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ROTOR WAKE EFFECTS ON HUB/PYLON FLOW. VOLUME II. PROGRAM SHAPES--ETC(U)

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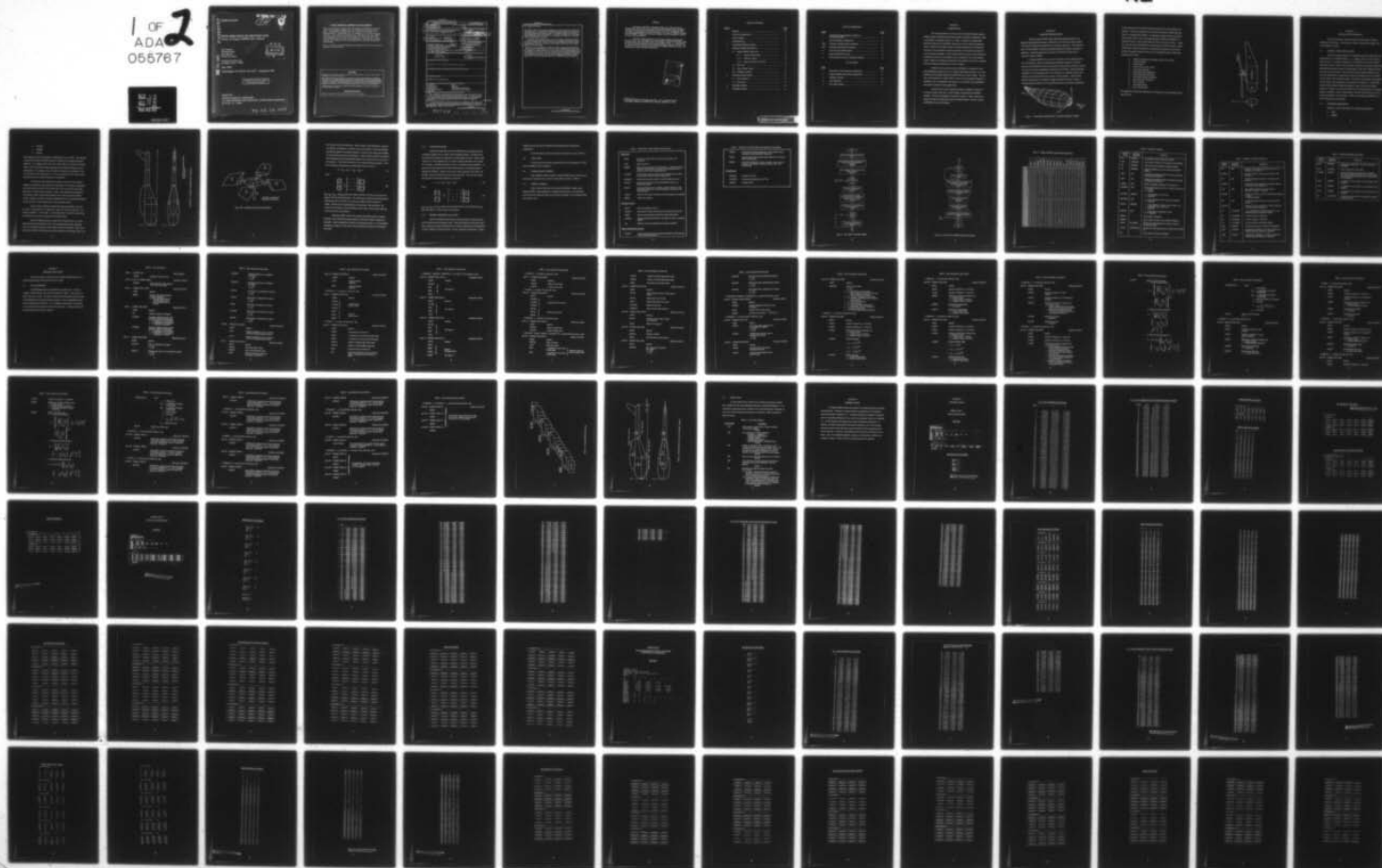
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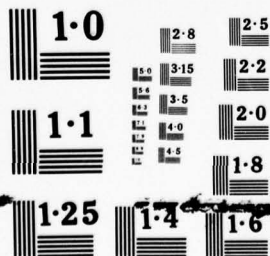
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ROTOR WAKE EFFECTS ON HUB/PYLON FLOW
Volume II, Program SHAPES User's Manual

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May 1978

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APPLIED TECHNOLOGY LABORATORY
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APPLIED TECHNOLOGY LABORATORY POSITION STATEMENT

This report presents a method for determining aerodynamic characteristics of helicopter shapes under the influence of the main rotor wake. The method is considered to be worthy of publication for dissemination of information and the stimulation of further related research. The reader is cautioned that this method does not predict flow separation as the title would imply, nor does the rotor wake fully impinge upon the body of the helicopter. The method is useful, however, as a design tool in determining rotor-fuselage aerodynamic interference.

Mr. F. A. Raitch of the Aeromechanics Technical Area served as project engineer for this effort.

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20. Abstract (Continued)

formulation is valid for fully unsteady aerodynamics, this report is mainly concerned with rotor aerodynamics. A potential flow aerodynamic program, SHAPES, with suitable rotor wake representation was developed to predict the separation characteristics of arbitrary three-dimensional helicopter configurations. In particular, the effect of the rotor blade wake, blade shank wake, and hub wake in the separation of the flow over a lifting helicopter in forward flight is analyzed.

The present method has potential application in the design of helicopters because it provides an analytical capability which can be used to develop low-drag profile as well as to explore problem areas. Extensive numerical results obtained from Program SHAPES demonstrated the flexibility and accuracy of the method. These results are in excellent agreement with existing data.

Volume II, The User's Manual, describes the structure and use of Program SHAPES. SHAPES is written in FORTRAN IV for operation on the CDC 6600 digital computer system at the Applied Technology Laboratory, U.S. Army Research and Technology Laboratories (AVRADCOM), Fort Eustis, VA. The User's Manual (Volume II) contains detailed information for preparing an input data deck and interpreting the computed data; a discussion of various subroutines, flow charts, common storage and definition of FORTRAN variables; sample cases to illustrate the program output; and a FORTRAN listing of the program.

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PREFACE

This report, prepared by Aerospace Systems, Inc. (ASI), Burlington, Massachusetts, for the U.S. Army under Contract DAAJ02-75-C-0041, documents the results of research performed during the period June 1975 to September 1977. The study was sponsored by the Eustis Directorate, U.S. Army Air Mobility Research and Development Laboratory,* Fort Eustis, Virginia, with Mr. Frederick A. Raitch serving as Technical Monitor.

The effort was directed by Mr. John Zvara, President and Technical Director of ASI. Mr. Paul Soohoo served as Principal Technical Staff Member under the supervision of Mr. Richard B. Noll, Vice President of ASI. Dr. Luigi Morino, Director of Computational Continuum-Mechanics Program at Boston University, and Dr. Norman D. Ham, Director of the V/STOL Technology Laboratory at MIT, contributed to the study as Principal Consultants.

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SECTION 1

INTRODUCTION

This volume describes the structure and use of a digital computer program, SHAPES, Subsonic Helicopter Aerodynamic Program with Effects of Separation, which was developed by Aerospace Systems, Inc. (ASI), to analyze the incompressible potential aerodynamics of helicopter configuration with rotor wakes and separation effects. Volume I of this report contains a complete description of the theoretical formulation and corresponding numerical procedure for the aerodynamic method for use in the computer program. It also includes extensive numerical results showing the flexibility and accuracy of the method as well as comparison with several existing results. Proper use of SHAPES is predicated on the assumption that the user is familiar with the techniques and limitations set forth in Volume I.

SHAPES is written almost entirely in FORTRAN IV for operation on the CDC 6600 digital computer system at the Applied Technology Laboratory, U.S. Army Research and Technology Laboratories (AVRADCOM), Fort Eustis, Virginia. The program was developed with a highly modular structure for ease of program checkout, to simplify the user's understanding of the program, and to facilitate any modifications that might be required for future applications.

Sections 2 and 3 contain programming details of SHAPES: functions of the various routines, flow charts, common storage, and definition of FORTRAN variables. The use of the program is presented in Section 4. Sample cases are presented in Section 5 to illustrate the output of Program SHAPES. Section 6 contains the FORTRAN listing of the program.

SECTION 2

COMPUTER PROGRAM SHAPES

Computer program SOUSSA (Steady Oscillatory Unsteady Subsonic and Supersonic Aerodynamics) discussed in Subsection 2.2 of Volume I has been modified to include rotor dynamics and separation from hub/pylon components. The revised program is called SHAPES, for Subsonic Helicopter Aerodynamic Program with Effects of Separation. Geometry preprocessor for single-rotor helicopter configurations is included in Program SHAPES.

