
202 200 60 00 01 0 0 0 0 289 290 296 000 000 304 305 306 204 201 200 292 500 290 205 291 300 302 203 293 301 S S S S S HON I I N D I TQNI INP7 INPT LANI INPT Tani INPT INPT NPT NPT INPT INPT TUPT INPT LUPT INPT INPT INPI INPT INPT INPT TUPT TUPT I d d l 9080 FURMAT(14 '254** ERRUR - XI AT STATION '13'12H IS NEGATIVE) 9090 FURMAT(14 '254** ERRUR - XI AT STATION '13,26H IS NOT IN ASCENDING INPUT SURFACE DISTANCE NOT IN ASCENDING OR 9040 FORMAT(1H0,52H**** WARNING - TREF INPUT = 0., VALUE RESET TO 519. 9045 FORMAT(140,67H**** WARNING - TREF IMPUT = 0°, VALUE RESET TO 288,3 9100 FORMAT(140, 40%,2541NSS NOT SUCCESSFUL NER . ,12,2%,104AT STATION, X WIT IN ASCFNDING ORDER AT STATION, 9020 FORMAT(1H0,51H**ERROR - INPUT NIR ()K S AT STATION 1 ARE INCORRECT) 9300 FURMAT(1H0,40%,25HINSR NNT SUCCESSFUL NER = ,12,2%,10HAT STATION, ~ FURMATCIMO,48H**FRROR - INPUT FLOW INDEX NOT EQUAL TO 1, OR 0. 9150 FORMAT(1H0,47H** ERROR - INPUT CP EXCEEDS ALLOWABLE LIMITS OF, 1 2E17.6,1X, 10HAT STATION,13 /) 9095 FORMAT(1H0,49M***** WARNING - ROIC INPUTEO, AT STATION , 13, 9030 FORMAT(1H0,42H**ERROR - NU INPUT FOR ETTHER VREF UR MREF) FURMATCIM "38M**ERRUR " XI AT STATIUN I NE OR GT 0") 1X, I3, /1H ,12X,1HI,15X,3HXIC,22X,3HYIC, //) 1X, 13/1H , 12X, 1HI, 15X, 3HX/C, 22X, 3HY/C, //) 9050 FORMAT(1H0,27H**ERROR . CHECK CPCOM INPUT) ~ 23M - VALUE RESET TO .0001 9010 FORMAT(1M S1H**ERROR = INPUT 9200 FURMAT(1H ,11X,13,2E20,9) 9006 FORMAT(1H ,66H**ERRUR -INER AT STATION. 13 //) 133 DFGREES KFLVIN 11 21 I DRDER) FND 9060 90706

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020 026 018 910 025 020020 029 T N M M M M O O C 100 003 002 000 001 008 600 010 210 210 010 010 NNNN COOC 030 5 M M M 004 110 FINF E I N E EINF FINF EINF EINF FINF EINF FINF EINF COMMON NX, NP, NPPH, JI, IT, NPVP, ISP, NPMI, JII, JIMI, NTC, NXT, NXW, NXM 8 % IGOL, IGOT, IGOW, IGON, IGCV, JGEG, IGNP, IGRC, IGTR CDMMCN/BLC1/F(100,2),U(100,2),V(100,2),ETA(100),DELETA(100) 日 - GRID POINTS ß 8 COMMON/BLC3/XI(100), XS (100), ETAINF(100), BETA(100) 6 8 P ≻ CALCULATES THE TRANSFURMED 8 8 Ð 8 500 500 500 0 e 10 G0 10 60 TN COMMON LG16, LG17, LG18, LG32, LG40 4 ß 09 8 IF(ABS(V(J,2)),LT,1,E=4) TF(ABS(V(J,2)).LT.1.E=5)
IF(ABS(V(J,2)).LT.1.E=6) ß IF(IGCV,EQ.1) GO TO 30 7F(NX,EQ.1) GO TO 50 IF(NX,EQ.2) GO TO 250 1F(IGNP,EQ.1) GO TO 300 IF(IGNP,EQ.1) GO TO 800 IF(IGNP,EQ.0) GO TO 800 GO TO 1000 GO TO 100 ŧ COMMON/BLC7/VGP "DETA1 6 6 8 "TITLE (15) THIS SUBROUTINE 8 EINF SUPROUTINE EINF DO 140 J=2, NP 8 100 DU 120 J=2,NP 50 IF(IGNP,EQ.0) TF(IGNP,EQ.1) WRITE(6,9910) WRITE(6,9920) 6 SUBROUTINE GO TO 1800 GO TO 1800 0 CONTINUE ¢ 8 [SPH] 9 R 0 0 0 0 120 30 安安 $\boldsymbol{\omega}$ c c cU $\circ \circ \circ$

ELNF

EINF

	15/11/11/11/10/00000 10/10/10/10/10/10/10/10/10/10/10/10/10/1	e Veneci	2 T 6
	11 ((()*C)*CC*****************************	LARL	090
	IF(U(J,2),LT,0,) GO TO 400	EINF	220
140	CONTINUE	EINF	030
	WRTTF(6,9930)	EINF	039
		EINF	048
	G0 T1 530	FINF	
0		FINF	042
250	IF(IGNP_E0,0) GO TO 1000	FINF	043
300	D() 320 J#JI,NP	EINF	040
	TF(ABS(V(J,2)),LT,1,E~5) GU TN 500	EINF	045
	IF (ABS(V(J,2)),LT,1,E=6) GU TU 500	EINF	046
320	CONTINUE	Einf	047
	DO 340 J=JI,NP	EINF	040
	IF(ABS(V(J,2)),LT,1,E=4) GO TO 500	EINF	049
	IF(J "EQ.NP) GO TO 330	EINF	020
	IF(U(J,2),GE, 999999) GO TN 500	EINF	051
0 M M	IF(U(J#2),LT_0.) 60 TO 400	EINF	032
340	CONTINUE	einf	5 C
		einf	050
	WRITE(6,9980)	einf	055
	IGRCal	s I ne	056
	FTAINF(NX) = ETAINF(NX) +10 .	EINF	057
	GU TO 1010	EINF	050
) 		EINF	050
400	WRTTE(6,9940) J	EINF	000
	LSPel	FINF	001
	GO TO 1800	EINF	062
) B B		EINF	063
0000	IF (IGTR "GT" 1) GO TO 600	EINF	064
0 2 3 0	ETAINF(NX) = ETA(J)	EINF	065
		EINF	066
		EINF	067
	WRITE(6,6010) ETAINF(NX)	EINF	068
•		EINE	000
0000	IGTREU		070

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EINF

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ã	ETURN	EINF	50
6 6 6 7		EINF	10
X 000 X		s I n F	10
1 I	FIK EQ. NXT) GU TU R20	EINF	076
I	F((ETAINF(NX#1),GT,FIAINF(NX+2)),AND,(IGTR LE, 1)) GO TO 850	EINF	
ليا ا	TAINF(NX) = ETAINF(NX=1) + 2	EINF	20
820 I	F(IGOT,EQ.1) ETAINF(NX)=ETAINF(NX=1)+10.	FINF	24
ยิ	1 T T 1000	LINF	070
A50 F	TAINF(NX)=ETAINF(NX=2)+(XI(NX)=XI(NX=2))/(XI(NX=1)=XI(NX=2))*	EINF	07
1	ETAINF(NX=1)=ETAINF(NX=2))	FINF	8
		r i n	00
1000 I	F(NX_GT_1) NPPR=NP	EINF	80
IOIOI	F(VGP。EQe1。)GU TO 1020	EINF	000
A	RGLDG=1.4ETAINF(NX)/DFTA14(VGP=1.)	EINF	00
Õ	LOGI = ALOG (ARGLOG)	EINF	00
•	RGINTE1 *DLDG1/ALDG(VGP)	EINF	õ
Z	PE INT(ARGINT)+1	EINF	00
Ū		EINF	00
1020 A	RGINT=ETAINF(NX)/DETAI+1.	EINF	00
Z		EINE	60
1050 N		E Z Z	0
-	F(NP_LE_100) GD 70 1060	E I N	60
3	RTTE(6,9970) NX, NP	E LNE	60
Ĺ	SP# 1	FINF	00
C	0 TO 1800		60
1060 E	TA(1)=0.	FINF	ŏ°
C	ELETA(1)#DETA1	EINF	60
Σ		E IN	60
£		FIN FIN	60
Z	P # M*(NP=1)+1	N N N N	õ
Z	PM] w NP=1	N N N	0
ē	D 1080 JE MINNPM	14 2 1 1	0
2			0
LA .' 1	TA(J) = DETA1 + VGP*ETA(N=1)		
C	ELETA(J=1) = ETA(J) = ETA(N*1)	AZ ZA	Ô,

EINF

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111 101 901 021 140 000 2 30 116 2 10 306 07 N ณี n EINF EINF EINF EINF FINF EINF EINF EINF EINF FINF EINF N N N EINF E INF EINF EINF EINF EINF FINF FINF EINF EINF - IMAX (, 13, 204) FXCEEDS 100 - IMAX=,13) 13 700 SMALL ETAINF a. 13) 1H #48H#* CALCULATIONS CONTINUING WITH THE INPUT - ETAE IS BEING REESTIMATED) 9940 FURMAT(1H ,1X,39H**ERROR - FP PROFILE TS NEGATIVE AT I STATION 9930 FORMAT(1H0,49H** WARNING - INPUT ETAE AT 9910 FORMAT(1H ,22H4* ERROR AT FTAE(1) **) 9920 FORMAT(1H ,22H** ERROR AT ETAE(2) **) = ,F10 6) IF(M .EQ, 2) G(1 T() 1080 FTA(J-2) = ETA(J=1) - DELLTA(J=2) FTA(J=1) = ETA(J) = DELETA(J=1) IF (VGP.NE.1.)ETAINF (NX)=FTA(NP) DE[ETA(J=1) = DELETA(J=1)/M6010 FORMAT(1H ./16X,10M# ETAF DELETA(J-2) = DELETA(J-1) DELETA(J=3) = DELETA(J=1) FORMAT(1M .1X,16M**ERROR FORMAT(1H " 3RH44 WARNING GU TO 1080 TF(M EQ. 1) CONTINUE CONTINUE RETURN [CNP=1 FND 9980 1800 1080 0166 00020

EINF

einf

	SUBROUTINE IVPF	JanI	100
6.3		IVPF	200
*	* SURROUTINE IVPF	IVPF	003
63	THIS SUBROUTINE GENERATES THE INITIAL VELOCITY PROFILE	IVPF	004
٤)		IVPF	002
	COMMON NX, NP, NPPR, JI, IT, NRVP, LSP, NPM1, JII, JIM1, NTC, NXT, NXW, NXM	IVPF	000
	1 "TITLE(15)	IVPF	100
	COMMON/BLC1/F(100,2),U(100,2),V(100,2),ETA(100),DELETA(100)	IVPF	000
	COMMON/BLC3/XI(100),X8 (100),ETAINF(100),BETA(100)	IVPF	000
	COMMON/BLC5/EM(100,2),EDV(100,2),E(100,2),EB(100,2),VPRT(100)	IVPF	0 i c
4 1		IVPF	011
ą ۲		IVDF	8 I O
	JF(IT «LE» 1 «AND» NX«EQ.1) E(1,1) 2 1.	IVPF	013
	F(1,2)=0.	IVPF	010
	U(1,2)=0,	IVPF	510
e L	····POLHAUSEN INITIAL VELOCITY PROFILE	IVPF	910
	VPGT = ETAINF(1)+BETA(1)/6	IVPF	017
	V(1,2)=2,/ETAINF(1) + VPGT	IVPF	018
	DO 50 Jæ2/NP	IVPF	610
	FOVE=ETA(J)/FTAINF(1)	IVPF	020
	EDVE2=EDVE*EDVE	IVPF	202
		IVPF	N N N
		IVPF	023
	FPGT = (.5"EDVE+.75*EDVE2".2*EDVE3)*ETA(J)**2*FTAINF(1)*BETA(1)/6.	I V P F	8 N O
	F(J,2)=EDVE2*ETAINF(1)*(1,=0.5*EDVE2+0.2*EDVE3) + FPGT	JAAI	5 N 0
	UPGT = EDVE*(1,-3,*(EDVE+EDVE2)=EDVE3)*ETAINF(1)**2*BETA(1)/6,	IVPF	020
	U(J, 2) = 2 = * EDVE= 2 * EDVE3 * EDVE4 * UPG1	IVPF	027
	VPGT = (1.=6.±EDVE+9.±EDVE2=4.*EDVE3)*FTAINF(1)*BETA(1)/6.	IVPF	028
	V(.[,2)=2,/ETAINF(1)*(1,=3,*EDVE2+2,*EDVE3) + VPGT	IVPF	020
	50 CONTINUE	IVPF	030
ас 64	00 RETURN	IVPF	120
	EVD	IVPF	032

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IVPF

		SUBROUTINE FLPR	8 6 1 2	001
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	u,	CODECT DISCORPOSED OF A		
ن		CALCULATE THE FLUID PROPENTIES AND THE TUC FERM		00
с С				000
		COMMON NX, NP, NPPK, JI, IT, NRVP, LSP, NPM1, JI, JI, JIMI, NIC, NXI, NYM, NXM		900
		1 "TITLE(15)	5 1 2 1	001
		COMMON LG16,1,617,LG18,LG32,LG40	FLPR	000
		1 "IGOL, IGOT, IGOM, IGON, IGCV, IGEG, IGNP, IGAC, IGTR	FLPR	600
		CCMMANN/BLC1/F(100,2);U(100,2),V(100,2);ETA(100),DELETA(100)	FLPR	010
		COMMUN/BLC3/XI(100),X3 (100),ETAINF(100),BETA(100)	FLPR	50
		COMMON/BL12/TI,RMI,UI,RI,PR,PRT,FK,RL,RMUI,KHUI,PSI,HE	FLPR	< 10
		1 , UE(100), RO(100), TW(100), QM(100), RP(100), FW(100)	FLPR	013
		2 BR(100), TE(100), RHNE(100), RMUE(100), GW(100), GPW(100)	FLPR	010
		3 PW(100), RF2(100), YS (100), IGX1(100), FPW(100), ROL(100)	FLPR	510
		COMMON/BL19/C(100,2),G(100,2),GP(100,2),	FLPR	010
		1 RHD(100), RMU(100), TVCT(100)	FLPR	110
ပ			8473	010
υ			FLPR	610
U			FLPR	020
			FLPR	120
		IF(XI(NX) "G7" 0") A1 = SGRT(2"*XI(NX))/(RHUI *UE(NX))	FLOR	022
U	8	Đ.	FLPR	023
		G(NP,2) = 1 0	FLPR	024
		SUM # 0.	FLPR	025
		F1 = RF1(NX)	FLPR	020
		TVCT(1) = 1,0	FLPR	277
		DO 500 [s2/NP state state state states	FLPK	028
		IF(LG18 "EQ" 0) GO TO 450 P P P P P P P P P P P P P P P P P P P	FLPR	029
		$F_{Z} \approx RF1(NX)$	FLPR	020
		SUM = SUM + (F1+F2)/2 *DELETA(I"1)	FLPR	031
		TVCT(I) = SQPT(1, + 2, *A1*SUM/(KL*RUL(NX)*ROL(NX)))	FLPR	032
			FLPR	033
		G() T() 500	FLPR	0.34
ů	B Û	• IF NO TVC THEN TVC = TERM = 1.0	FLPR	035

FPR

FLPR

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c			
(1) # 1. . TNUE JRN			
450 TVC1 500 CINT 800 RETU FND			

		SUBROUTINE ERVS	EOV	00	
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، د		THIS SUBSTOCIAL OF COMPLETE INC. CONTRACTORIA			81
L				00	n ·
		COMMON NX, NP, NPPR, JI, IT, NRVP, LSP, NPMI, JII, JIMI, NTC, NXT, NXW, NXM	E 0 V	00	S
		1 "TTTLF(15)	FD V	00	
		COMMON LG16, LG17, LG18, LG32, LG40	EDVS	00	0
	~	1 , IGOL, IGOT, IGOM, IGON, IGCV, IGEG, IGNP, IGRC, IGTH	EDV	00	۲
		CUMMAN/BLC1/F(100,2),U(100,2),V(100,2),ETA(100),DELETA(100)	EDV	0	0
		COMMAN/BLC3/X1(100),XS (100),ETAINF(100),BETA(100)	EDV S	° C	ça t
		CUMMON/BLC5/FM(100,2),EDV(100,2),E(100,2),FB(100,2),VPRT(100)	EDVS	0	N
		COMMON/BLIO/SWP, TANL WERN(100,2), WP(100,2)	EDV	0	m
		COMMON/BL12/T1,RM1,U1,R1,PR,PR1,FK,RL,RMU1,RMO1,PS1,ME	EDVS	0	8
		1 UE(100),R0(100),TW(100),GW(100),RP(100),FW(100)	EDV	10	SA .
	• પા	Z RR(100), TE(100), RHAE(100), RMHE(100), GW(100), GPW(100)	EDV	50	\$
	•	3 PFI(100), RF2(100), YS (100), IGX1(100), FPW(100), ROL(100)	EOV	0	
		COMMON/BL19/C(100,2),G(100,2),GP(100,2),	EDV	0	•
		1 RHD(100) RMU(100) FVCT(100)	E D V	0	•
		COMMON/BL20/ RTHTR, UEIN,ROIN,GAMAT	NO NO	0	0
		DIMENSION EDVI(100), EDVU(100) ,EDVM(100)	EDV.	0	6 74
		DATA DATA1/。0168/,DATA2/。40 / DATA3/。080/。DATA4/。44/	EDV	0	N
ບ			FOX V	0	2
U			FD<	202	3
U			FDV	0	ŝ
		IF(IGOL FG 1) GO TO 500	EDV	N 0	9
		SQPXI = SQRT(2 _e *XI(NX))	FOV	N O	~
		TC = RHUI +UE(NX)+RAL(NX)/SOZXI	EDV	0	8
		IF(IG07°F0,1) GO TO 600	FOX	20 2 3	Ø
່ບ	8 8 8	F D S' F O R L A M I N A R F L O M S	EDV	0	0
а,	000	00.520 J # 1, NP	EDV	r c	
		EM(J,2)= 1,0	E D V	0	Ni
		$FDV(J_PZ) = 0_{\circ}$	FDV	0.3	2
		VPRT(J) = PRT	FOX	n c	1
аў -	200	CONTINUE	EOV	0	S

EDV3

EUVS

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EDVS E D V S EDVS EUVS EDVS EDVS EDVS EDVS EDVS EDVS EDVS EDVS SNO FDVS FDVS FDVS EDVS EDVS 。55*(1。=FXP(=。243*SQRT(XPMI)=298*XPMI)) ŝ x SUMT/TC \odot _ (F3+F4)/2 * DELETA(Jm1) ٤. (F1+F2)/2 * DELETA (J*1) -= E(1,1) 2 60 70 720 GU TN 750 = TC+UF (NX)*ABS(VWPSQT) DATAN=DATA1*(1.55/(1.+CPHI)) LL: نے RTHI = UE(NX)*(RHOI/RMUI C1 .--- CJ .ZJ /TVCT(J) ⊃ 60-70 620 E(1,2) œ α 425,) • 6000° Q \supset XPHIH RTHI/425.41 -= V(1,2) ີ່ 00 620 J=1,NP 4 IF (RTHI .LT. **Ε**ω. 1) α EDV(J,2) = 0 61 = F2*U(J EM(J, Z) #1 0 SUM # SUM + = SUMT 0 ۰ ۲e 3000 GO TO 770 0 GO TO 770 L o n 0 CONTINUE CPHIz,55 . \circ °. IF(RTHI ni M c 6 . TFLGED 11 F 3 = 0 LUSAMA Flalo(MAUNG Ę 1 CPHIE TFLT ഗ 10 11 TF CJ 88 SUMT <u>م</u> SUM1 CPHI SUMT <u>م</u> SUM 09 Fμ 3 750 620 720 600 C

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No.

066

EDVS

	TAUW Z RMUI +DUDYW +E(1,2)	EDVS	100
	USTAR = SURT(TAUW/RMAI)	EDVS	072
029	DPDX = =IC*TC*UE(NX)*RMUI =BETA(NX)	EDVS	073
	PPLUS = -RMUI +DPDX/(RHOI+RHOI +USTAR+USTAR+ USTAR)	EDVS	074
	A m 26.	EDVS	510
	ARMT = 1. = 1. = 8 + PPLUS	EDVS	076
020	CONTINUE	EDVS	077
045	APLUS Z A/SORT(ARMT)	EDVS	070
	EDVO(J) = DATAN*UE(NX)*(RHOI/RMUI) * ABS(SUM/TC)	EDVS	079
	VPRT(J) & PRT	EDVS	000
	IF (IFLGED "EQ. 1) GO TO 1098	FDVS	100
	F2 = 1./TVCT(J)	EDVS	002
	IF(J "EQ. 1) GO TO 1060	EDVS	003
	SUM1 = SUM1 + (F1+F2)/2,*DFLETA(Ja1)	EDVS	004
		EDVS	500
060	Y & SUM1 /TC	EDVS	086
	IF (TVCT(J) .GT. 1.005) Y = RO(NX) * ALDG(TVCT(J))	EDVS	0.07
	VPLUS = Y*USTAR*RMOI/RMUI	FDVS	
	YA = YPLUS/APLUS	EDVS	080
	EL & DATAZ*Y	EDVS	000
	IF(YA .LT. 20.) EL E EL ¢(1. «EXP(«YA))	EDVS	160
	BPLUS = 34e	EDVS	200
	IF(J .NE. 1) GO TO 1065	EDVS	2003
	VPRT(J) = DATA2/DATA4 + BPLUS/APLUS	EDVS	994
	GO TO 1070	EDVS	560
065	VPAT(J) # EL/(DATA4*Y)	EDVS	960
	YB = YA&APLUS/BPLUS	EDVS	100
	IF(YB "LT, 20.) VPRT(J) = VPRT(J)/(1."EXP(-YB))	EDVS	860
010	VwPSGT=V(J,2)	FDVS	660
	DUDY = TCAUE(NX) AABS(VWPSQT) / FR	EDVS	100
	FOVI(J) = FL*FL*DUDY*RMOI/RMUI * TVCT(J)	E D V S	101
	TE(EDVI(J) , LT, EDVO(J)) GO TO 1100	EDVS	102
	IFLGEDEL	R 0 < 3	103
(IF (J .LE. 2) #RITE(6,9030)	EDVS	104
0	EDV(J,2) = EUVU(J)	EDVS	S S

EDVS

EDVS

6 5 5 5 5 5 4 0 N N N () • • \$ \$ 120 NNN 52 106 100 60 011 6 64 67 S N N 0 N 0 NN 2 2 A 300 137 100 139 - N - -5 EDVS EDVS EDVS EDVS FOVS EDVS EDVO EDVS EDVS EDVS FDVS EDVS EDVS EDVS EDVS EDVS EDVS EDVS EOVS EDVS UEIN = UFIN + "5*((1./UE(NX))+(1./UE(NX=1)))+(XS(NX)=XS(NX=1)) IF(FK .eg. 0.) GU TD 2200 ROIN = ROIN + "5*((1./RO(NX))+(1./RO(NX=1)))*(XS(NX)=XS(NX=1)) GU TO 2500 GTR = ((UR/ATR)**2)*UE(NX)/(RTHTR**2.6A) IF(FK .NE. 0.) AREXP = AREXP = AREXP + R0(NXT) SUMT = SUMT + (F1+F2) + DELETA(J=1) + 5 JF (AREXP .GT. 10.) GU TN 2500 IF(LG17,EQ.0 ,OR, IGTR,EQ.2) UR = UE(NX)*RH01/RHUI 60 70 2300 IF(NX .6T. NXT) 60 TO 2150 IFITELGED, EQ. 1) GU TO 2050 GO TO 2300 IF(IT .6T. 1) GO TO 2500 IF (J .LE. NP) GU TU 1030 GAMAT # 1. . EXP(ARFXP) F2 = U(J,2)*(1.=U(J,2)) ARFXP = GIRAUEINAROIN ROTN = XS(NX)=XS(NXT) RTHTR = URASUMT/TC EDVI(J) EDV(J,2)≈EDVΩ(J) IF(LG16 "NE, 0) DO 2100 JE2,NP WRTTE (6,9020) EDV(J,2) =GU TN 2300 GU TR 1200 ATR = 60. 0 11 UEIN # 0. ROAN NO. CONTINUE * **^** = ** Fl = 0. F1 = F2 SUM7 2100 2200 1200 2300 2150 1100 2050

EDVS

EDVS

F D V S 141 F D V S 142 F D V S 142 F D V S 144	FDVS 145 FDVS 145	100 100 100 100 100 100 100 100 100 100	正	с с с с с с с с с с с с с с с с с с с	
WRYTE(6,9500) GAMAT 100 DU 2550 J=1,NP IF(J,GT,1) GO TU 2510 Edvm(1) = Edv(1,2)	GO TO 2550 10 IF(J.EQ.NP) GU TO 2520 EDVM(J) =(EDV(J-1,2)+EDV(J+1,2))/3.0	60 TO 2550 20 EDVM(MP) =(FDV(NP=2,2)+EDV(NP=1,2)+EDV(NP,2))/3,0 50 CONTINUE 10 2560 J=1,HP EDV(J,2)=EDVM(J) 1F(LG17,EQ=0 ,0N, 1GTR_EQ.2) GU TO 2560 FDV(J,2) = EDV(J,2)+GAMAT	560 CONTINUE 100 E(1,2)=(EM(1,2)+EDV(1,2)) 10 3010 J=2,NP E(J,2)=(EM(J,2)+EDV(J,2)) EB(J=1,2) = 0.55 (E(J,2) + E(J=1,2)) 10 CUNTINUE 100 RETURN	<pre>>== >10 FORMAT(1H , 30%,43H**PPLUS EXCEFUS THE LAMINARIZATION LIMIT **) >20 FORMAT(1H , 30%,45H**NOTE = EPS UISTRIBUTION = EPS(INNER) ONLY* >330 FORMAT(1H , 30%,45H**NOTE = EPS DISTRIBUTION = EPS(OUTER) ONLY* 500 FORMAT(1H ,41%,11HGAMMA(TR) =, E17,6) END</pre>	