In Program SHAPES the user need not be familiar with the aerodynamic portion of the program, unlike other sophisticated aerodynamic programs in which the choice for the combination of various aerodynamic functions (sources, doublets, vortices) is an art which requires considerable understanding of the method. Another advantage of SHAPES is that the paneling used for the aerodynamics is completely arbitrary and, therefore, may coincide with the one used for structural analysis. A typical finite element representation of a helicopter fuselage configuration is shown in Figure 1. The aerodynamic paneling can be accomplished manually by inputting the coordinates

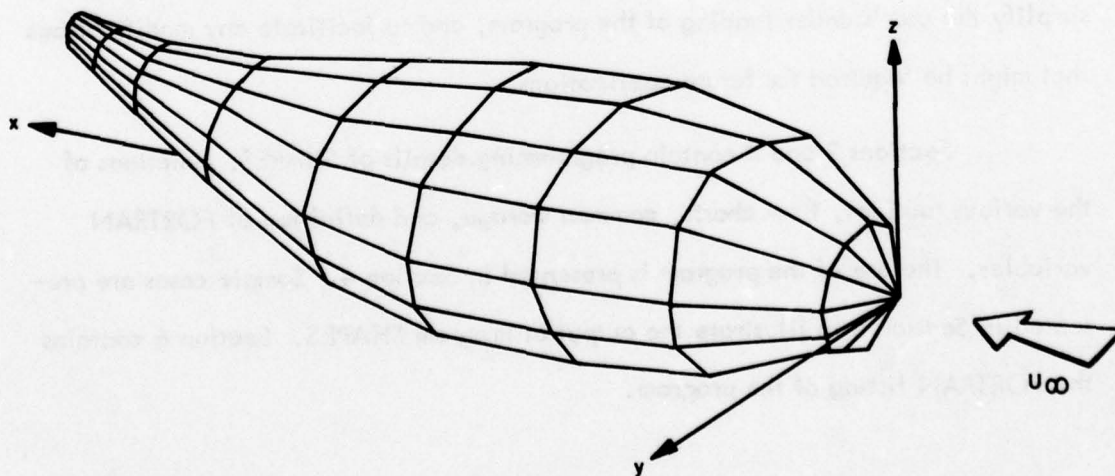


Figure 1. Finite Element Representation of Arbitrary Helicopter Fuselage.

of the corner points of all selected aerodynamic panels or by using a geometry preprocessor. A geometry preprocessor for conventional helicopter configurations (see Figure 2) is incorporated in SHAPES. The fuselage is assumed to have an elliptical center section with the nose and tail approximated by elliptical paraboloids. An ellipsoidal element is used to approximate the rotor hub and pylon sections. In addition, the rotor shaft and blade shank are represented by cylindrical sections. Given the helicopter configuration geometry, the preprocessor computes the corner point locations of required aerodynamic panels for the complete helicopter configuration. Required inputs include:

- Shape and dimensions of fuselage, pylon, shaft, and hub
- Number of blades
- Rotor diameter
- Extent of root cutout or shank
- Cross-section of shank
- Rotor blade airfoil designation
- Rotor blade chord distribution
- Rotor blade thickness distribution
- Rotor blade twist distribution
- Rotor tip speed
- Freestream velocity
- Rotor wake geometry

This capability eliminates the requirement for the selection of the aerodynamic paneling by the user.

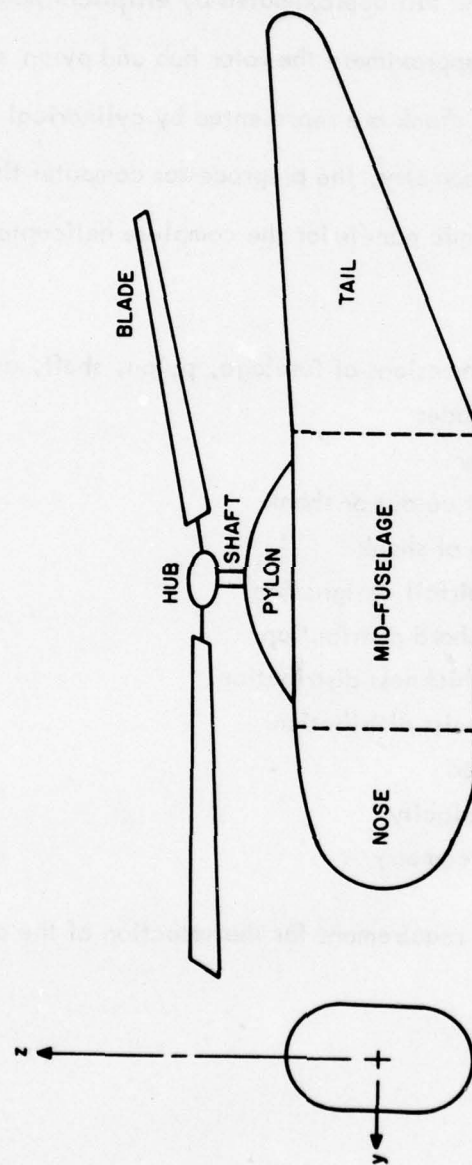


Figure 2. Typical Helicopter Configuration.

SECTION 3

PROGRAM SHAPES DESCRIPTION

This section contains a brief description of the organization of Program SHAPES and its subroutines, a flow diagram, a table of common block storage, and a list of FORTRAN variables.

3.1 PROGRAM SHAPES ORGANIZATION

The present computer program for incompressible potential aerodynamics with separated flow for a complete helicopter, i.e., fuselage, pylon, and rotor, contains three main parts: (1) geometric preprocessor, (2) coefficient matrix, and (3) pressure distribution and force. Based on data provided, the geometric preprocessor automatically generates the aerodynamic panels for the helicopter as well as the numbering and location of the panel corner points in the reference Cartesian (global) coordinate system. The matrix coefficients are determined by evaluating the doublet and source integrals over the surface of the aerodynamic panels. This yields N simultaneous linear equations with N unknown velocity potentials at the centroids of N elements. A standard IBM subroutine GELG (Gaussian elimination method) is used to solve for the unknown potentials. To obtain a continuous distribution for the velocity potential, an averaging scheme is introduced. Hence, the perturbation velocities and the pressure at the centroid of each element can be evaluated. Finally, the aerodynamic coefficients, i.e., lift and induced drag, are computed.

3.1.1 GEOMETRIC PREPROCESSOR

Presently, five main subroutines form the geometric preprocessor:

- DATA
- PREPRO

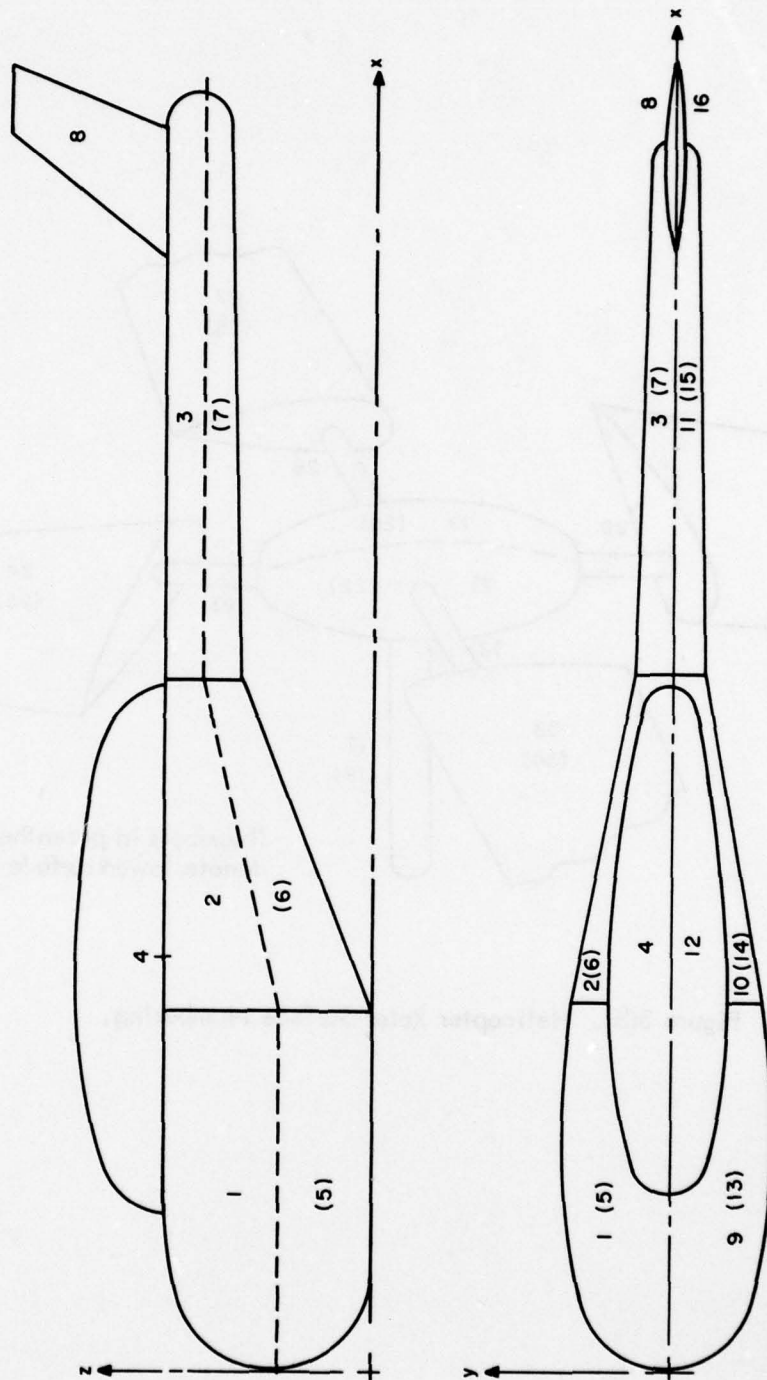
- COODPT
- GEOMET
- VEC123

Basic geometric inputs of the problem are defined by the user in DATA. This subroutine automatically generates the global subsurface numbering of the complete helicopter geometry; i.e., fuselage, pylon, shaft, hub, shank, blade, and vertical tail sections. Figure 3 shows the subsurface global numbering for the helicopter fuselage and rotor configurations. One important input for DATA is the number of the elements in the x and y directions for each subsurface, IS. This input controls the total number of aerodynamic panels used to model the geometry of the problem.