EDVS

		SURRUUTINE SHFT	SHF 7	001
6.1	如如	SUBROUTINE SHET	SHEI	200
£. }		THIS SUBROUTINE PROVIDES THE INITIAL GUESSES FOR EACH STATION	SHF 1	003
£.:			STR T	004
\$		COMMON NX,NP,NPPR,JI,IT,NRVP,LSP,NPM1,JI1,JIM1,NTC,NXT,NXW,NXM	SHFT	002
		1 "TTLE(15)	N L L L	000
	-	COMMON LG16,LG17,LG18,LG32,LG40	LLIS	001
		1 . IGOL, TGOT, IGOM, TGON, IGCV, TGEG, IGNP, IGRC, IGTR	SHFT	000
	-	COMMON/BLC1/F(100,2),U(100,2),V(100,2),ETA(100),DELETA(100)	STFT	000 000
		COMMON/BLC3/X1(100),XS (100),ETAINF(100),BETA(100)	SHFT	010
		COMMON/BLC5/EM(100,2),EDV(100,2),E(100,2),EB(100,2),VPRT(100)	SHFT	011
		COMMON/BL19/C(100,2),G(100,2),GP(100,2),	SHFT	~10
		1 RHO(100), RMU(100), TVCT(100)	SHF1	210
		COMMON/BL21/ A1(100,2),A2(100,2)	SHFT	014
U			SMFT	012
6.)		8 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8	SHFT	016
C			SHET	017
)		IF/IGRC.EQ.1) GD TO 200	LAIS	018
			SHF T	610
	50		SHFT	020
	•	PHIEF(JI, 2) = FIAINF(NX=1)	GIFT	120
		00 70 Jæl, JI	SHF1	220
	9		SHFT	023
	•	U(J,1)=U(J,2)	SHFT	870 8
		V(J,1)=V(J,2)	SHFT	025
	5	EDV(J,1)=EDV(J,2)	SHFT	026
		$E(J_n 1) = E(J_n 2)$	SHFI	027
		IF(J_EQ_JI) GO TO 70	SHFT	020
		ER(J, 1) #FB(J, 2)	SHFT	029
	70	CONTINUE	SHFT	020
	6	DO 90 Jajii, NP	SHFI	031
	50	F(J,1)=PHI+ETA(J)	SHF 7	032
		U(J,1)=1.	SHFT	033
		V (J , 1) = 0 .	SHFI	030
		EDV(J,1)=EDV(JI,2)	SHFT	035

SHFT

N N N

<pre>90 CONTINUE 90 CONTINUE 1F(TGRC_EQ40) GO TO 100 1F(TGRC_EQ40) GO TO 100 1G(C) TO 1800 GO TO 1800 0 TO 120 J=J11.MP 0 TO 100 TO 100 0 TO 100 TO 100 0 TO</pre>	E(J,1) #E(J1,2)	N T T N
9) CONTINUE 167 TO 100 167 TO 120 JEJII,NP 167 D3 167 D3 167 D3 167 D4 167 D4	F8(J=1,1)=E8(JTM1,2)	SHFT
<pre>If(IGRC.FG.0) GO TO 100 IGC20 GO TO 1800 IGC20 U(J.2)=PH1+FTA(J) U(J.2)=PH1+FTA(J) U(J.2)=PH1+FTA(J) U(J.2)=PH1+FTA(J) U(J.2)=P(J-1) V(J.2)=P(J-1) V(J.2)=P(J-1) U(J.2)=F(J-1) U(J.2) U(J.2)=F(J-1) U(J.2)=F(J-1) U(J.2) U(J.2)=F(J-1) U(J.2) U(J.2)=F(J-1) U(J.2) U(J.</pre>	DO CONTINUE	S N N
IGRC=0 IGRC=0 IGRC=0 IGG TT 1800 IGG TT 1800 IGG TT 1800 IGG TD 100 IGG T	IF(IGRC,EQ.0) GO TU 100	SXFI
GO TO 1800 GO TO 120 J=J11,NP F1,2>3=HT 04 F1,2>3=HT 04 F1,2>3=HT 04 U(J,2>1=0. V(J,2>1=0. GO TO 1800 GO TO 1800 GO TO 1800 GO TO 1800 GO TO 1800 SHF 05 SHF 05	IGRC=0	SMFT
<pre>00 00 120 J=JI1.NP 01(J,2)3=PH1+ETA(J) 01(J,2)3=PH1+ETA(J) 01(J,2)3=PH1+ETA(J) 00 00 220 J=1,JI 00 00 220 J=1,JI 01(J,2)3=F(J,1) 01(J,2)3=F(J,2)3=F(J,2)3=F(J,2)3=F(J,2)3=F(J,2)3=F(J,2)3=F(J,2)3=F(J,2)3=F(J,2)3=F(J,2)3=F(J,2)3=F(J,2)3</pre>	GO TN 1800	NON CONTRACTOR
00 120 J=J1.NP F(J,2)=PH1+ETA(J) V(J,2)==1. V(J,2)=1. CONTINUE F(IGRC,EQ.1) GO TO B0 6 C2 0 J=(J) 10 F(J,2)=F(J,1) 10 F(J,2)=F(J,1) 10 F(J,2)=EDV(J,1) 10 F(J,2)=EDV(J,1) 11 F(J,2)=EDV(J,1) 12 F(J,2)=EDV(J,1) 13 F(J,2)=EDV(J,1) 14 F(GFR °GT, 1) PHI = F(J1,2)=ETAINF(NX) 10 RETURN 10 RETURN 10 RETURN 10 RETURN	E B	SHFT
<pre>F(J,2)=PHI+ETA(J) U(J,2)=PHI+ETA(J) U(J,2)=1,0 F(IGRC,EQ.1) GO TO BO CONTRUE FF(IGRC,EQ.1) GO TO BO CONTRUE IF(IGRC,EQ.1) GO TO BO CONTRUE IF(IGRC,EQ.1) GO TO BO F(J,2)=U(J,1) U(J,2)=U(J,1) U(J,2)=U(J,1) If(J,2)=EDV(J,1) If(J,2)=EDV(J,1) If(J,2)=EDV(J,1) If(J,2)=EDV(J,1) If(IGR GG TO 220 FHI F(J1,2)=ETAINF(NX) If(IGR GG T) PHI = F(J1,2)=ETAINF(NX) SHFT 05 FHI F(IGR F) SHFT 05 FHI F(IGR</pre>	0 00 120 JEJI, NP	LLIN
U(J,2)=1. V(J,2)=0. V(J,2)=0. FT(GRC,EQ.1) GO TO 80 GO TO 1000 DO 220 J=1,JI 10 F(J,2)=F(J,1) U(J,2)=U(J,1) V(J,2)=U(J,1) 15 F(J,2)=U(J,1) 15 F(J,2)=EDV(J,1) 15 F(J,2)=EDV(J,1) 15 F(J,2)=EBV(J,1) 15 F(J,2)=EBV(J,1) 15 F(J,2)=EB(J,1) 16 T(J,2)=EB(J,1) 17 (J,2)=F[J,1] 17 (J,2)=F[J,1] 16 D TO 220 17 (J,2)=F[J,1] 17 (J,2)=F[J,1] 16 D TO 220 17 (J,2)=F[J,1] 17 (J,2)=F[J,1] 16 D TO 220 17 (J,2)=F[J,1] 17 (J,2)=F[J,1] 10 D TO 20 17 (J,2)=F[J,1] 10 D TO 20 17 (J,2)=F[J,1] 10 D TO 20 10 D TO 100 10 D T	F(J ₀ 2)=PHI+ETA(J)	SMF 7
<pre>2 V(J,2)=0. 2 N(J,2)=0. 5 NFT 04 6 TT 1800 6 TT 1800 6 TT 1800 6 TT 1800 6 TT 1800 7 NFT 05 5 NFT</pre>	U(J,2)¤1。	L L NO
Z0 CONTINUE IF(IGRC,EQ.1) G0 T0 80 60 T0 1800 10 C(J,2)=F(J,1) 10 F(J,2)=E(J,1) 10 F(J,2)=U(J,1) V(J,2)=E(J,1) 15 E0V(J,2)=E0V(J,1) 15 E0V(J,2)=E0V(J,1) 15 E0V(J,2)=E0V(J,1) 15 E0V(J,2)=E0V(J,1) 15 E0V(J,2)=E0V(J,1) 15 E0V(J,2)=E1/1) 16 T0 Z0 17 T0 Z0 17 T0 Z0 20 T0 100 20 T0 20 20 T0 20 2	V(J, P2)=0.	
<pre>IF(IGRC.FG.1) GO TO 80 IF(IGRC.FG.1) GO TO 80 IF(IGRC.FG.1) GO TO 80 IF(IJ.2)=F(J.1) IF(IJ.2)=F(J.1) IF(IJ.2)=F(J.1) IF(J.2)=F(J.1) IF(J.2) IF(J.2)=F(J.1) IF(J.2)=F(J.1) IF(J.2)=F(J.1) IF(J.2)=F(J.1) IF(J.2) IF(J</pre>	PONTINUE	2 A A O
<pre>60 T0 1800 00 D0 220 J=1,JI 10 F(J,2)=F(J,1) U(J,2)=F(J,1) U(J,2)=U(J,1) U(J,2)=U(J,1) 15 EDV(J,2)=EDV(J,1) 17(J,2)=EG,J1) G0 T0 220 18 F(J,2)=EB(J,2)=ETAINF(NX=1) 17 F(J,2)=ETAINF(NX=1) 17 F(J,2)=ETAINF(NX=1) 17 F(J,2)=ETAINF(NX=1) 17 F(J,2)=ETAINF(NX) 50 T1 100 10 RETURN 10 RETURN 10 END</pre>	IF(IGRC,EQ.1) 60 70 80	0 N F 1
00 D0 220 J=1,JI 10 F(J,2)=F(J,1) U(J,2)=U(J,1) V(J,2)=V(J,1) V(J,2)=E(J,1) SHFT 05 SHFT 06 SHFT 06 SHF	GO TO 1800	SHT S
10 F(J,2)=F(J,1) U(J,2)=V(J,1) V(J,2)=V(J,1) SHFT 05 F(J,2)=EDV(J,1) F(J,2)=E(J,1) F(J,2)=E(J,1) F(J,2)=EF(J,1) F(J,2)=EF(J,1) F(J,2)=EF(J,1) F(J,2)=EFAINF(NX=1) F(J,2)=EFAINF(NX=1) F(J,2)=ETAINF(NX=1) F(J,2)=F(J,2)	10 DO 220 J=1,JI	LANO
U(J,2)=U(J,1) V(J,2)=V(J,1) V(J,2)=E(V(J,1) F(J,2)=E(V(J,1) F(J,2)=E(J,1) E(J,2)=E(J,1) CONTINUE PHI=F(JI,2)=ETAINF(NX=1) FF(J,2)=ETAINF(NX=1) FF(J,2)=ETAINF(NX=1) FF(J,2)=ETAINF(NX=1) FF(J,2)=ETAINF(NX=1) FF(J,2)=ETAINF(NX=1) SHFT 05 SHFT 05 SHF	0 F(J,2)=F(J,1)	OMF
<pre>V(J,2)=V(J,1) IS EDV(J,2)=EDV(J,1) F(J,2)=E(J,1) IF(J,EQ,JI) GO TO 220 EB(J,2)=EEB(J,1) SHFT 05 SHFT 05 SHFT 05 PHI=F(JI,2)=ETAINF(NX=1) IF(IGTR 6GT, 1) PMI = F(JI,2)=ETAINF(NX) O6 TO 10 100 RETURN END SHFT 06 /pre>	U(J,2)=U(J,1)	OMF
<pre>15 EDV(J,2)=EDV(J,1) F(J,2)=E(J,1) GO TO 220 IF(J.EQ.JI) GO TO 220 EB(J,2)=EF(J,1) GO TO 220 EB(J,2)=EF(J,1) F(J,2)=EF(J,1) F(J,2)=ETAINF(NX=1) IF(IGTR .GT. 1) PHI = F(JI,2)=ETAINF(NX) GO TO 100 RETURN END 8HFT 06 SHFT 06 SHF</pre>	V(J,2)¤V(J,1)	SMFT
F(J,2)=E(J,1) GO TO 220 IF(J.EQ.JI) GO TO 220 EB(J,2)=EB(J,2)=EB(J,1) GO TO 220 EB(J,2)=EB(J,2)=EAINF(NX=1) PHI=F(J1,2)=ETAINF(NX=1) IF(IGTR .GT.1) PHI = F(J1,2)=ETAINF(NX) SHFT 05 GO TO 100 END END SHFT 05 SHFT 05 SHFT 05 SHFT 05 SHFT 05 SHFT 05 SHFT 06 SHFT 06 S	IS EDV(J,2)=EDV(J,1)	0 I M I
<pre>IF(J.EQ.JI) GO TO 220 EB(J.2)#EB(J.1) GO TO 220 EB(J.2)#EB(J.1) SHFT 05 SHFT 05 PHI=F(J1,2)=ETAINF(NX=1) IF(IGTR .GT.1) PMI = F(J1,2)=ETAINF(NX) SHFT 06 SHFT 06 SHFT 06 SHFT 06 SHFT 06 SHFT 06</pre>	F(J,2)¤E(J,1)	- LIS
EB(J, 2) = EB(J, 1) 20 CONTINUE PHI=F(JI, 2) = ETAINF(NX+1) IF(IGTR .GT, 1) PHI = F(JI, 2) = ETAINF(NX) GO TO 100 SHFT 06 SHFT 06 S	TF(J.EQ.JI) GO TO 220	LANG
ZO CUNTINUE PHI=F(JI,Z)=ETAINF(NX=1) IF(IGTR .GT. 1) PMI = F(JI,Z)=ETAINF(NX) GO TI 100 SMFT 06 SMFT 06 SMFT 06 SMFT 06 SMFT 06 SMFT 06 SMFT 06 SMFT 06	EB(J,2)=EB(J,1)	SHE
PHI=F(JJ,2)=ETAINF(NX=1) IF(IGTR .GT. 1) PHI = F(JJ,2)=ETAINF(NX) GO T1) 100 SHFT 06 SHFT	20 CONTINUE	SHFT
IF(IGTR GT. 1) PMI = F(JI/2) - ETAINF(NX) GO TO 100 GO RETURN END END	PHIEF(JL, 2) = ETAINF(NX=1)	SHFT
GO TO 100 SHFT 06 SHFT 06 SHFT 06 SHFT 06 SHFT 06 SHFT 06	IF(IGTR GT, 1) PMI = F(JI,2)=ETAINF(NX)	SHFT
DO RETURN END SHFT D6 SHFT D6	GO TO 100	SHFT
	JO RETURN	SHFT
		SMFT