The variation of the element sizes (uniform or nonuniform finite element breakup) is another basic input parameter to the program. In the present investigation, particular attention must be paid to the flow field in the vicinity of the rotor shaft, pylon, hub, and upper fuselage elements. Hence, small elements are prescribed for the hub/pylon region, whereas larger elements can be used on the lower fuselage section. Moreover, the local curvilinear coordinates ξ and η are automatically defined so that the normal to each surface panel is always directed outward.

Finally, DATA automatically defines the parameter KWAKES, which has the value 1 if the subsurface, IS, generates a wake and a value of 0 otherwise. For example, KWAKES = 1 on the pylon. A vortex-layer wake is assumed to emanate from the separation point and this is represented as a doublet layer.

Subroutine PREPRO generates a nodal function NOFCT (IXY, IS), which relates the local nodal numbering, IXY, with the required global nodal numbering. Next, the Cartesian coordinates of these nodes is obtained by COODPT. Basic inputs required for COODPT are the shape and overall dimensions of the fuselage, pylon, and



(Numbers in parentheses denote lower surface.)

Figure 3(a). Helicopter Fuselage Surface Numbering.

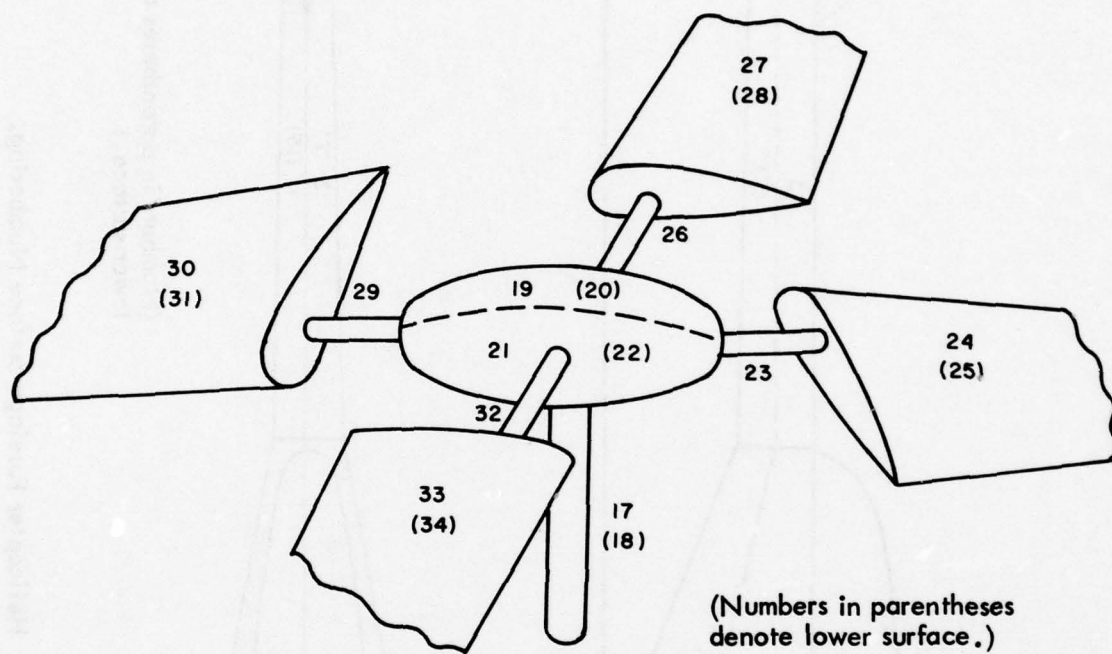


Figure 3(b). Helicopter Rotor Surface Numbering.

hub sections, blade-twist distribution, blade thickness, chord distribution, number of rotor blades, rotor diameter, and extent of root cutout (shank). Subroutine GEOMET automatically generates a parameter NODE as a function of the corner point ICORNR for each aerodynamic panel of the helicopter. Finally, VEC123 completes the geometry of the aerodynamic panel (hyperboloidal element) that contains the four corner points of the element. This results in continuity of the complete helicopter geometry. Note that the equation that represents a hyperboloidal element is given by

$$\bar{P} = \bar{P}_0 + \bar{P}_1 \xi + \bar{P}_2 \eta + \bar{P}_3 \xi \eta \quad (1)$$

where

$$\begin{Bmatrix} \bar{P}_0 \\ \bar{P}_1 \\ \bar{P}_2 \\ \bar{P}_3 \end{Bmatrix} = \frac{1}{4} \begin{bmatrix} 1 & 1 & 1 & 1 \\ 1 & 1 & -1 & -1 \\ 1 & -1 & 1 & -1 \\ 1 & -1 & -1 & 1 \end{bmatrix} \begin{Bmatrix} \bar{P}_{pp} \\ \bar{P}_{pm} \\ \bar{P}_{mp} \\ \bar{P}_{mm} \end{Bmatrix} \quad (2)$$

$\bar{P}_{pp}$, $\bar{P}_{pm}$, $\bar{P}_{mp}$, and $\bar{P}_{mm}$ denote the Cartesian location of the four corner points and $\bar{P}_0$ gives the centroid of the element. This subroutine also performs the Prandtl-Glauert transformation and the rotation of the axis due to angle of attack and angle of sideslip. PRINTA writes the specifications of the problem, node coordinates, the centroid of each element, nodal numbering for each surface, and the nodal numbering of the corner points of the element.

Subroutine CHECK verifies if the maximum permissible number of elements along the x and y directions on each subsurface and the total number of elements are exceeded. Several compatibility conditions exist between the data. If an incompatible relationship is present, an error code will be printed and the execution of the program terminated.

3.1.2 COEFFICIENT MATRIX

Subroutine COEFF forms the matrix coefficients by evaluating the source and doublet integrals over the surface of the aerodynamic panels. The effect of the rotor wake and the presence of separation are automatically included. COEFF yields a system of N linear equations with N unknown velocity potentials at the centroid of N elements. SOLUTN calls GELG to solve N simultaneous linear equations. To obtain the velocity potential at the node of each element, an averaging scheme is employed by AVERAG. Using the value of the velocity potential at the nodes, PHI provides a continuous distribution of the velocity potential. Note that the equation that represents this continuous distribution is given by

$$\varphi = \varphi_0 + \varphi_1 \xi + \varphi_2 \eta + \varphi_3 \xi \eta \quad (3)$$

where

$$\begin{Bmatrix} \varphi_0 \\ \varphi_1 \\ \varphi_2 \\ \varphi_3 \end{Bmatrix} = \frac{1}{4} \begin{bmatrix} 1 & 1 & 1 & 1 \\ 1 & 1 & -1 & -1 \\ 1 & -1 & 1 & -1 \\ 1 & -1 & -1 & 1 \end{bmatrix} \begin{Bmatrix} \varphi_{pp} \\ \varphi_{pm} \\ \varphi_{mp} \\ \varphi_{mm} \end{Bmatrix} \quad (4)$$

φ_{pp} , φ_{pm} , φ_{mp} , and φ_{mm} denote the velocity potential at the nodal points and φ_0 gives the value of φ at the centroid of the element.

3.1.3 PRESSURE DISTRIBUTION AND FORCE

VELXYZ evaluates the perturbation velocity (Cartesian coordinate system) at the centroid of each aerodynamic panel. Subroutine CPLINR uses Bernoulli's equation to compute the pressure distribution at the centroid. PRINTB writes the distribution of sources, doublets, velocity potential, velocity, and pressure distribution. Finally,

FORCE evaluates the total lift coefficient and induced drag on the helicopter configuration.

A brief description of the main program and subroutines is given in Table 1.

3.2 FLOW CHART

In order to provide a general understanding of the overall program, the flow chart for SHAPES is shown in Figure 4.

3.3 COMMON BLOCK STORAGE

Most FORTRAN-related variables in Program SHAPES used by more than one subroutine are organized into a number of common blocks as shown in Table 2.

3.4 FORTRAN VARIABLES

Table 3 presents definitions of all principal FORTRAN variables used in Program SHAPES. Where appropriate, mathematical definitions are also indicated. The units of each variable are those used internally by SHAPES, and occasionally differ from the input units.

Table 1. Description of Main Program and Subroutines.

<u>Preprocessor</u>	
MAIN	Controls the logical flow of information supplied by the subroutines.
DATA	Reads input data.
PREPRO	Defines nodal numbering for the helicopter. (The surface of the helicopter configuration is divided into 34 subsurfaces with a maximum of four rotor blades permitted.)
COORDPT	Defines and/or reads in the Cartesian coordinates of the nodes on the surface of the helicopter configuration.
GEOMET	Defines the four nodal corners for each aerodynamic panel.
VEC123	Defines the equation of each hyperboloidal surface (i.e., aerodynamic panel).
PRINTA	Writes specification of the problem, nodal numbering for the helicopter configuration, nodal coordinates, and the centroid of the elements.
CHECK	Verifies if the maximum defined in the main program is exceeded.
DEBUG	Writes error message.
<u>Coefficient Matrix</u>	
COEFF	Forms the coefficient matrix.
SOLUTN	Calls GELG to obtain the perturbation aerodynamic potential.
GELG	Solves system of general equations by Gauss elimination.
AVERAG	Obtains potential distribution at the nodes by using an averaging scheme.
PHI	Defines a continuous distribution of velocity potential.
<u>Pressure Distribution and Force</u>	
VELXYZ	Evaluates the velocity (perturbation) distribution at the centroid of each aerodynamic panel.

Table 1. Description of Main Program and Subroutines (Concluded).

CPLINR	Evaluates the pressure distribution at the centroid of each aerodynamic panel (Bernoulli's equation).
FORCE	Evaluates the lift and induced drag coefficients on the helicopter configuration.
PRINTB	Writes the distribution of source, doublet, wake, velocity potential, perturbation velocities, pressure, lift, and induced drag.
<u>Miscellaneous</u>	
ASINH(X)	Evaluates $\sinh^{-1}(X)$.
ATANP(X)	Evaluates principal part of $\tan^{-1}(X)$.
LOG(X)	Evaluates $\ln(X)$.

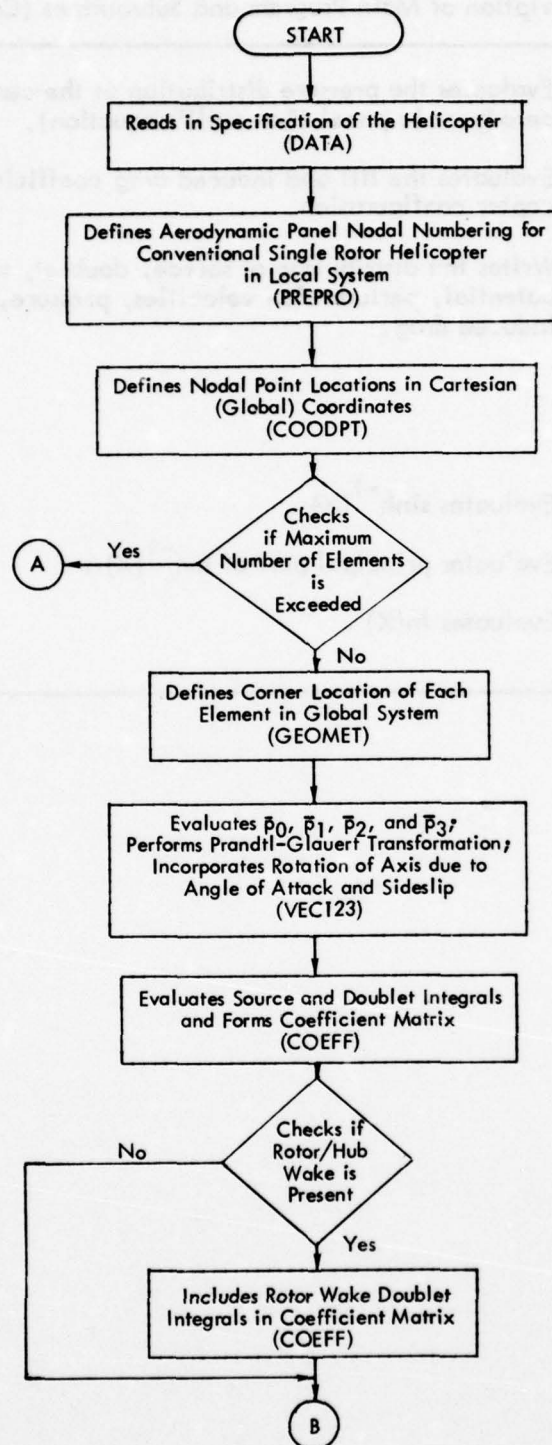


Figure 4. Flow Chart for SHAPES Program.

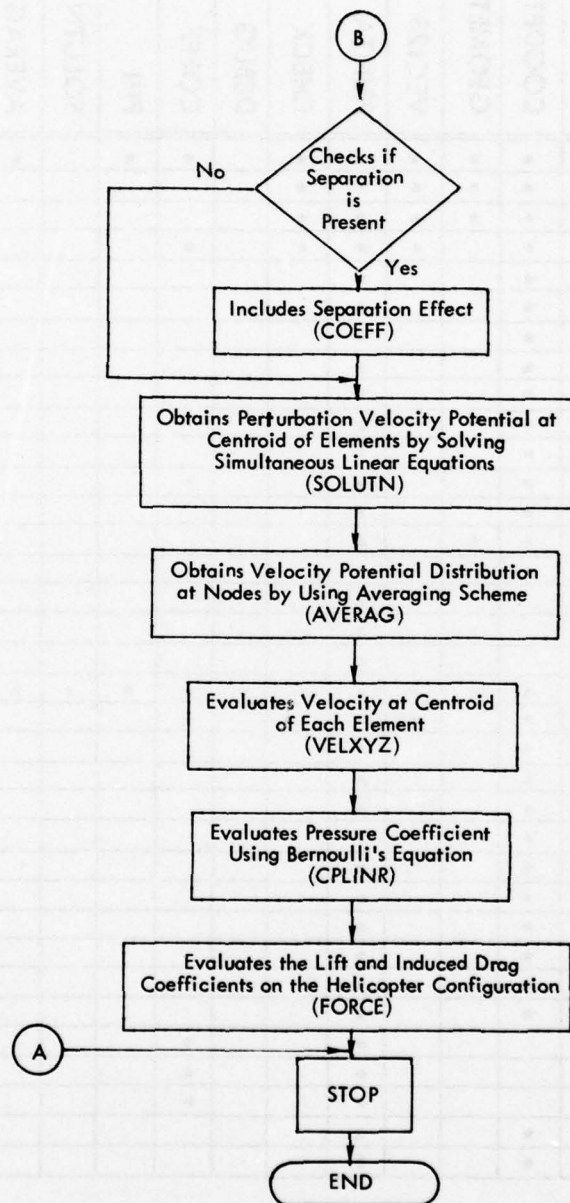


Figure 4. Flow Chart for SHAPES Program (Concluded).

Table 2. Program SHAPES Common Block Organization.

	MAIN	DATA	PREPRO	COORDPT	GEOMET	VEC123	PRINTA	CHECK	DEBUG	COEFF	PHI	SOLUTN	AVERAG	VELXYZ	CPLINR	FORCE	PRINTB
ZZZ1	*	*	*	*	*	*	*	*		*	*		*	*	*	*	*
ZZZ2	*	*	*	*	*	*	*	*									*
ZZZ3	*	*	*	*	*	*	*	*									*
ZZZ4	*	*		*		*	*	*		*						*	*
ZZZ5	*	*		*			*										*
ZZZ6	*	*		*			*										*
ZZZ7	*	*		*			*										*
ZZZ8	*	*		*			*										*
ZZZ9	*	*		*			*										*
ZZZ10	*	*		*			*										*
ZZZ11	*	*		*			*										*
ZZZ12	*	*		*			*			*							*
ZZZ13	*	*		*			*										*
ZZZ14	*	*		*	*		*										*
ZZZ15	*	*		*			*										*
ZZZ16	*	*					*										*
ZZZ17	*	*					*										*
ZZZ18	*	*					*										*
ZZZ19	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
ZZZ20	*	*		*		*	*			*							*
ZZZ21	*	*	*	*			*										*
ZZZ22	*	*		*			*										*
ZZZ23	*	*		*			*										*
ZZZ24	*	*		*			*										*
ZZZ25	*	*		*			*										*
ZZZ26	*	*		*			*										*
ZZZ27	*	*		*			*										*
ZZZ28	*	*		*			*										*
ZZZ29	*	*		*			*										*
ZZZ30	*	*		*			*										*
ZZZ31	*	*					*			*							*
ZZZ32	*	*					*			*							*
ZZZ33	*	*					*			*							*
ZZZ34	*	*		*			*										*
ZZZ35	*	*		*			*										*

Table 3. FORTRAN Variables.

Variable Name	Maximum Dimension	Definition
AA	(NESQ)	A coefficient matrix (stored columnwise).
AVG	(NNODE)	The number of elements surrounding the node INODE.
BC	(NELEM)	Downwash on the centroid of IELEMth element.
CP	(NELEM)	Pressure coefficient at the centroid of the IELEMth element.
HCSI	(11)	Defines the normalized nodal line locations along the x direction for surface IS.
HETA	(11)	Defines the normalized nodal line locations along the y direction for surface IS.
ISFACE	(NS)	Defines the global numbering of the surface IS.
KNORML	(NS)	Indicates the direction of the unit normal on surface IS. = 1 outward = -1 inward
KROTOR	(NELEM)	= 1 if the element is on the rotor = 0 otherwise
KROTORS	(NS)	= 1 if the subsurface is part of the rotor assembly = 0 otherwise
KWAKE	(NELEM)	= 1 if the element is in contact with a wake, i.e., rotor blade, hub, pylon, etc. = 0 otherwise
KWAKES	(NS)	= 1 if the surface IS generates a wake = 0 if otherwise
NELEM		Total number of elements.
NNODE		Total number of nodes on the surfaces considered.
NODE	(4,NELEM)	Defines the nodal numbering at the four corners of the element IELEM.
NOFCT	(NXYMP,34)	Defines the nodal numbering of the nodes on the surface IS.
NS		Total number of surfaces considered.

Table 3. FORTRAN Variables (Continued).

Variable Name	Maximum Dimension	Definition
NT	(34)	Subtotal of the number of elements up to, but not including, the surface IS.
NTMAX		Maximum number of elements permissible on the helicopter.
NX	(34)	Number of elements along the x direction of the surface IS.
NXMAX		Maximum number of elements permissible along the x direction on any subsurface.
NXV	(34)	Total number of elements on the surface IS [NXV(IS) = NX(IS) * NY(IS)]
NXYMP		Defines the maximum number of elements permitted on a surface = NXMAX*NYMAX
NY	(34)	Number of elements along the y-direction of the surface IS.
NYMAX		Maximum number of elements permissible along the y direction on any subsurface.
PC	(3,NELEM)	x,y,z coordinates of centroid of elements in the reference Cartesian coordinate system.
P1	(3,NELEM)	A vector along the ξ direction.
P2	(3,NELEM)	A vector along the η direction.
P3	(3,NELEM)	A vector normal to the element IELEM.
PHIC	(NELEM)	Velocity potential at the center of the element.
PHI1	(NELEM)	Interpolation coefficient - the local variation of velocity potential along the ξ direction.
PHI2	(NELEM)	Interpolation coefficient - the local variation of velocity potential along the η direction.