1800

SMF 7.

SHF 7

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	SUI	BRAUTINE MAMX	XWOW	001
C			MOMX	002
C	** SUI		X NOW	003
U	1	WD THE SOLUTION OF THE X-MOMENTUM EQUATION	X XOX	004
ပ			XWOW	005
	Û U	MACIN NX,NP,NPPR,JI,II,NRVP,LSP,NPM1,JI1,JIM1,NTC,NXI,NXW,NXM	MOMX	006
		øTTLE(15)	XWOW	007
	ΰ υ	MMUN/BLC1/F(100,2),U(100,2),V(100,2),ETA(100),DELETA(100)	XWOW	008
	000	MMN [616,[617,[618,[632,L640	XWOW	000
		, TGOL, TGOT, TGOW, TGON, TGCV, TGEG, TGNP, TGRC, IGTR	X WOW	010
	Ο _υ	MMIN/FLC3/XI(100),XS (100),ETAINF(100),BETA(100)	XWOW	10
	C C C	MMUN/BLC5/FM(100,2),EDV(100,2),E(100,2),EB(100,2),VPRT(100)	XWOWX	012
	õ	MMUN/BLC8/A(100),CEL(100)	XMOMX	210
	0 U	MMN/BL11/VWPRI,UWPRI,DELV1	XWOW	014
	ũ	MMNN/BL12/TI,RMI,UI,RI,PR,PRT,FK,KL,RMUI,RHOI,PSI,HE	XWOW	S 10
		, UF(100), R0(100), TW(100), GW(100), RP(100), FW(100)	XWOW	010
	2	, AR(100), TE(100), RHME(100), RMUE(100), GW(100), GPW(100)	XNON	017
	۴٩	, RF1(100), RF2(100), YS (100), IGX1(100), FPW(100), ROL(100)	XMOMX	018
	00	MMUN/BL19/C(100,2),6(100,2),6P(100,2),	XWOWX	610
	-	RHO(100),RMU(100),TVCT(100)	X & O W	020
	10	MENSION AI(100), B1(100), G1(100), D(100), SF(100), S(100),	MOMX	120
	çai	X(100),Y(100),Z(100),DELF(100),DELU(100),DELV(100)	XMOW	N N O
J			XXOW	023
U	8	建有能异素的 医白色白色 化一羟氨基合合 化二羟基乙基合合 化合合合合合合合合合合合合合合合合合合合合合合合合合合合合合合合合合	XWOW	24
U			XMOM	025
	<u>14</u> p=++	fIT_GT_1) GO TO 100	XNOW	026
	<u>نا</u>	(NX « FQ « I)	XMOM	027
		<pre>(NX.GT.1) CEL(NX)=2.*XI(NX=1)/(XI(NX)=XI(NX=1))*1.</pre>	XWOW	028
	N N	PR[=V(1,1)	XWOW	029
	M C .	PRT=U(1,1)	XWOW	030
U	2 0 V 0		XXOX	031
	MA 001	PR[#V(1,2)	XWOW	220
	MO	PRT=U(1,2)	XWOW	<u>5</u> 2 2 0
ပ	888		XWOW	034
	Å (1) # 0.	XMOM	0 25

XWOW

227

XMOM

DO 320 J = 2, NP	XWOW	9 2 0
320 A(J) = DELETA(J=1) / 2.	X C C C C C C C C C C C C C C C C C C C	037
	MOMX	S N C
D(1 900 J # 2, NP	XWON	039
FB = = (F(J,2) + F(J=1,2)) + A.5	XMOM	040
VB = = (V(J,2) + V(J=1,2)) + A=5	XWOW	041
JF (NX GT, 1) GO TU 600	XMOMX	042
	XMOMX	043
	XWOWX	
CVB x 0 a	XŴOW	045
GO TO 700	XWOWX	046
600 CFR == (F(J,e1) + F(J,e1,e1)) = 0,e5	XWOW	047
CUR =(U(J,1) + U(J.1,1)) * 0,5	XWOWX	040
CVR = (V(J,1) + V(J=1,1)) + 0,5	XMOM	600
	XMOM	020
700 TH1 = A(J) /FB(Jm1,2)	XWOWX	150
AI(J) = TM1 * ((1, * CEL(NX)) * V6 * CEL(NX) * CVB)	XWOW	220
BI(J) = 1 + 7M1 + ((E (J,2) = E (J=1,2))/DELETA(J=1) + (1	XWOW	053
I ~ CEL(NX)) * FB ~ CEL(NX) * CFB)	XWOW	920
	XWOW	055
IF (NX «EQ. 1) RB = 0.	XMOMX	056
IF (NX "GT" 1) RB EMEB(J"1,1) * ((V(J,1) - V(J"1,1)) / DELETA	XWOW	057
1 (J=1)) + (((E (J,1) = E (J=1,1)) / DELETA(J=1)) + CFB	XWOW	050
2)*CVB *BETA(NX=1)*,5	XWOW	050
3 = CFL(NX)*(CFB*CVB=CUB*CUB) + BETA(NX=1)*,5)	XWOW	090
S(J)=V(J=1,2)=V(J,2)=DELETA(J=1)/EB(J=1,2) * ((1 + CEL(NX)	XWOW	061
1) *F8*VB = (BETA(NX)+CEL(NX))*((U(J,2)+U(J=1,2))* ₆ 5)**2	XWOW	062
2 = CEL(NX)*CFB*VB + BETA(NX)*,5 + CEL(NX)*CVB*FB = RB	MOMX	063
3 +VB*(E(J,2)=E(J=1,2))/DFLETA(J=1) + BETA(NX)*_5)	XWOW	064
900 CONTINUE	XMOM	065
	XWOW	066
905 D(2) = ~.5*(~A(2)/EB(1,2)*(BETA(NX)*CEL(NX))*(U(2,2)+U(1,2))	XMOM	067
$1 \neq A(2) \neq A(2) \neq B(2) / A(2)$	XHOM	068
SE(2) = = A(2)	XWOW	069
G1(2) = D(2) = 1, / A(2)	XWOW	010

MOMX

XMOM

Y(2) = F(1,2)=F(2,2) + DELETA(1)*.5*(U(2,2)+U(1,2))	MOMX	071
X(2) ==0.5 * (S(2) + A1(2) * Y(2) + B1(2) * (U(1.2)=U(2.2)+	XMOW	240
1 DELETA(1)*(V(2,2)+V(1,2))*,5)/A(2))	MOMX	073
Z(2) = =X(2)=(A(2)+(V(2,2)+V(1,2)) +U(1,2)=U(2,2)) /A(2)	MOM X	074
DO 950 J = 3, NP	XWOWX	075
THR11 = "A(J) +SF(J=1)	XMOM	076
TMR21 = - A1(J) *SE(J=1) + G1(J=1) * (2, - B1(J))=(U(J,2)+U(J=1,2)	MOMX	077
1) * A(J)/EB(J=1,2)*(BETA(NX)+CEL(NX))	MUMX	078
TMR31 H #1, + A(J) + G1(J=1)	MUMX	079
D(J) = (A(J) * A(J) * A1(J) *(A(J)**2)*(BETA(NX)+CEL(NX)) *	XWOW	080
1 (U(J,2)+U(J=1,2))/EB(J=1,2) + B1(J)	MOMX	081
2 / ("IMR11 * A1(J) * A(J) * A(J) * TMR21 + TMR31 * B1(J))	XWOW	082
SE(J)# = A(J) = TMR11 = D(J)	XWOW	063
G1(J) = (TMR31 + D(J) + 1,) / A(J)	XMOMX	084
TMM1 = A(J)*(U(J=1,2)+U(J,2))+F(J=1,2)=F(J,2) + Y(J=1)	XMOW	005
	XMOX	086
TMM3 = A(J)*(V(J,2)+Z(J=1) +V(J=1,2)) = U(J,2)+U(J=1,2)	XWOW	067
DNTR = = A(J) * TMR11 * A1(J) + A(J) * TMR21 * TMR31 * B1(J)	XMOMX	088
X(J) = (- A(J) + A1(J) + TMM1 + A(J) + TMM2 + B1(J) + TMM3) / DNTR	XMOM	089
Y(J) H TMM1 = TMR11 + X(J)	XMOM	000
Z(J) = (TMR31 * X(J) = TMM3) / A(J)	NOMX	100
950 CONTINUE	XWOW	200
	XMOM	095
DELF(NP) = Y(NP)	XWOW	094
DELLI(NP-1) = X(NP)	XMOM	000
DELV(NP) = Z(NP)	XWOW	096
	XMOM	160
	XMOW	098
	XMOM	000
DELF(J) = Y(J) =SE(J) = DELU(J)	XWOW	100
DELU(J=1) = X(J) = D(J) = DELU(J)	MOMX	0
DELV(J) = Z(J) = G1(J) = DFLU(J)	XNOM	102
IF (J _GT ~ 3) GO TO 1000	XWOW	103
DELF(2) = Y(2) =SE(2) + DELU(2)	XWOW	104
DELV(2) = Z(2) - G1(2) + DELU(2)	XNOW	102