Table 3. FORTRAN Variables (Concluded).

Variable Name	Maximum Dimension	Definition
PH13	(NELEM)	Interpolation coefficient - the local variation of downwash.
SOR	(NNODE)	Velocity potential at the nodes.
SOURCE	(NELEM)	Source distributions at the centroids of elements. After calling subroutine GELG, this variable stores the velocity potential distributions at the centroids of the elements.
VELX	(NELEM)	x component of the velocity at the centroids of the elements.
VELY	(NELEM)	y component of the velocity at the centroids of the elements.
VELZ	(NELEM)	z component of the velocity at the centroids of the elements.
XK	(3,NNODE)	Coordinates of the nodes in the reference Cartesian coordinate system.

SECTION 4

PROGRAM SHAPES USAGE

This section contains a description of the Program SHAPES data input including program options and a description of error codes.

4.1 INPUT DESCRIPTION

All SHAPES data input is accomplished via punched cards. The input variables, required formats, and options are presented in Table 4. Some inputs may require more than one card. The number of input data cards required varies from case to case depending on the type of problem considered. Several compatibility conditions exist among some of the data. If an incompatible relationship is encountered, an error code will be printed and the execution terminated. A typical data setup for running multiple cases is shown in Figure 5.

Table 4. Input Description.

Data 1:	FORMAT (I5)	(Main Program)
	NCASE	Number of cases to be run
Data 2, 3, and 4:	FORMAT (20A4)	(Subroutine DATA)
	GG(20)	Name, location, date, description of job, and remarks
Data 5:	FORMAT (2A4, 10I5)	(Subroutine DATA)
	GG(2)	Remarks
	KREAD	Control code for the definition of nodal coordinates = 0 the coordinates will be defined automatically = 1 the coordinates will be read in
Data 6:	FORMAT (2A4, 10I5)	(Subroutine DATA)
	GG(2)	Remarks
	NS	Number of surfaces considered
	KSYMMY	Symmetry condition between left- and right-hand side of helicopter = -1 if geometry is antisymmetric = 0 if geometry has no symmetry = 1 if geometry is symmetric
	KSYMMZ	Symmetry condition between upper and lower surfaces of helicopter = -1 if geometry is antisymmetric = 0 if geometry has no symmetry = 1 if geometry is symmetric
Data 7:	FORMAT (2A4, 10I5)	(Subroutine DATA)
	GG(2)	Remarks
	NPYLON	Pylon is considered for analysis = 1 yes = 0 no
	NBODY1	Fuselage nose section is considered for analysis = 1 yes = 0 no

Table 4. Input Description (Continued).

NBODY2	Fuselage midsection is considered for analysis = 1 yes = 0 no
NBODY3	Fuselage tail section is considered for analysis = 1 yes = 0 no
NVTAIL	Vertical tail is considered for analysis = 1 yes = 0 no
NSHAFT	Rotor shaft is considered for analysis = 1 yes = 0 no
NHUB	Rotor hub is considered for analysis = 1 yes = 0 no
NSHANK	Blade shank is considered for analysis = 1 yes = 0 no
NBLADE	Rotor blade is considered for analysis = 1 yes = 0 no
Data 8:	FORMAT (2A4,10I5) (Subroutine DATA)
GG(2)	Remarks
KPYL1	Number of elements in the x direction of the mid-fuselage before the pylon
KPYL2	Number of elements in the x direction of the mid-fuselage after the pylon
Data 9:	FORMAT (2A4,7F8.3) (Subroutine DATA)
GG(2)	Remarks
UMACH	Freestream Mach number
OMEGA	Rotor rotational speed (rpm)
AREA	Reference area for evaluating aerodynamic coefficient

Table 4. Input Description (Continued).

Data 10: FORMAT (2A4,7F8.3) (Subroutine DATA)

GG(2)	Remarks
ALFA	Angle of attack (degrees)
BETA	Angle of sideslip (degrees)

If NPYLON = 1, use Data 11; otherwise, skip.

Data 11: FORMAT (2A4,7F8.3) (Subroutine DATA)

GG(2)	Remarks
XPYCTR	Coordinates of pylon's center
YPYCTR	
ZPYCTR	
RXPYL	Radii of pylon section
RYPYL	
RZPYL	

If NVTAIL = 1, use Data 12; otherwise, skip.

Data 12: FORMAT (2A4,7F8.3) (Subroutine DATA)

GG(2)	Remarks
VSPAN	Span length of vertical tail
XLEZV	x coordinate of vertical tail leading edge
XTEZV	x coordinate of vertical tail trailing edge
TANLEV	Tangent of leading edge sweep angle
TANTEV	Tangent of trailing edge sweep angle
TAUV	Thickness ratio of vertical tail
ZPV	Height of root chord of vertical tail with respect to global Cartesian coordinate system

Table 4. Input Description (Continued).

If $(N\text{BODY1} + N\text{BODY2} + N\text{BODY3}) \neq 0$, use DATA 13-16; otherwise, skip.

Data 13: FORMAT (2A4, 7F8.3) (Subroutine DATA)

GG(2)	Remarks
XNOSE	} See Figure 6
XBD1	
XBD2	
XTAIL	

Data 14: FORMAT (2A4, 7F8.3) (Subroutine DATA)

GG(2)	Remarks
YNOSE	} See Figure 6
YBD1	
YBD2	
YTAIL	

Data 15: FORMAT (2A4, 7F8.3) (Subroutine DATA)

GG(2)	Remarks
ZNOSE	} See Figure 6
ZBD1	
ZBD2	
ZTAIL	

Data 16: FORMAT (2A4, 7F8.3) (Subroutine DATA)

GG(2)	Remarks
RYBD1	} Radii of fuselage section
RZBD1	
RYBD2	
RZBD2	

See Figure 6

Table 4. Input Description (Continued).

If NSHAFT = 1, use Data 17; otherwise, skip.

Data 17: FORMAT (2A4,7F8.3) (Subroutine DATA)

GG(2)	Remarks
RSHAFT	Radius of rotor shaft
LSHAFT	Length of rotor shaft

If NHUB = 1, use Data 18; otherwise, skip.

Data 18: FORMAT (2A4,7F8.3) (Subroutine DATA)

GG(2)	Remarks
XHUBCR	} Coordinates of hub center
YHUBCR	
ZHUBCR	
RXHUB	} Radii of hub section
RYHUB	
RZHUB	

If NSHANK = 1, use Data 19; otherwise, skip.

Data 19: FORMAT (2A4,7F8.3) (Subroutine DATA)

GG(2)	Remarks
RSHANK	Radius of blade shank
LSHANK	Length of blade shank

If (NSHAFT + NHUB + NSHANK + NBLADE) $\neq$ 0, use Data 20-23; otherwise, skip.

Data 20: FORMAT (2A4,7F8.3) (Subroutine DATA)

GG(2)	Remarks
RROTOR	Blade tip radius
YCUT	Blade root cutout
XBLE	x coordinate of root chord leading edge
XBTE	x coordinate of root chord trailing edge

} Reference blade at azimuth angle of 90°

Table 4. Input Description (Continued).

TANBLE	Tangent of leading edge sweep angle
TANBTE	Tangent of trailing edge sweep angle
TAUBL	Thickness ratio of blade airfoil
Data 21: FORMAT (2A4,7F8.3)	(Subroutine DATA)
GG(2)	Remarks
THET75	Blade collective pitch at three-quarter radius
THET1C	Blade lateral cyclic pitch
THET1S	Blade longitudinal cyclic pitch
CONING	Blade coning angle
AZIMUTH	Blade azimuth angle (degrees)
Data 22: FORMAT (2A4,7F8.3)	(Subroutine DATA)
GG(2)	Remarks
RPITCH	Collective pitch angle at blade root (degrees)
TWIST	Blade twist (degrees)
Data 23: FORMAT (2A4,10I5)	(Subroutine DATA)
GG(2)	Remarks
KBLADE	Number of blades
ITWIST	Defines blade twist distribution
Data 24: FORMAT (2A4,10I5)	(Subroutine DATA)
GG(2)	Remarks
NWAKPY	Flow separation considered for analysis = 1 yes = 0 no

Table 4. Input Description (Continued).

NWAKHB	Rotor hub wake is generated for analysis = 1 yes = 0 no
NWAKSK	Blade shank wake is generated for analysis = 1 yes = 0 no
NWAKBL	Rotor blade wake is generated for analysis = 1 yes = 0 no

If (NWAKHB + NWAKSK + NWAKBL) $\neq$ 0, use Data 25; otherwise, skip.

Data 25: FORMAT (2A4,15,2F8.3) (Subroutine DATA)

GG(2)	Remarks
NSPIRAL	Number of elements along one rotor wake spiral
SPIRAL	Number of rotor wake spirals
UWAKE	Induced rotor velocity = $\sqrt{1/2 C_T} \Omega R$

If NWAKPY = 1, use Data 26-27; otherwise, skip.

Data 26: FORMAT (2A4,10I5) (Subroutine DATA)

GG(2)	Remarks
NSTAG	Vortex layer from separation line is considered for analysis = 1 yes = 0 no
NVORT	Isolated vortex (branch wake) is considered for analysis = 1 yes = 0 no

Data 27: FORMAT (2A4,7F8.3) (Subroutine DATA)

GG(2)	Remarks
CSTAG	Intensity of the vortex layer from separation line
CVORT	Intensity of the isolated vortex (branch wake)

Table 4. Input Description (Continued).