XMUMX

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XWDWX

XNON

DELV(1) = X(2) = D(2) = D(2) = D(2) = O(2) =		MOM	106
DELUCID = 0. IF (TT.EG. 1) WRITE (6, 9510) WRITE (6, 9521)IT, V(1,2), DELV(1) DO 1020 Je1,NP DO 1020 Je1,NP TF (J -EG.NP) GO TO 1010 U(J,2) = F(J,2) + DELU(1) O(J,2) = V(J,2) + DELV(J) O(J,2) = V(J,2) + DELV(J) V(J,2) = V(J,2) + DELV(J) O(NTIUE V(J,2) = V(J,2) + DELV(J) O(NTIUE V(J,2) = V(J,2) + DELV(J) O(NTIUE OCUTIUE OCUTIUE DELV1 = DELV(1) OREVII = DELV(1) OREVII = DELV(1) OREVII = DELV(1) OREVII = DELV(1) OREVII = DELV(1) OREVII = DELV(1) O(NT 12) HOWX 122 TO 0, 9, 10X, F20, 9) HOWX 122 HOWX 122, 10X, F20, 9) HOWX 122 HOWX 122	DELV(1) = X(2) = D(2) = DELU(2)	MOMX	101
<pre>Prove the second state (s, 9510) "ATTE (s, 9521)IT, V(1,2), DELV(1) "ATTE (s, 9521)IT, V(1,2), DELV(1) D1 1020 Js1,NP TF (J .E0. NP) G0 T0 1010 U(J,2) = U(J,2) + DELV(J) V(J,2) = V(J,2) + DELF(J) V(J,2) = V(J,2) + DELF(J) V(J,2) = V(J,2) + DELV(J) V(J,2) = V(J,2) + DEVV(J) V(J,2) = V(J,2) + DEVV(J) V(</pre>	DELU(1) = 0,	XMOM	0
<pre>If (IT.EG. I) WRITE (6, 9510) WRITE (6, 9521)IT. V(1,2), DELV(1) DO 1020 Ja1,NP DO 1020 Ja1,NP TF (J .EG. NP) GO TO 1010 U(J,2) = U(J,2) + DELV(J) D F(J,2) = U(J,2) + DELV(J) TO F(J,2) = V(J,2) + DELV(J) TO F(J,2) + DELV(J)</pre>		XWOw	00
<pre>#RITE (6, 9521)17, V(1,2), DELV(1) D) 1020 J=1,NP TF (J .E0. NP) GO TO 1010 U(5,2) = U(J,2) + DELV(J) 10 F(J,2) = F(J,2) + DELV(J) 20 C0NTRUUE 20 C0NTRUUE 20 C0NTRUUE 20 C0NTRUUE 21 V 11 PELV(1) 00 RETURN 21 F(1H .20X,4HFPPM _ 26X,5HDELVW 32 F(0,9,10X,F20,9) 40HX 12 40HX 1</pre>	IF (IT,EQ, 1) WRITE (6, 9510)	XMOM	
D1 1020 Je1,NP TF (J .60, NP) GD T0 1010 U(J,2) = U(J,2) + DELU(J) 10 F(J,2) = F(J,2) + DELV(J) 20 CONTINUE DELV1 = DELV(1) 00 RETURN 10 FORMAT (1H .20X,12,10X,F20,9,10X,F20,9) 10 FORMAT(1H .20X,12,10X,F20,9)10X,F20,9) MOMX 12 MOMX 12	WRITE (6, 9521)IT, V(1,2), DELV(1)	XWOW	ලාත් ලාත්
D0 1020 J91,NP 17 (J *E0. NP) G0 T0 1010 10 F(J/2) = U(J/2) + DELU(J) 20 CONTINUE 20 CONTINUE DELV1 = DELV(J) 20 CONTINUE DELV1 = DELV(1) 20 RETURN 21 FORMAT (1H0, 21X,1HT,20X,4HFPPM, 26X,5HDELVW) 21 FORMAT (1H *20X,12,10X,F20.9,10X,F20.9) 21 FORMAT(1H *20X,12,10X,F20.9,10X,F20.9) 21 FORMAT(1H *20X,12,10X,F20.9) 21 FORMAT(1H *20X,10X,10X,F20.9) 2		XMOM	-
IF (J. EQ. NP) GO TO 1010 U(J.2) = U(J.2) + DELU(J) V(J.2) = V(J.2) + DELV(J) 20 CUJ.2) = V(J.2) + DELV(J) 20 CUTINUE DELV1 = DELV(1) 00 RETURN 10 FORMAT (1H0, Z1X,1H1,20X,4HFPPM , 26X,5HDELVW) 21 FORMAT (1H ,20X,12,10X,F20,9)10X,F20,9) 21 FORMAT(1H ,20X,12,10X,F20,9)10X,F20,9) 21 FORMAT(1H ,20X,12,10X,F20,9)10X,F20,9)		XWOW	وينه وينه ليط
U(U,Z) = U(J,Z) + DELU(J) 10 F(J,Z) = F(J,Z) + DELV(J) 20 CONTINUE DELVI = DELV(I) 00 RETURN 11 FORMAT (1H0, Z1X,1HI,20X,4HFPPM, Z6X,5MDELVW) 10 FORMAT (1H ,20X,1Z,10X,FZ0,9)10X,FZ0,9) 21 FORMAT(1H ,20X,1Z,10X,FZ0,9) 21 FORMAT(1H ,20X,1X,10X,10X,10X,10X,10X,10X,10X,10X,10	IF (J "EQ, NP) GO TO 1010	XMOM	-93 699 699
10 F(J,2) = F(J,2) + DELF(J) 20 CONTINUE DELV1 = DELV(J) 00 RETURN 11 MOHX 11 00 RETURN 11 FORMAT (1H0, 21X,1H1,20X,4HFPPM, 26X,5HDELVW) 11 FORMAT (1H0, 21X,1H1,20X,4HFPPM, 26X,5HDELVW) 12 MOHX 12 10 FORMAT (1H + 20X,12,10X,E20,9) 12 MOHX 12 14 MOHX 12 16 MOHX 12 17 MOHX 12 10 MOHX 12 12 12 12 12 12 12 12 12 12	$U(J_rZ) = U(J_rZ) + DELU(J)$	XMOMX	ୁ କ୍ୟୁ କ୍ୟୁ
CONTINUE V(J,2) + DELV(J) DELV1 = DELV(1) DELV1 = DELV(1) 00 RETURN 21 FORMAT (1H0, 21x,1H1,20x,4HFPPM , 26x,5HDELVW) 21 FORMAT (1H ,20x,12,10x,F20,9) 21 FORMAT (1H ,20x,12,10x,F20,9) 21 FORMAT (1H ,20x,12,10x,F20,9)	$F(J_0Z) \equiv F(J_0Z) + DELF(J)$	MOMX	- 90 - 90
ZO CONTINUE DELVI = DELV(1) 00 RETURN 10 FORMAT (1H0, 21X,1HI,20X,4HFPPW, 26X,5HDELVW) 21 FORMAT (1H,20X,12,10X,F20,9) 21 FORMAT(1H,20X,12,10X,F20,9) 21 FORMAT(1H,20X,12,10X,F20,9) 21 FORMAT(1H,20X,12,10X,F20,9)	$V(J_{\rho}Z) \equiv V(J_{\rho}Z) + DELV(J)$	XWOW	া প্রান্থ জন্ম প্রান্থ
DELV1 = DELV(1) 00 RETURN 10 FORMAT (1H0, Z1X,1H1,20X,4HFPPW, Z6X,5HDELVW) 10 FORMAT(1H,20X,1H1,20X,4HFPPW, Z6X,5HDELVW) 21 FORMAT(1H,20X,12,10X,F20,9) 21 FORMAT(1H,20X,12,10X,12	CONTINUE	XWOW	
00 RETURN 10 FORMAT (1H0, Z1X,1H1,20X,4HFPPW , Z6X,5HDELVW) ROMX 12 FORMAT(1H,20X,12,10X,F20,9) ROMX 12 MOMX 12 ROMX 12 R	DELVI = DELV(1)	MOM	
10 FORMAT (1H0, Z1X,1H1,20X,4HFPPW , Z6X,5HDELVW) ROMX 12,10X,E20,9,10X,E20,9) END MOMX 12,10X,E20,9) MOMX 12,10X,E20,9)	RETURN	XMOW	
Z1 FORMAT (1H0, Z0X, 4HFPPW , Z6X, SMDELVW) R1 FORMAT(1H, 20X, 4HFPPW , Z6X, SMDELVW) MOMX , 26X, SMDELVW) MOMX , 26X, SMDELVW) MOMX , 26X, SMDELVW) MOMX , 26X, SMDELVW) MOMX , 27X, 12, 10X, F20, 9, 10X, F20, 10X,		MOMX	
	FURMAI (INU, ZIX, INI, ZOX, 4MFPPM, 26X, 5MDELVW)	XMOM	N.
	FURMATIIM PZOXPIZPIOXPEZ0.9PIOXPEZ0.9)	XMOM	2
		MOMX	120

	SUBROUTINE TRNS	TRNS	001
		TRNS	002
金	SUBROUTINE TRNS	TRNS	003
	THIS SUBROUTINE COMPUTES THE LOCATION OF B. L. TRANSITION	TRNS	004
		TRNS	0.05
	COMMON NX, NP, NPPR, JI, IT, NRVP, LSP, NPM1, JI1, JIM1, NTC, NXT, NXW, NXM	TRNS	000
	. TITLE(15)	TRNS	007
	COMMON L616, 1617, L618, L632, L640	TRNS	000
	I , IGOL, IGOT, IGOM, IGON, IGCV, TGEG, IGNP, IGRC, IGTR	TRNS	600
	COMMON/BLC1/F(100,2),U(100,2),V(100,2),ETA(100),DELETA(100)	TRNS	010
	COMMON/BLC3/XI(100), XS (100), ETAINF(100), BETA(100)	TRNS	
	COMMON/BL12/T1. RM1, UT, R1, PR, PRT, FK, RL, RMUI, RMOI, PSI, ME	TRNS	012
	<pre>i</pre>	TRNS	210
	2 RR(100), TE(100), RHOE(100), RHUE(100), GW(100), GPW(100)	TRNS	014
	5 RFI(100) RF2(100) YS (100) IGX1(100) FPW(100) ROL(100)	TRNS	015
	COMMON /BL14/ RX1, RTH1, CF0, CF1, CF2, CFSUM0, CFSUM,	TRNS	016
	THE TA(100), DELS(100), FPPW(100)	TRNS	110
	COMMUN/BL20/ RTHTK, UEIN, ROIN, GAMAT	TRNS	010
	DIMENSION C(3)	TRNS	010
	DATA C1, C2, C3, C4, C5, C6 /66 4665, -3. 357287, 12. 31885, 48447, 19 ,	TRNS	020
		TRNS	021
		TRNS	N NO
		TRNS	023
		TRNS	020
	K H N X + [TRNS	025
	IIGREO	TRNS	026
	TF(LGI6_NE_0) G7 T7 50	ARNS	027
	WRITE(6,9010)	TRNS	028
	L SP#1	TRNS	020
	GU TU 1800	TRNS	020
20	IF(V(1,2) .LE. 0.) GO TO 600	TRNS	031
	AG1=UE(NX)+RHDI/RMUI	TRNS	032
	IF(FK "FQ" 1") GO TO 55	TRNS	033
	RX12ZAG1*XS(NX)	TRNS	034
	RTH128AG1*THFTA(XX)	TRNS	035

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TRNS

TRNS

0690 020 \$50 50 950 220 020 090 062 063 190 065 000 067 068 010 036 120 030 039 000 200 043 8 7 C 045 000 700 000 600 050 250 250 00% 041 150 TRNS RNS TRNS RRNS **RNS** 1 RNS TRNS TRNS TRNS TRNS TRNS TRNS TRNS TRNS TRNS **R**NS r RNS SZQ TRNS TRNS 7 RNS TRNS TRNS TRNS TRNS TRNS V R NO TRNS 1 R N 00 TRNS TRNS TRNS TRNS TRNS TRNS RTHE9 = C1 + C2*RX2 + C6*SQR1(C3*RX2*RX2+C4*RX2+C5) 60 70 550 AG1=RTH2=((RTH2=RTH1)/(RX2=KX1))*RX2 RSM4AC = C(2)+C(2) - 4 + C(1)+C(3) . "AND, RTD,GE.10.) 60 70 65 GU TN 70 RTHIPEAGIATHETA(NX)ARDL(NX) IF(RX2 .LT. 1.) GO TO 550 C(2)=48447.19=2.0+463+464 AG2=(KTH2-RTH1)/(RX2-RX1) S2#524(RUL(I)**2)*(DEL93) C(3)==19886.08=464*464 IF(IGTR.NE.0) GD 70 60 RX1±1.6E=05 * RX12 .GF. 10.) C(1)=12,31885-AG3*AG3 DELS3= XS(I)=XS(Im1) IF(RSM4AC .GF. 0.) RXIZ RTD = RTHE9-RTH2 AG3=AG2+3 357287 AG42AG1-66,4663 RX261 . F. 05 * RTH28KTM12 00 56 1=2,NX IF (RTO.GT.O. PX12EAG1 + S2 IF (ARS(RTO) RTH1 #RTH12 GO TO 1800 RUTZERXZ 60 10 95 CUNTINUE GO TO 57 RUT1=0, IGTR=3 65 IGTRE3 IGTREI 32=0° 000 ទ С 0 5