Data 28: FORMAT (2A4,10I5) (Subroutine DATA)

GG(2)	Remarks
KPRINT(I)	Output control code
	= 1 yes
	= 0 no
	I = 1 specification of the problem
	I = 2 nodal numbering of surfaces and corner nodal numbering of elements
	I = 3 Cartesian coordinates of the nodes
	I = 4 Cartesian coordinates of the centroids of the element
	I = 5 coefficient matrix AA
	I = 6 source integrals
	I = 7 velocity potential distributions
	I = 8 perturbation velocity distributions
	I = 9 pressure coefficients
	I = 10 lift and induced drag coefficients

If NBODY1 = 1, use Data 29; otherwise, skip.

Data 29: FORMAT (2A4,10I5) (Subroutine DATA)

GG(2)	Remarks
NX(KS)	Number of elements in x direction
NY(KS)	Number of elements in y direction
KNSELE	Define the variation of element size
	= 0 define by input
	= 1 uniform along x direction
	= 2 quadratic along x direction
KNSSH	Defines nose shape
	= 1; $r = R [\xi]^{1/2}$
	= 2; $r = R [\xi]^{1/3}$
	= 3; $r = R [\xi]^{1/4}$
KNSTYP	Defines nose type
	= 1 circular cross section
	= 2 elliptical cross section

Table 4. Input Description (Continued).

If NBODY2 = 1, use Data 30; otherwise, skip.

Data 30: FORMAT (2A4,10I5)

(Subroutine DATA)

GG(2)	Remarks
NX(KS)	Number of elements in x direction
NY(KS)	Number of elements in y direction
KBDELE	Defines the variation of element size = 0 define by input = 1 uniform along x direction = 2 quadratic along x direction
KBDSHP	Defines the fuselage shape = 1 cylindrical
KBDTYP	Defines the fuselage type = 1 circular cross section = 2 elliptical cross section

If NBODY3 = 1, use Data 31; otherwise, skip.

Data 31: FORMAT (2A4,10I5)

(Subroutine DATA)

GG(2)	Remarks
NX(KS)	Number of elements in x direction
NY(KS)	Number of elements in y direction
KTNELE	Defines the variation of element size = 0 define by input = 1 uniform along x direction = 2 quadratic along x direction
KTNSHP	Defines aft-body shape = 1; $r = R\sqrt{\xi}$ = 2; $r = R[\xi]^{1/3}$ = 3; $r = R[\xi]^{1/4}$
KTNTYP	Defines aft-body type = 1 circular cross section = 2 elliptical cross section

Table 4. Input Description (Continued).

If NPYLON = 1, use Data 32; otherwise, skip.

Data 32: FORMAT (2A4,10I5) (Subroutine DATA)

GG(2)	Remarks
NX(KS)	Number of elements in radial direction
NY(KS)	Number of elements in circumferential direction
KPYELE	Defines the variation of element size = 0 define by input = 1 uniform element distribution along radial and circumferential direction = 2 quadratic along radial direction with uniform element distribution in circumferential direction
KPYSHP	Defines pylon shape = 1 elliptical
KPYTYP	Defines pylon type = 1 elliptical

If NVTAIL = 1, use Data 33; otherwise, skip.

Data 33: FORMAT (2A4,10I5) (Subroutine DATA)

GG(2)	Remarks
NX(KS)	Number of elements in x direction
NY(KS)	Number of elements in y direction
KVTELE	Defines the variation of element size = 0 define by input = 1 uniform element distribution along axial and spanwise direction = 2 nonuniform (quadratic) element distribution along axial and spanwise direction = 3 quadratic along spanwise direction with uniform element distribution in axial direction = 4 quadratic along axial direction with uniform element distribution in spanwise direction

Table 4. Input Description (Continued).

KVTSHP

Defines vertical tail shape
= 1 circular biconvex airfoil

$$Z = \pm \left\{ \left[\frac{\left(\frac{c}{2}\right)^2 + \tau_{\max}^2}{2 \tau_{\max}} \right]^2 - \left[X - \frac{X_{LE} + X_{TE}}{2} \right]^2 - \left[\frac{\left(\frac{c}{2}\right)^2 - \tau_{\max}^2}{2 \tau_{\max}} \right] \right\}^{1/2}$$

= 2 define by following equation

$$Z = \pm \tau \left\{ \sqrt{\frac{X}{X_{TE} - X_{LE}}} \left(1 - \frac{X}{X_{TE} - X_{LE}} \right) \sqrt{1 - \frac{Y}{S}} \right\}$$

= 3 define by following equation

$$Z = \pm (4 \tau) (2 C_o) \left\{ \left(\frac{X}{X_{TE} - X_{LE}} \right) \left(1 - \frac{X}{X_{TE} - X_{LE}} \right) \sqrt{1 - \frac{Y}{S}} \right\}$$

Table 4. Input Description (Continued).

KVTSHP (Cont.)

where

c = chord length

X_{LE} = x components of sectional leading edge

X_{TE} = x components of sectional trailing edge

y = spanwise location of the section

S = half span

$$\bar{\tau} = \tau_{\max} \left(\frac{3}{4} \sqrt{3} \right) (2 C_o)$$

C_o = root chord

KVTYP

Define vertical tail type
= 1

If NSHAFT = 1, use Data 34; otherwise, skip.

Data 34: FORMAT (2A4,10I5)

(Subroutine DATA)

GG(2)

Remarks

NX(KS)

Number of elements in shaft direction

NY(KS)

Number of elements in circumferential direction

KSHELE

Defines the variation of element size
= 0 define by input
= 1 uniform element distribution

KSHSHP

Defines rotor shaft shape
= 1 cylindrical

KSHTYP

Defines rotor shaft type
= 1 circular cross section

Table 4. Input Description (Continued).

If NHUB = 1, use Data 35; otherwise, skip.

Data 35: FORMAT (2A4,10I5) (Subroutine DATA)

GG(2)	Remarks
NX(KS)	Number of elements in x direction
NY(KS)	Number of elements in circumferential direction
KHBELE	Defines the variation of element size = 0 define by input = 1 uniform element distribution
KHBSHP	Defines rotor hub shape = 1 elliptical
KHBTP	Defines rotor hub type = 1 elliptical

If NSHANK = 1, use Data 36; otherwise, skip.

Data 36: FORMAT (2A4,10I5) (Subroutine DATA)

GG(2)	Remarks
NX(KS)	Number of elements in shank direction
NY(KS)	Number of elements in circumferential direction
KSKELE	Defines the variation of element size = 0 define by input = 1 uniform element distribution
KSKSHP	Defines blade shank shape = 1 cylindrical
KSKTYP	Defines blade shank type = 1 circular cross section

If NBLADE = 1, use Data 37; otherwise, skip.

Data 37: FORMAT (2A4,10I5) (Subroutine DATA)

GG(2)	Remarks
NX(KS)	Number of elements in x direction

Table 4. Input Description (Continued).

NY(KS)	Number of elements in y direction
KBLELE	Defines the variation of element size = 0 define by input = 1 uniform element distribution = 2 nonuniform (quadratic) element distribution
KBLSHP	Defines rotor blade shape = 1 circular biconvex airfoil

$$Z = \pm \left\{ \left[\frac{\left(\frac{c}{2}\right)^2 + \tau_{\max}^2}{2 \tau_{\max}} \right]^2 - \left[X - \frac{X_{LE} + X_{TE}}{2} \right]^2 - \frac{\left(\frac{c}{2}\right)^2 - \tau_{\max}^2}{2 \tau_{\max}} \right\}^{1/2}$$

= 2 define by following equation

$$Z = \pm \tau \left\{ \sqrt{\left(\frac{X}{X_{TE} - X_{LE}} \right)} \left(1 - \frac{X}{X_{TE} - X_{LE}} \right) \sqrt{1 - \frac{r}{R}} \right\}$$

= 3 define by following equation

$$Z = \pm (4 \tau) (2 C_o) \left\{ \left(\frac{X}{X_{TE} - X_{LE}} \right) \left(1 - \frac{X}{X_{TE} - X_{LE}} \right) \sqrt{1 - \frac{r}{R}} \right\}$$

Table 4. Input Description (Continued).

KBLSHP (Cont.)

where

c = blade chord

X_{LE} = x components of blade leading edge

X_{TE} = x components of blade trailing edge

r = radial location

R = rotor radius

$$\bar{\tau} = \tau_{\max} \left(\frac{3}{4} \sqrt{3} \right) (2 C_o)$$

C_o = blade root chord

KBLTYP

Defines rotor blade type
= 1

If NPYLON = 1, use Data 38-39; otherwise, skip.

Data 38: FORMAT (10F8.3)

(Subroutine COODPT)

HCSI(IX)

Normalized x direction nodal line coordinates
[Note that HCSI(IX), IX = 1, NXP is implied with NXP denoting the number of nodal lines along the x direction]

Data 39: FORMAT (10F8.3)

(Subroutine COODPT)

HETA(IY)

Normalized y direction nodal line coordinates
[Note that HETA(IY), = 1, NYP is implied with NYP denoting the number of nodal lines along the y direction]

If NVTAIL = 1, use Data 40-41; otherwise, skip.

Data 40: FORMAT (10F8.3)

(Subroutine COODPT)

HCSI(IX)

Normalized x direction nodal line coordinates
[Note that HCSI(IX), IX = 1, NXP is implied with NXP denoting the number of nodal lines along the x direction]

Table 4. Input Description (Continued).

Data 41: FORMAT (10F8.3) (Subroutine COODPT)

HETA(IY) Normalized y direction nodal line coordinates
[Note that HETA(IY), IY = 1, NYP is implied
with NYP denoting the number of nodal lines
along the y direction]

If NSHAFT = 1, use Data 42-43; otherwise, skip.