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7 RNS

SZAL

	#RTTE(6,7000) NX	TRNS	1 ∑ 0
	Gr) TN 550	TRNS	072
70	RDT1 = (=C(2) + SGRT(BSM4AC))/(2,*C(1))	TRNS	520
	R012 = (=((2) = SQRT(BSM4AC))/(2, = C(1))	TRNS	074
	IF(ROTI,LE.O.,AND,RUT2,LF.O.) GU TU 550	TRNS	075
	TF (ROT1, GT.O, AND. HOT2, GT.O.) GO TO 80	TRNS	076
	IF (RUTI GT, 0,) RX=1, FO5*RUTI	TRNS	110
	IF(RUT2,GT.0.) RX=1.F05*R072	TRNS	078
	60 TO 100	TRNS	610
68	I [GR = 1	TRNS	080
	RXERNT1 * 1.FO5	TRNS	081
	GD TD 100	T R N S	082
00	IIGK=2	TRNS	083
	RX=RNT2 * 1 .E05	TRNS	084
		TRNS	085
	GU TO 100	A RNS	086
s S	RX=1 FOS+ROT2	TRNS	067
	X T R H X S (N X)	L R NO	088
	GU TO 200	TRNS	080
100	UETR = UE(NX) + (UE(NX)=UE(K))*(1 E=05&RX=PX1)/(PX2=PX1)	TRNS	000
	XTR=RX*RMUI/(RHGI*UETR)	TRNS	160
	IF(XTR=XS(NX)) 300,200,500	TRNS	092
200	WRITE(6,6010) NX	TRNS	093
	GO TO 700	TRNS	760
300	IF(XTR'LE' XS(K)) GU TO 500	TRNS	500
	WRTTE(6,6020) XTR	TRNS	096
	GO TO 1000	TRNS	100
500	IF(IIGR,EQ,I) GD TD 90	TRNS	098
520	TF(V(1,/2),LE,0,) GN TD 600	TRNO	660
	IF (IGTR "EU O) GO TO 1800	TRNS	100
	RX1=RX2	T R N S	101
	RTHIERTHZ	TRNS	102
	CFA = CF1	TRNS	201
	CFSUM0 = CFSUM	TRNS	104
	RETURN	TRNS	105

C

TRNS

TRNS

0 7 7 († 1 5 1 1 10 108 60 8 7 7 7 200 20 3 135 9 <u>کی</u> مح 6) 2) 2) NNN 200 5 2 82 129 30 23 134 20 34 2 00 55 001 õ TRNS RRNS TRNS TRNS TRNS TRNS TRNS TRNS TRNS T RNS N N N O N N S TRNS RNNS **RNS** TRNS TRNS V RNS C RNS 8 N N S S N S SNS' N N N S S S S S RNS TRNS TRNS SNG A RNS TRNG SN SS **TRNS** SN Q T R N S RN S 6030 FORMATCIM1//// 45X, 384LAMINAR SEPARATTON OCCURRED AT STATION, 13, 6040 FORMAT(1H1////// 45%,34HLAMINAK SEPARATION OCCURRED AT S = "F12 6) FORMAT(1H1///40%, 39HATTEMPT TO FIND X(TR) FAILED AT STATION ,13/) FORMAT(1H0,35%,33HTURBULENT FLOW STARTED WITH NTR = ,13 ////) *(* XTR=XS(NX)=(XS(NX)=XS(K))+ V(1,2)/(V(1,2)=V(1,1) 34HTRANSITION HAS OCCURRED AT STATION, 13/) 30HTRANSITION HAS OCCURRED AT S = F12.6 /) FORMAT(1H "24HAA ERROR IN TRFLAG INPUT, /) ROIN/RO(NX) GO 70 1800 GO TO 1800 IF(V(1,2),LT,0,) GO TU 800 6010 FORMATCIM1/////// 30X. 6020 FORMATCIM1////// 30X. ROIN ROIN = XS(NX) = XTR UEIN = ROIN/UE(NX) WRITE(6,6040) XTR WRITE(6,6050) NXT WRITE(6,6050) NXT WRITE(6,6030) NX •EG. 0) IF((G17 .69. 0) IF(FK .NE. 0.) CFSUM # CFSUMO CF1 = CF0 CFSUM = CFSUM0 GU TU 1800 °0 CFI = CFOUEIN = 0. LG17 = 0 IF (LG17 R01N = XNHNXN IGTREZ 1000 NXT=NX RETURN **a**nd 0000 gand 600 700 1800 0509 7000 0106 008 S

TRNS

2000 CONTINUE End

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910 610 002 900 007 000 600 010 2 0 1 9 2 0 1 2 010 Sic 10 018 020 2 2 2 0 520 023 020 6 N N N O C 027 020 029 020 n M O N00 003 000 021 033 034 330 031 500 100 310P stop SLOP slop SLOP SLOP SLOP A TUPUT ((I)X=(I+I)X) / ((I)A=(I+I)A) (l=l)x=(l)x) / ((l=l)A=(l)A) SURROUTINE SLOPE(NPX, XC, YC, DYDX, MER) COMPLITE THE DERIVATIVE DOUX FROM X VS DIMENSION XC(150), YC(150), DYDX(150) DIMENSION X (300) , Y (300) , XY (301) CALL INSICK(I) XY , Y(I) NLG, NEW) IF(I .LT. NP2MI) GO TO 150 X(T) = (XY(I) + XY(I + 2)) + STF(I . EQ. NP2) GO TO 50 GO TN 20 JF(I .GT. 1) GO TO 100 XY(ZAI41) = YC(I) SUBROUTINE SLOPE DO 200 1=1 002 00 V(I-1) = XY(I+1)XY(I+2) = XC(I) 00 50 I=2,NP2,2 JF(MER "NE" V) NP2m(= NPX X(T=1) = XY(T)I=1,NPX NO 10 I=1, NPX NP2MI = NP2MI X(T) = XC(T)V(T) = VC(T) XA(1) = NPX NP2 = 24NPX DAUX(I) = = (I)XUAO GO TN 200 GO TO 80 CONTINUE CONTINUE CONTINUE NLQE 2 00 40 0 2 05 e S 100 C T 66 白白白 **ပ**ပပပ

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G0 T0 200 A1 = (7 × (1) + (7 + (1 + 1) + (7 + 1) + (7 + 1) + (7 + (1 + 1)) + (7 + (1 + 1) + (7 + 1)) + (7 + 1) + (7	9 4 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6	9979 1111 1111 1111 1111 1111 1111 1111	6 6 6 7 7 7 7 7 8 6		
GU TU 200 1 F(Y(T=1),EG,Y(T) ,AND, Y(T),EG,Y(T+1)) GU TU 180 A2 = (2,*X(T)+X(T+1)) / (X(T)+1)+X(T+1))*(X(T)-X(T+1))) A3 = (X(T)-X(T+1)) / (X(T+1)-X(T+1))*(X(T)-X(T+1))) A3 = (X(T)-X(T+1)) / (X(T+1)-X(T+1))*(X(T))) A3 = (X(T)-X(T+1)) / (X(T+1)-X(T+1))*(X(T))) / (X(T)) / (X(T+1)) /	0000000 000000000000000000000000000000	010000000000000000000000000000000000000			
	<pre>GU TU ZOO A1 = (X(T)=X(I+1)) / (X(L)=LQ=Y(I+1)) GU TO 180 A1 = (X(T)=X(I+1)) / ((X(L-1)=X(I))*(X(T-1)=X(I+1))) A2 = (2=*X(I)=X(I+1)=X(I=1)) / ((X(L)=X(T+1))*(X(I)=X(I+1))) A3 = (X(T)=X(I=1)) / ((X(I+1)=X(I=1))*(X(I+1)=X(I+1))) A5 = (X(T)=X(I=1)) / (X(I+1)=X(I=1))*(X(I+1)=X(I+1))) A5 = (X(T)=X(I=1) + A2*Y(I) + A3*Y(I+1))</pre>	0 DYDX(I) = 0. 0 continue 1f(mer ,eg, 0) return Dn 300 t=1.NPX	0 DYDX(I) = DYDX(2*I=1) Return End		

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	SUBROUTIVE OTPT	1910	001
4	SUBDOUTTINE OTOT		V M 0 C 0 C
ľ	DUTPUT THE RESULTS OF THE B. L. CALGULATIONS		200 000
		0177	002
	COMMON NX, NP NPH, JI, IT, NRVP, LSP, NPM1, JII, JIM1, NIC, NXT, NXW, NAM	0101	000
-	l "TITLE(15)	0101	007
	COMMON LG16,1 G17,LG18,LG32,LG40	urpt	000
	1 / IGOL, IGOT, IGOM, IGON, IGCV, TGEG, IGNP, IGRC, IGTR	0101	600
	COMMON /HEADR/ CASE, IPAGE	0101	010
	COMMON/BLC1/F(100,2),U(100,2),V(100,2),ETA(100),PELETA(100)	01P1	022
	COMM <u>n</u> n/BLC3/XI(100),XS (100),ETAINF(100),BETA(100)	DIPT	012
	COMMON/BLC5/EM(100,2),EDV(100,2),E(100,2),EB(100,2),VPRT(100)	0107	013
	COMMCN/BL12/TI,RMI,UI,RI,PR,PRT,FK,RL,RMUI,RMOI,PSI,ME	0101	014
	,000,000,000,000,0000,0000,0000,0000000	0101	015
	Z , , BR(100), TE(100), RMNE(100), RMUE(100), GW(100), GPW(100)	0101	016
	3 "RFI(100)"RF2(100)"YS (100)"IGXI(100)"FPW(100)"ROL(100)	0707	017
	COMMON /BLI4/ RX1, RTM1, CF0,CF1,CF2,CF3UM0,CFSUM,	07P7	610
-	1 THETA(100),DELS(100),FPPM(100)	1410	610
	COMMON /BL16/ NTYPE, IOUT	OTPT	020
	COMMON /BL17/ RX(100), CFA(100), CF(100), ETAE(100), CD1(100), ST(100),	OTPT	021
	1 INP(100)	OTPT	022
	CCMMON/BL19/C(100,2),G(100,2),GP(100,2),	0101	023
	1 RMD(100), RMU(100), TVCT(100)	0101	020
	COMMUN/RADIUS/ ROMAX	0101	025
	DIMENSION Y(100)	0101	026
		0101	027
		0101	020
		0101	020
	IF (TOUT , NE, 0) GO TO 900	1410	020
	IPRT = (NP+18)/30	0101	031
	IF(NP .LT. 30) IPKTEL	0101	032
		0101	033
	UEUI = UE(NX)/UI	0101	034
	THETA(NX) = A. A second s	0797	033

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038 039 040 042 043 045 046 048 049 0540055 036 037 041 044 047 056 058 059 062 065 0 6 S 068 090 061 063 1064 067 0690 010 0197 0101 0101 0101 OTPT 0191 OTPT 0101 0101 0101 1910 0191 1410 0107 0707 0101 0797 OTPT 0101 1910 OTPT 0101 OTPT 0101 0101 0101 0191 0101 0791 07PT UTP1 0101 1dlu *F(1,2) * \ (1 ° \) * KUL (N X) - F(JINP,2)) *UF(NX)*ROL(NX)) SUM1 = SUM1 + (F1+F2)/2,*0FLETA(J=)) + F(1,2) RTHETA = RX(NX)*THETA(NX)/XS(NX) CF(NX) = SGRT(2,/XT(NX)) + RMUI TUMA/(XX)=XS(NX)×RHU]×CE(NX)/AMUI IF(XI(NX) *EQ* 0*) . GO TO 300
A1 = SORT(2**XI(NX))/(RHUT 。 0 11 $F_{2} = U(J, 2) * (1, 0 + U(J, 2))$ DELS(NX) = AI*(ETAE(NX) ő SURTICE (NX)/2.) H = DELS(NX)/THETA(NX) CF(NX) = ABS(CF(NX)) CFSUM " THETA(NX) # SUM1*A1 CF1 FTAE(NX) = ETA(NP) V(1,2) 4NIC 2=5 06 00 DEISTNX) = 0. IF(NX .EQ. 1) IF(NX .EG. 1) $CFA(NX) = 0_{e}$ ST(NX) = 0. RTHETA = 0. ိ ő •0 ŧŧ ő INP(NX) INP dN = dNIC SUM2 E 0. • * FPPw(NX) SUH1=0.0 CONTINUE 11 11 6 CF(NX) F3=1.0 F1=0. F1=F2 YPI US 1101 US USTUE USTUF • 0 || I 06

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610 003 0 8 ¢ 085 080 007 000 680 060 200 093 990 095 960 008 660 C O J NO 0 0 50 240 074 016 110 010 080 092 160 510 520 100 16 C 0 120 0197 0191 0797 1410 1410 1910 0191 0101 OTPT 0101 0191 1910 0101 0101 DTPT OTPT 0101 0101 0101 0101 0101 0101 0101 1910 0101 1910 1910 0101 0101 1910 WRITE(6,2100) (CF1+CF2)*(YS(NX)=YS(NX=1))*.5 CFSUM=CFSUM + (CF1+CF2) + (YS(NX)+YS(NX+1))+_5+R GO 70 420 IF(XI(NX=1) °EQ, 0,) CFSUM = 2,47HETA(NX) CFA(NX) = CFSUM / (YS(NX)-YS(1)) IF(NX .EQ. 1) CF1=CF(NX)+UEUI+UEUI+RQ(NX) IF(XT(HX=1) .EQ. 0.) CFSUM=2.4THETA(NX) CF1 = CF(NX) #UEUL#UEUT SUMY = SUMY + (F1+F2)/2,*DFLET&(J=1) GO TO 400 IF(LG32 FU.1 & AND, IGXI(NX), FQ.0) CFA(NX)=CFSUM + 2. /(ROMAX+ROMAX) IF((UG32.EQ.0.0R.IGX1(NX).NE.0)) IF(LG32 .EQ. 2) #RITE(6,2150) CF2=CF(NX)*UFU1*UEU1*R0(NX) IF(LC .LT. LCMAX) GO TO 340 1.0) GO TO 200 T = 1 + ((J=1)/[PRT)*[PRT IF(J.NF.I . AND. J.NE.NP) GO TO 300 IF(J .EQ. 1) GO TO 350 IF (NX "EQ" 1) GO TO 300 CFP = CF(NX) *UEUI*UEUT WATTE (6, 2000) NX, YS (NX) ¢ = CFSUM «FQ. 1) 00 400 J≡1 NP FZEL . / TVCT(J) ٩ ۲ ۵ و 30 9 0 CALL HEAD CFI = CF2 GU TR 300 LCMAX=42 CONTINUE CF1=CF2 SUMY = Fla1.0 CFSUM LC=60 TFONX TFINX 7 F (F K LCal 340 300 250 200

123 132 108 109 1 2 4 115 110 8 61 120 122 124 126 128 106 101 011 212 44 44 14 130 521 134 135 136 9000 9000 900 2 200 39 140 0TPT 1910 07970 1910 0107 0107 0101 OTPT 1410 Idlù OTPT 0101 01PT 1010 TPT 0101 1910 0101 1910 0101 1910 0107 LdLU 0101 0101 141U 0101 0101 0101 0101 UTPT 1970 1970 1410 D P P T WRITE(6,3200) NX,XS(NX), IHETA(NX), DELS(NX),CF(NX),V(1,2),GW(NX) WRITE(6,4200) I,XS(I),THETA(I),DELS(I),CF(I),FPPW(I),GW(I),INP(I) Write(6,4250) YS(I), RX(I),RTHETA, H, CFA(I),GPW(I),S1(I),FTAE(I) WRITE(6,3250) YS(NX), RX(NX),RTMETA, H, CFA(NX),GPW(NX),ST(NX) 1 J. ETA(J), F(J, 2), U(J, 2), V(J, 2), Y(J), YPI US, UPLUS, FDV(J, 2) GO TO 800 YPLUS = Y(J) *UE(NX) *RHOE(NX) *USTUE/RMUF(NX) IF(LSP "EQ. 1 "AND, NX "GT. 1) NXENX-1 700 IF(LG32,EQ.1 ,ANP, IGX1(NX),EQ.0) Wrttf(6,3000) RTHFTA = XX(J) * THE TA(I) / XS(I) 0,) GN TU 950 60 TU 370 TFULC .LT. LCMAX) 60 TO 940 IF(IOUT , EQ, 0) GU TO 1800 H = DELS(I)/THFTA(I) $UPIUS = U(J_s)/USTUE$ TITLE TFrustue , Fo, 0,) DO 1000 I=1, NX SUMYAA1 WRITE(6,3500) IF(XI(I) .FQ. WRITE(6,6060) WRTTE (6,4000) WRTTF(6,4000) CALL HEAD RTHFTA=0. CAIL HEAD 400 CONTINUE LCMAX=45 CONTINUE LC=LC+1 88 Y(J) 。 11 11 LC=1 LC=1 420 0 0 0 0 800 370 006 020 070 () = = = = = = =

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Adl()

	L CæL C + 3	0101	5 (7 5
0001	CONTINUE	0101	142
	DD 1003 I#1, NX	0101	
1003	DEI S(I)=DELS(I)/RL	1910	1 44
		1410	5 0
	WRITE(2) (DELS(K), KEL,NX)	0101	146
υ	THE CALCULATION OF THE BASE DRAG IS DONE AT THIS POINT USING	1910	147
υ υ	A METHID GIVEN IN MOERNERS# BOOK ON AERODYNAMIC DRAG	0101	89
	TECROCNA) "LT" ROMAA) GO TO 1010	0191	67I
	CDRASE= 029/SGRT(CFA(NK))	0101	150
	6g fn 1020	0191	1 1 1 1
0101	CFAGECFA (NX)	0107	222
	CDBASE= 029*(RO(NX)/ROMAX)**3/SURT(CFAB)	0101	153
1020	WRITE(6,1030) CDBASE	1910	5 5 5
1030	FORMATCINO, 77M THE BASE DRAG FOR THIS CONFIGURATION BASED ON THE	0191	5
·	(MAXIMUM FRONTAL ARFA IS = FI5_R)	0101	156
1800	RETURN	0191	151
• 0 • •	Ð 8-	0101	150
2000	FORMAT(IM '3X, 11MSTATION NO_ 13, 30X, 5HS/C =, F12, 6 /)	0101	1 59
2100	FORMATCIMO.ZX, IMI, 7X, 3META, LIX, LMF, 14X, 2MFP, 14X, 3MFPP, 14X, 14Y, 14X,	1410	160
	I SHYPLUS, 12X, SHUPLUS, 12X, 4HEPS+ /)	OTPT	161
2150	FORMATCIMO, 2X, 1HI, 7X, 3HETA, 21X, 1HF, 14X, 2HFP, 14X, 3HFPP, 11X,	0101	162
	L 7HY/THETA,9X,5MPPLUS,12X,5HUPLUS,12X,4HEP8+, /)	DIPT	163
2200	FORMATCENDOZX, IMI, 7X, 3META, 21X, 1MF, 14X, 2MFP, 14X, 3MFPP, 14X, 1MY, 12X,	0101	160
	L GMW/WE JPX 5H WP J2X GHEPS+ /)	1910	165
2300	FORMATCIMORZY, 1MIRTA SHETA IN VING 14X 2HGP 14X 2H YRIX Y 13X 4H I	DIPT	166
	L IAX, 4M PRT, 12X, 2MMU, 14X, 2MM ,/)	0701	167
2400	FORMATCIMO, 2X, 1MI, 7X, 3META, 11X, 1MG, 14X, 2MGP, 11X, 7MY/TMFTA, 10X,	DIPT	168
	I QHT/TE,IIX,ION PRT , BX, GHMU/MUE,IOX, 4MM/ME, /)	0797	169
3000	FORMATCIMO// 7X, 1MN, 12X, 4M S ,13X, 5HTHETA, 12X, 4MDELS, 14X, 2MCF,	1910	170
	I Lax, GHFPPW, IAX, ZHGW, /IM ,5X, 3HX/C, I2X, ZHRX, I3X, 6HRTHETA, 14X	07970	171
	2 "IHH, ISX, 3HCFA, 14X, 3HGPU, 14X, 2HST, /)	0797	172
3200	FORMATCIM /1H .IT. 4X, 6E17.6)	0101	173
3250	FÜRMATCIH "FII"5"6E17°6)	0101	174
3500	FORMAT(IM "42X" 14HOUTPUT SUMMARY 1544/)	1910	573

07 P T

3HX/C,12X,2HRX,13X, 0TP
W, 14X, 2HST, 14X, 6HETATNF, 1) OTPT
1 d L O
1 d l U
0177
1410 01PT
01PT

- N M 0 0 0 0 0 0 002 004 100 FURMAT(1H1,/1H "ZX"6H CASE "A4"21X"51H***** CEBECI-KELLER BOUNDAR 1Y LAYER PROGRAM ******* 23X " 13HPROGRAM K99A) COMMON /HEADR/ CASF, IPAGE WRITE (6,100) CASE IPAGE = IPAGE + 1 SURROUTINE HFAD SURROUTINE HEAD RETURN END 發發 ບບບ

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MEAD

SMOT

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001C	0 0 2 C	1200	0 0 A	005	000	007	008	000	010	110	210	013	014	្លា	010	017	018	610	020	021	022	023	024	025I	0260	027					5
SMO1	SMOT	SMOT	SMOT	SMOT	SM01	SMOT	SMOT	SM01	LCMS	SM07	0 MO1	SMOT	SMOT	SMO1	SM01	SMOT	SMOT	SMOT	SMOT	SMOT	0 MO1	SHOT	SMOT	SMOT	SMOT	SMOT					
UVERIAY(AXSY 66.0)	PRICEAM SMOUTH	SUBROUTINE SMODTH	· · · · · · · · · · · · · · · · · · ·	THIS SUBROUTINE CONTROLS THE SMOOTHING OF THE INPUT COORDINATES	我长去长天天天天天天天天天天天天天天天天天天天天天天天天天天天天天天天天天天天	DIMENSION X(100), Y(100), XU(100), YO(100)	REWIND	REWIND 10	READ(5,1) NPTS "ITAPE	IF(ITAPE .NE. 0) GO TO 5	READ(5,2) (X(I),I=1,NPTS)	READ(5,2) (Y(I), I=1, NPTS)	GO TD 7	5 READ(1) (X(1),I=1,NPTS)	READ(1) (Y(1), T=1, NPTS)	7 CONTINUE	CALL SM5PT(X,Y,XO,YU,NPTS)	WRITE(10,10) (XO(I), I=1, NPTS)	WRTTF(10,10) (YO(I), I=1, NPTS)	REWIND 10	1 FORMAT(214)	2 FORMAT(6F10.0)	O FURMAT(6F10,6)	RETURN	EN CONTINUE						

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	SURRUUTINE SM5PT (XI,YI,X0,Y0,N)	LSWS LSWS	1 C 0 C
	TUIS DIVISTING HER STAF SPITMIN & DOINT SMONTAING METHOD A 7 DOINT		
۔ ں ر	METHOD TS USED AT THE END POINTS.	SM57	, 9 0 0 0 0 0
υ		SMST	002
	DIMENSION XI(1), YI(1), XU(1), YU(1)	SMST	000
J		SMST	001
ں د		L S S S S S S S S S S S S S S S S S S S	000
	2 H 7	S N N N	000
		S N U	010
	(I+C)IX = (I+C	SAS1	0 2 2
	(I+C)IA ≅ (I+C)UA	5 X 3 1	~10
	XO(J) = 0,25*(XI(J=1) + 2,0*XI(J) + XI(J+1))	SMST	810
	YO(J) = 0,25*(YI(J+1) + 2,0*YI(J) + YI(J+1))	SMST	010
	IF (I "FQ, 1) GO TO 20	SMST	510
		S M J L	016
		SNST	017
	G0 T0 10	SMST	018
ບ		SMST	019
N	0 CONTINUE	SMST	020
	N2 1 N 1 2N	SMOT	120
	DO 30 J=3/N2	SNST	022
	x((2+)]X=(1+f)IX+0°7+(f)IX+0°0+(1-f)IX+0°7+(Z=f)IX=) = (f)UX	SMST	023
	1 0 0625	SMST	020
ዞ ግ	0 YO(J) = (~YI(Jm2)+4°0*YI(Jm1)+10°0*YI(J)+4°0*YI(J+1)#YI(J+2))*	P S N S I	025
	1000625	S M S I	026
د د		SMS	027
	RETURN	SMST	020
	END	SMST	029

SNST

SMST

ITRT

	UVERLAY (AXSY, 7, 0)	LTRI	0010
	PRNGRAM TIFRAT	ITRT	0020
ι.	SURRINTINE ITERAT	IAT	1200
	nIMENSION S(100),DELLS(100),X(100),Y(100),SURF(100),SINAL(100),	I C I I	004
	1 COSAL(100),SMD(100),DFLSTR(201),TSINAL(201),TCOSAL(201),	T X T I	002
	2 XNEW(100), YNEW(100) , DESU(100)	TRT	006
	REWIND 15	ITRI	007
	REWIND 2	ITRT	008
0	SURFACE DISTANCES FROM BOUNDARY LAVER TNPUT	ITRT	600
	READ(2) N	ITRI	010
	READ(2) (S(1), 1#1, N) and a second	ITRT	110
6.3	BOUNDARY LAYER DISPLACEMENT THICKNESS	ITRI	012
	READ(2) NN	ITRI	210
	READ(2) (DELLS(1),I=1,NN)	INI	014
e 1	THIS DO LOOP IS USED IN CASE THE BOUNDARY LAYER DOES NOT	IRI	012
£ >	CALCULATE A COMPLETE BOUNDARY DISPLACEMENT THICKNESS ARRAY	1181	016
£ 3	DUE TO TURBUIENT BUUNDARY LAYER SEPARATION	ITRT	110
	DO 10 TANNAN	ITRT	018
	10 DELLS(1) = DFLLS(NN)	ITRT	019
<i>e</i> 1	THE COURDINATES OF THE TRANSFORMED BODY ARE READ IN AT THIS POINT	ITRI	020
	READ(15) NTS	1911	021
	READ(15) (X(1),I=1,NTS)	1101	220
	READ(15) (Y(1), I=1, NTS)	141	023
	THE SURFACE DISTANCE OF THE INPUT BODY COORDINATES ARE CALCULATED	ITRT	024
	SURF(1)=0,0	1121	0 2 2 2
	DO 30 I=2,NTS	ITRT	026
	DESURF#SGRT(rx(I)=X(I=1))**2+(Y(I)=Y(I=1))**2)	ITAT	027
	30 SURF(I)=DESURF+SURF(I=1)	ITRT	028
	S(N)=SURF(NTS)	1011	029
6 3	NDTE S(I) IS DURFACE DISTANCE FROM LEADING EDGF TO TRAILING EDGE	ITATI	030
٤ ٢	BASED ON COORDINATES ASSOCIATED WITH THE BOUNDARY LAYER SOLUTION	I T R I	120
a >	SURF(1) IS SHRFACE DISTANCE FROM LEADING EDGE TO TRAILING FDGE	ITRT	032
6 3	BASED ON THE X AND Y COURDINATES OF THE TRANSFORMED ORIGINAL	T R T	M M O
¢ . 1	BODY AT WHICH THE VALUE OF DISPAACEMENT THICKNESS IS TO BE ADDED		7 L 7 C
	NEXT THE CUSINE AND SIN OF THE LUCAL SURFACE ANGLES		5