Data 42: FORMAT (10F8.3) (Subroutine COODPT)

HCSI(IX) Normalized x direction nodal line coordinates
[Note that HCSI(IX), IX = 1, NXP is implied
with NXP denoting the number of nodal lines
along the x direction]

Data 43: FORMAT (10F8.3) (Subroutine COODPT)

HETA(IY) Normalized y direction nodal line coordinates
[Note that HETA(IY), IY = 1, NYP is implied
with NYP denoting the number of nodal lines
along the y direction]

If NHUB = 1, use Data 44-45; otherwise, skip.

Data 44: FORMAT (10F8.3) (Subroutine COODPT)

HCSI(IX) Normalized x direction nodal line coordinates
[Note that HCSI(IX), IX = 1, NXP is implied
with NXP denoting the number of nodal lines
along the x direction]

Data 45: FORMAT (10F8.3) (Subroutine COODPT)

HETA(IY) Normalized y direction nodal line coordinates
[Note that HETA(IY), IY = 1, NYP is implied
with NYP denoting the number of nodal lines
along the y direction]

If NSHANK = 1, use Data 46-47; otherwise, skip.

Data 46: FORMAT (10F8.3) (Subroutine COODPT)

HCSI(IX) Normalized x direction nodal line coordinates
[Note that HCSI(IX), IX = 1, NXP is implied
with NXP denoting the number of nodal lines
along the x direction]

Table 4. Input Description (Continued).

Data 47: FORMAT (10F8.3) (Subroutine COODPT)

HETA(IY) Normalized y direction nodal line coordinates
[Note that HETA(IY), IY = 1, NYP is implied
with NYP denoting the number of nodal lines
along the y direction]

If NBLADE = 1, use Data 48-49; otherwise, skip.

Data 48: FORMAT (10F8.3) (Subroutine COODPT)

HCSI(IX) Normalized x direction nodal line coordinates
[Note that HCSI(IX), IX = 1, NXP is implied
with NXP denoting the number of nodal lines
along the x direction]

Data 49: FORMAT (10F8.3) (Subroutine COODPT)

HETA(IY) Normalized y direction nodal line coordinates
[Note that HETA(IY), IY = 1, NYP is implied
with NYP denoting the number of nodal lines
along the y direction]

If KREAD = 1, use Data 50; otherwise, skip.

Data 50: FORMAT (3E12.4) (Subroutine COODPT)

XK(K,INODE) The nodal coordinates in global Cartesian system
[Note that (XK(K,INODE), K = 1,3), INODE = 1,
NNODE) is implied]

If NWAKPY = 1 and NSTAG = 1, use Data 51-54; otherwise, skip.

Data 51: FORMAT (3E12.4) (Subroutine COODPT)

YPP(K)

Data 52: FORMAT (3E12.4)

YPM(K)

Data 53: FORMAT (3E12.4)

YMP(K)

Data 54: FORMAT (3E12.4)

YMM(K)

The separation wake nodal coordinates
in global Cartesian system [Note that
K=1,3 is implied]

Table 4. Input Description (Concluded).

If NWAKPY = 1 and NVORT = 1, use Data 55-58; otherwise, skip.

Data 55: FORMAT (3E12.4)	}	(Subroutine COEFF)
YPP(K)		
Data 56: FORMAT (3E12.4)		
YPM(K)		
Data 57: FORMAT (3E12.4)	}	The isolated vortex branch wake nodal coordinates in global Cartesian system [Note that K=1,3 is implied]
YMP(K)		
Data 58: FORMAT (3E12.4)		
YMM(K)		

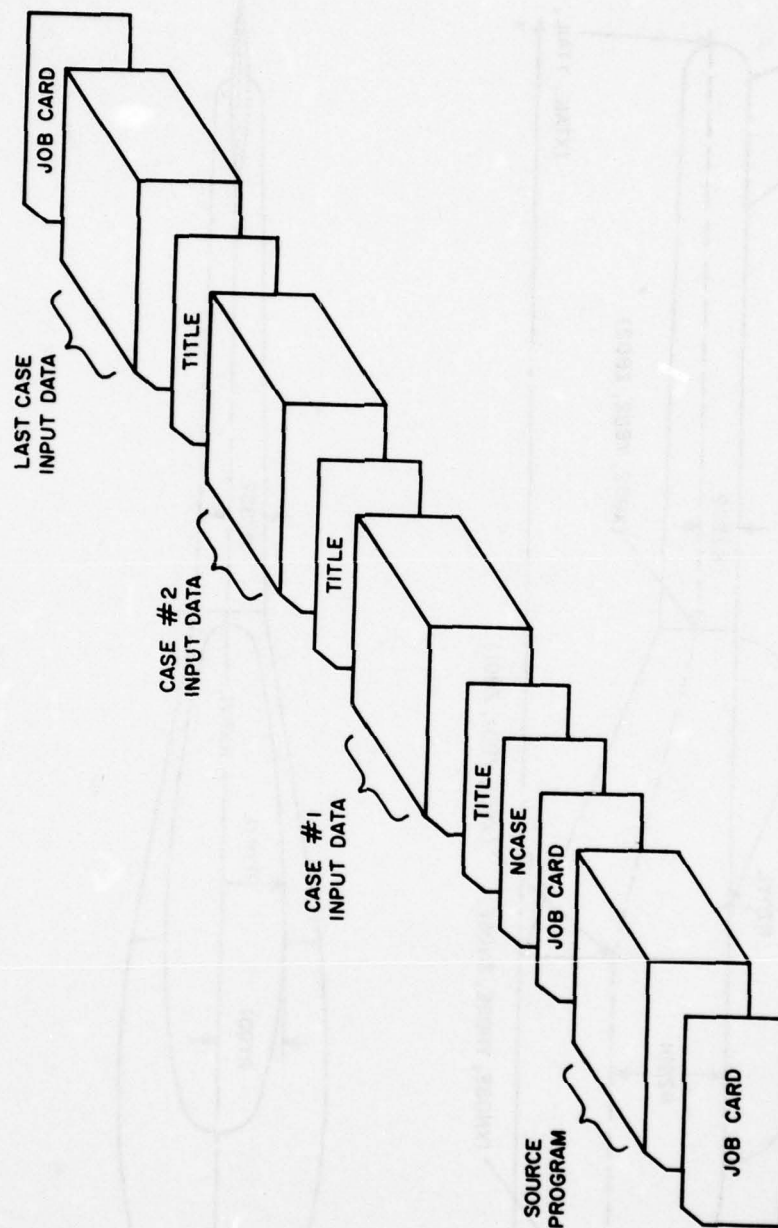


Figure 5. Program SHAPES Data Setup.

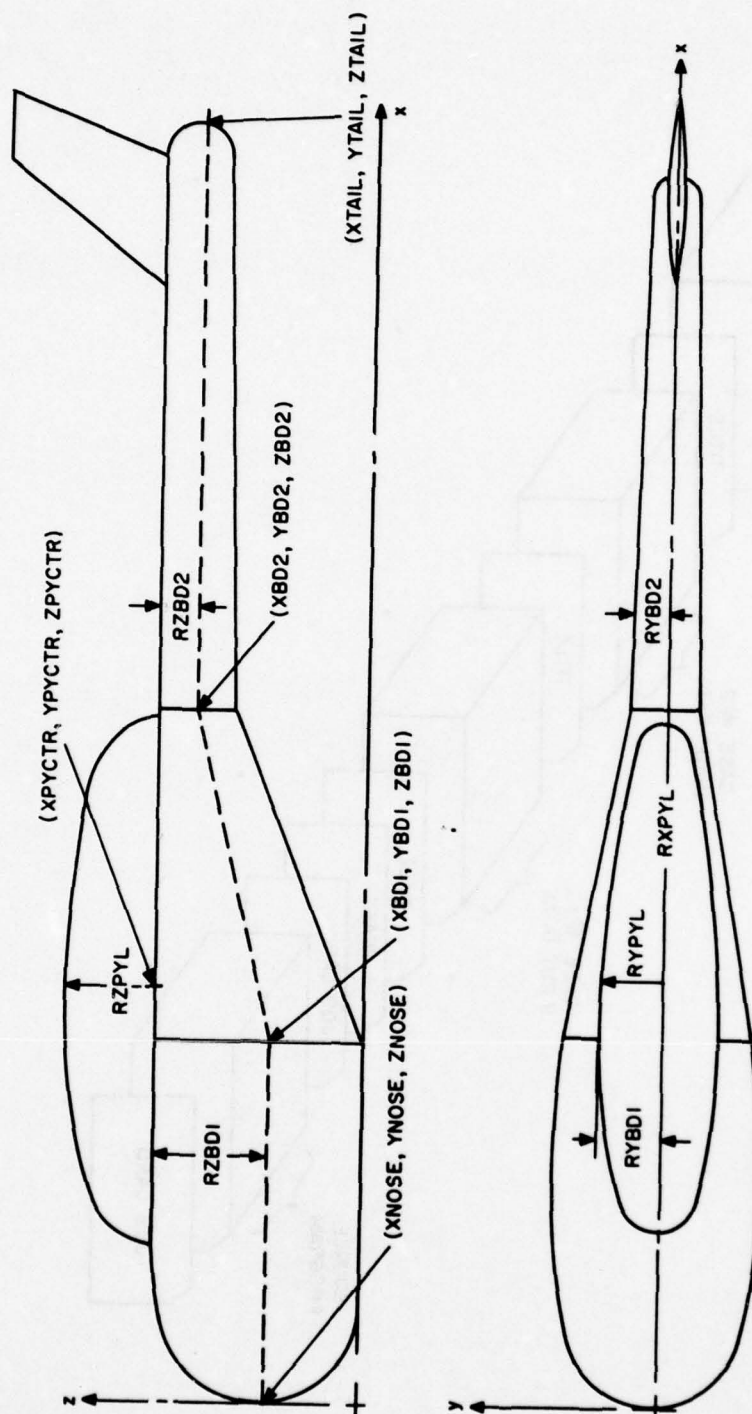


Figure 6. Basic Geometric Inputs for Helicopter Fuselage.