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047 053 063 046 040 040 055 056 058 02:0 090 062 064 065 035 137 038 039 040 042 500 004 045 020 250 053 050 057 190 990 067 170 -a-TRT TRT 121 ITRT TRT ITRY TRT 141 ITRT ITRT 1911 1011 TRT TRT T A L 101 IRT TRT 1471 TRT ITRT 181 ITRT ITRT TATI TRT ITRT TRT TRI 1971 ITRT SIN AND COSINE MERE IS MODIFIED TO ACCOUNT FOUND AND Y CUURDINATES THE SURFACE LISTANCE CORRESPONDING TO FACH OF THESE S AND Y ARE PESU(I)=SuHT((X([+1)=X(I))**2+(Y([+1)=Y(J))**2) SHD (NTSMM) = SHD (NTS) + . 5 + (SURF (NTS) - SURF (NTSM)) SMD([+1) = SMD([)+.5*(SURF([+1)=SURF([-1)) DISPLACEMENT THICKNESS AT THE VALUES OF IF SEPARATION HAS OCCURRED, THE BODY × TABLE1 (NTSMM, SMD, SINAL, TSINAL) TABLE1 (NTSMM, SMD, COSAL, TCNSAL) CALL INSI (SURFF, DELSTR, DELST, 1, NER) SINAL([+1) = (Y([+1)-Y([))/DESU(I) CDSAL([+1) = (X([+1)-X(1))/DESU(I) INSI (SURFF, TSINAL, SINU, 1, NER) INSI (SUPFF, TCOSAL, COSU, 1, NEP) THF NEW CUTRDINATES ARE FURMED HERE MIDPUTNTS OF TABLE1 (N, S, DELLS, DELSTB) PATRS ARE CALCULATFD HERE XNFW(1) = X(1) = DFL(S(2))YAFW(I)=Y(I)+DELST*COSU COSAL (NTSMM)=COSAL (NTS) XNFW(I)=X(I)=DF(S1*SINU SINAL (NTSMM)=SINAL (NTS) SINAL(1) = SINAL(2) COSAL(1) = CPSAL(2)SMD(2)=°5×SURF(2) 4 H E DO 50 1=2,NTSM 00.40 T=1,NTSM D() 60 I=1,NTS SURFF=SURF(I) FUUND AT NTSAM=NTS+1 SMD(1)=0.0 NTSM=NTS=1 CALL CALL CALL CALL CALL ARE

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SEPARATION BUBBLE

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FOR THIS BY ADDING A CIRCULAR RADIUS

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	X N F W P H X N F W C N N P N P N P N P N P N P N P N P N P	TRT	071
	XNFW3#XNFW(NN+1)	ITRT	220
	YNFW # YNFW (NN=3)	ITRI	073
		T R T	074
	Y NE Z MAY NE Z (NE Z)	ITRT	075
	CALL CIRCLE(XNFW1, XNFW2, XNFW3, YNFW1, YNFW2, YNFW3, RADIUS, XCENT,	ITAT	076
	I YCENT, DYDX)	1911	110
		ITRT	078
	DO 70 I=NNN,NTS	ITRT	010
	DELTA=X(I)-XCENT	ITRI	080
	IF(DFLTA "GE、 O。) KM=I	ITRT	081
	IF(DELTA GE 0, GOTO 90	ITRT	082
	YCIR¤(RADIUS **2 = DFLTA **2)	ITRT	083
	IF(DYDX "GE, 0,) GO TO 65	TRT	084
	YNEW(I)#YCENT=SQRT(YCIR)	TATI	085
	CO TO TO	ITRI	080
65	YNFW(I)=YCENT+SGRT(YCIR)	ITRI	087
70	CONTINUE	TRT	088
	GO TO 80	ITRT	089
00	CONTINUE	1411	060
	DO 100 I=KM, PVTS	1911	091
00	Y NEW (I) HY NEW (KM®1)	ITRT	092
80	CONTINUE	ITRT	093
	IF THE BODY RADIUS BECOMES EDUAL TO THE DISPLACEMENT THICKNESS AT	ITRT	094
	SOME POINT THEN THE NEW BODY IS MODIFIFD TO KEEP THE SAME AREA	1781	560
	DUE TO THE DISPLACEMENT THICKNESS	ITRI	960
	NXSL=NTS/2	ITRT	160
	DO 105 K=NXSL, NTS SAT	TRT	098
	DYNEWSYNEW (K) = Y (K)	1471	660
	IF(DYNEW "GE" Y(K)) KSL=K=2	TRT	100
	TF(DYNFW .GE, Y(K)) G() T() 110	TRT	101
50	CONTINUE	ITRT	102
	GQ TN 115	TRT	50 ¥
10	DAREA#3。14159*(YNE%(KSL)**2#Y(XSL)**2)		104
	DO 112 I=KSL "NTS	TATI	507

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		ARFA=3.14159*Y(I)*Y(I)+DARFA	TRT	106
æ.	n F	YNEW(1)=SQRT(AREA/3.14159)	TAT	107
. 62		WRTF(6.4)	TAPI	108
,	•	WRTF(6.5) (XNEW(I), YNEW(I), [Z], NTS)	191	109
		XNEW AND YNEW ARE THE VISCOUS CUORDINATES WHICH SHOULD BE WRITTEN	ITRT	011
		ON TAPE AND TRANSFERRED TO THE SMODTHING ROUTINE	ITRT	8-4 8-4
1		REWIND	ITRT	212
		WRITE(1) (XNFW(1),141,NTS)	ITRT	200
		WRITE(1) (YNEW(1), IH1, NTS)	TRT	122
	4	FORMAT(1H , 10%, 4HXNEW, 20%, 4HANFW)	1911	512
	ſ	FDRMAT(2F20.R)	TRT	116
	•	RETURN	ITRT	11
		END	ITRT	18

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ROUTINE INSI UT INTO ARRAYS				
LE) LE(201) FOR INPUT TO SUB F X AND Y TO RE PU	·			
URROUTINE TABLEI(N,X,Y,TAB IMENSION X(100),Y(100),TAB HIS ROUTINE SFTS UP TABLES TS THE NUMBER OF VALUES ON E? O 200 I=1,N ARLE(J)=X(I) ARLE(J)=X(I) ARLE(J)=X(I) ARLE(J)=X(I) ARLE(J)=N ONTINUE ARLE(I)=N	ND ND			
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600 100 003 002 000 100 008 010 - N M 3 L 9 M 80 0 - N M 3 M N N N N N N C C O O O O O 026 025 020 000 CIRC CIRC CIRC CIRC CIRC CIRC CIAC CIRC CIRC CIRC CIRC CIRC CIRC CIRC (X1. X2. X3. Y1. Y2. Y3. R. XCENT. YCENT. DYDX) E1=(XY1=XY2)*(X2=X3)=(XY2=XY3)*(X1=X7) F2=(Y1=Y2)*(X2=X3)=(Y2=Y3)*(X1-X2) D=((XY2-XY3)=E*(Y2=Y3))/(X2=X3) 0 ? DYDXE=(X3=H)/(Y3=CENTK) 0 RUSORT (NaH+CENTKAA20F) CC=C*(1°+DYDXS)**1.5 IF(DYDX "GE" 0°) GU XCFNT=X3+R*SIN(PMI) YCENT=Y3+K*COS(PHI) XCENT=X3+R*SIN(PMI) YCENT=Y3=R*COS(PHI) X Y 3 8 8 ( X 3 * X 3 * Y 3 * Y 3 SURROUTINE CIRCLE CAACAANXACX) - II CAX lAslas (xs [ X ) = = | A X Faxy1-Dax1-Eav1 XQYDXS=DYDX*DYDX DDVDX=ABS(DVDX) PHI=ATAN(DDYPX) CFNTK==E/2ª CC=ABS(CC) GU TO 30 CONTINUE E=F1/E2 H2=0/2. Cal./R RETURN E N N

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FIGURE 1. COORDINATE SYSTEM FOR THE BOUNDARY LAYER ON A BODY OF REVOLUTION



FIGURE 2. EDDY-VISCOSITY DISTRIBUTION ACROSS A BOUNDARY LAYER



FIGURE 3. COORDINATES FOR AXIALLY SYMMETRIC BODY WITH THICK BOUNDARY LAYER



FIGURE 4. EFFECT OF TRANSITION REGION MODIFICATION ON THE SKIN FRICTION



FIGURE 5. TRANSITION CORRELATION CURVE FROM REFERENCE 32



FIGURE 6. COMPARISON OF EXPERIMENTAL AND CALCULATED TRANSITION LOCATIONS FROM VARIOUS METHODS FOR FAVORABLE GRADIENT FLOWS



FIGURE 7. FLOW DIAGRAM OF COMPUTER PROGRAM FOR AXISYMMETRIC ANALYSIS AND DESIGN METHOD (ADAM)



FIGURE 8. SCHEMATIC DIAGRAM OF CYLINDRICAL WAKE SHAPE USED TO MODEL SEPARATION



FIGURE 9. PRESSURE DISTRIBUTION FOR SPHERE IN SUPERCRITICAL REGION USING CYLINDRICAL SEPARATION MODEL



FIGURE 10. SCHEMATIC DIAGRAMS OF CIRCULAR ARC FAIRING USED IN THE MODEL FOR SEPARATED FLOW.



FIGURE 11 AXISYMMETRIC BASE DRAG AS A FUNCTION OF FOREBODY SKIN FRICTION COEFFICIENT



FIGURE 12 COMPARISON OF BASE DRAG CALCULATED BY ADAM TO EXPERIMENTAL DATA



FIGURE 13. SCHEMATIC OF HIGH FINENESS RATIO BODY FROM REFERENCE 35



FIGURE 14. HIGH FINENESS RATIO BODY AND SIMULATED TUNNEL USED IN POTENTIAL FLOW PROGRAM TO ACCOUNT FOR WALL EFFECTS ON PRESSURE DISTRIBUTION



FIGURE 13. EFFECT OF WIND TUNNEL WALLS ON INVISCID PRESSURE DISTRIBUTION FOR HIGH FINENESS RATIO BODY AS CALCULATED BY POTENTIAL FLOW PROGRAM



FIGURE 14. COMPARISON OF CALCULATED "VISCOUS" PRESSURE DISTRIBUTION FOR HIGH FINENESS RATIO BODY TO EXPERIMENTAL DATA



FIGURE 15. EQUIVALENT BODY INCLUDING SEPARATED WAKE USED TO CALCULATE "VISCOUS" FLOW ABOUT SPHERE IN SUPERCRITICAL REGIME



FIGURE 16. COMPARISON OF CALCULATED "VISCOUS" PRESSURE DISTRIBUTION FOR SPHERE IN SUPERCRITICAL REGIME TO EXPERIMENTAL DATA



FIGURE . EFFECT OF "VISCOUS" MODELING ON CALCULATION OF LOCAL SKIN FRICTION COEFFICIENT FOR SPHERE IN SUPERCRITICAL REGIME



FIGURE 17. EQUIVALENT BODY INCLUDING SEPARATED WAKE USED TO CALCULATE "VISCOUS" FLOW ABOUT SPHERE IN SUBCRITICAL REGIME



FIGURE 18. COMPARISON OF CALCULATED "VISCOUS" PRESSURE DISTRIBUTION FOR SPHERE IN SUBCRITICAL REGIME TO EXPERIMENTAL DATA



FIGURE



* U.S. GOVERNMENT PRINTING OFFICE: 1975-635-049 / 69



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