4.2 ERROR CODES

To insure proper data are read in and to minimize unnecessary computer time, SHAPES contains several debugging statements at specified checkpoints. If an inconsistency among input data or violation of the input specification is detected, an error code will be printed and the computer run terminated. Table 5 summarizes these error codes.

Table 5. Error Codes Summary.

<u>Code Number</u>	<u>Description</u>
100	Mach number is greater than 1 (Present SOUSSA is a subsonic program) (DATA)
200	$NS \neq (NPYLON + NVTAIL)*MULTY + (NBODY1 + NBODY2 + (NBODY3)*MULT*MULTY + (NSHAFT*MULTY + (NHUB*MULT*MULTY* + KBLADE*(NSHANK + NBLADE*MULT)$ (DATA)
300	Number of elements in the x direction of a sub-surface exceeds the maximum permissible value. This is limited by the storage capacity of the computer. The user has the option of changing the value of NXMAX and NYMAX defined in the main program. (DATA)
400	Same as code number 300 except for the y direction. (DATA)
500	Total number of elements required for analysis exceeds the maximum limit specified in the main program. (DATA)
IER	IBM subroutine GELG provides error code = 0 no error = 1 no result is obtained because the number of equations is less than 1 or the pivoting element at any elimination step equals 0 = N warning is indicated because of a possible loss of significant figures at elimination step N+1 where the pivoting element is less than equal to the specified tolerance times the magnitude of the greatest element of matrix A (DATA)

SECTION 5

PROGRAM OUTPUT

In Program SHAPES several output options are available and these are briefly summarized here. The amount of output required to be printed out is controlled by Data 28, described in Subsection 4.1. Among the information available is the specification of the problem defined by the user and the basic geometric inputs to the problem, i.e., overall dimensions and shapes used to model a helicopter configuration. In addition, the nodal numbering of the aerodynamic breakup as well as the Cartesian coordinate location of the nodal points and the centroid of each aerodynamic panel can be requested. Furthermore, the coefficient matrix and source distribution can be output. Also, the perturbation potential, velocity, and the pressure coefficient are available as outputs. Finally, the lift and induced drag can be requested.

SAMPLE CASE 1:
SINGLE-BLADE ROTOR

```

PROGRAM SHAPES
HUB PYLON FLOW SEPARATION
SINGLE RAYON BLANK PROFILE
READ      0
P         2   1   0
CO        0   0   0   0   0   0   0   0   1
CS        0   2
SWATCH    0.000  395.830
ALFA      0.000  1.600
COTOR     17.980  2.310  0.000  1.000  0.000  0.200  .000
INETSZ    0.620  4.020  5.660  10.200  20.600
RPITCHP   10.610  0.070
KELADE    0   1
WHAKE     1   0   0   1
SPFDEL    10  3.880  20.660
KNOWINT   1   1   1   1   1   1   1
KNOTORN   3   7   2   1   1

DATA

HELEN =  42

IS=  1 NI=  3 NY=  7 NTV= 21 ISPACE=  1 NI=  0 KNOPML=  1 KWAKES=  1 KROTORS=  1
IS=  2 NI=  3 NY=  7 NTV= 21 ISPACE=  2 NT= 21 KXANML= -1 KWAKES=  1 KROTORS=  1

PREPRO
NNODE= 46

```

FOR PAGE 24
NN= 3
NY= 7

FOR PAGE 25
NN= 3
NY= 7

MELEN= 62

KSYNNY= 1
KSYNNY= 2

49

X, Y, and Z Coordinates of the Nodes

NODE=	X	Y	Z
1	0.00000	2.33000	0.00000
2	.12025	2.33000	-.01163
3	.47803	2.33000	-.06234
4	1.06448	2.33000	-.19941
5	0.00000	6.35469	0.00000
6	.12025	6.35469	-.01163
7	.47803	6.35469	-.06234
8	1.06448	6.35469	-.19941
9	0.00000	9.76020	0.00000
10	.12025	9.76020	-.01163
11	.47803	9.76020	-.06234
12	1.06448	9.76020	-.19941
13	0.00000	12.54553	0.00000
14	.12025	12.54553	-.01163
15	.47803	12.54553	-.06234
16	1.06448	12.54553	-.19941
17	0.00000	14.71367	0.00000
18	.12025	14.71367	-.01163
19	.47803	14.71367	-.06234
20	1.06448	14.71367	-.19941
21	0.00000	16.26163	0.00000
22	.12025	16.26163	-.01163
23	.47803	16.26163	-.06234
24	1.06448	16.26163	-.19941
25	0.00000	17.19041	0.00000
26	.12025	17.19041	-.01163
27	.47803	17.19041	-.06234
28	1.06448	17.19041	-.19941
29	0.00000	17.50000	0.00000
30	.11630	17.50000	-.03269
31	.46818	17.50000	-.11491
32	1.06448	17.50000	-.19941
33	.11630	2.33000	-.03269
34	.46818	2.33000	-.11491
35	.11630	6.35469	-.03269
36	.46818	6.35469	-.11491
37	.11630	9.76020	-.03269
38	.46818	9.76020	-.11491
39	.11630	12.54553	-.03269
40	.46818	12.54553	-.11491
41	.11630	14.71367	-.03269
42	.46818	14.71367	-.11491
43	.11630	16.26163	-.03269
44	.46818	16.26163	-.11491
45	.11630	17.19041	-.03269
46	.46818	17.19041	-.11491

X, Y, and Z Coordinates of the Centroid of Aerodynamic Panels

ELEM=	XPC	YPC	ZPC
1	.06012	4.34235	-.00581
2	.29914	4.34235	-.03698
3	.77126	4.34235	-.13087
4	.06012	8.05745	-.00581
5	.29914	8.05745	-.03698
6	.77126	8.05745	-.13087
7	.06012	11.15337	-.00581
8	.29914	11.15337	-.03698
9	.77126	11.15337	-.13087
10	.06012	13.63010	-.00581
11	.29914	13.63010	-.03698
12	.77126	13.63010	-.13087
13	.06012	15.48765	-.00581
14	.29914	15.48765	-.03698
15	.77126	15.48765	-.13087
16	.06012	16.72602	-.00581
17	.29914	16.72602	-.03698
18	.77126	16.72602	-.13087
19	.05963	17.34520	-.00845
20	.29741	17.34520	-.04619
21	.77003	17.34520	-.13744
22	.05815	4.34235	-.01634
23	.29224	4.34235	-.07380
24	.76633	4.34235	-.15716
25	.05815	8.05745	-.01634
26	.29224	8.05745	-.07380
27	.76633	8.05745	-.15716
28	.05815	11.15337	-.01634
29	.29224	11.15337	-.07380
30	.76633	11.15337	-.15716
31	.05815	13.63010	-.01634
32	.29224	13.63010	-.07380
33	.76633	13.63010	-.15716
34	.05815	15.48765	-.01634
35	.29224	15.48765	-.07380
36	.76633	15.48765	-.15716
37	.05815	16.72602	-.01634
38	.29224	16.72602	-.07380
39	.76633	16.72602	-.15716
40	.05864	17.34520	-.01371
41	.29397	17.34520	-.06459
42	.76756	17.34520	-.15059

Nodal Numbering for Surfaces

FOR SURFACE 24							
1	5	9	13	17	21	25	29
2	6	10	14	18	22	26	30
3	7	11	15	19	23	27	31
4	8	12	16	20	24	28	32

FOR SURFACE 25							
1	5	9	13	17	21	25	29
33	35	37	39	41	43	45	30
34	36	38	40	42	44	46	31
4	8	12	16	20	24	28	32

Nodal Numbering for Elements

ELEM	++	+-	-+	--
1	6	2	5	1
2	7	3	6	2
3	8	4	7	3
4	10	6	9	5
5	11	7	10	6
6	12	8	11	7
7	14	10	13	9
8	15	11	14	10
9	16	12	15	11
10	18	14	17	13
11	19	15	18	14
12	20	16	19	15
13	22	18	21	17
14	23	19	22	18
15	24	20	23	19
16	26	22	25	21
17	27	23	26	22
18	28	24	27	23
19	30	26	29	25
20	31	27	30	26
21	32	28	31	27
22	33	35	1	5
23	34	36	2	6
24	4	8	34	36
25	35	37	5	9
26	36	38	35	37
27	8	12	36	38
28	37	39	9	13
29	38	40	27	39
30	12	16	38	40
31	39	41	13	17
32	40	42	39	41
33	16	20	40	42
34	41	43	17	21
35	42	44	41	43
36	20	24	42	44
37	43	45	21	25
38	44	46	43	45
39	24	28	44	46
40	45	30	25	29
41	46	31	45	30
42	28	32	46	31

The Distribution of the Source

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THE DISTRIBUTION OF SOURCE

FOR SUBSURFACE 24

-0.14553E+01	-0.190951E+01	-0.13411E+02	-0.11471E+02	-0.10312E+02	-0.10733E+02	-0.10910E+02
-0.27443E+01	-0.42637E+01	-0.14447E+01	-0.77902E+01	-0.67444E+01	-0.88677E+01	-0.53715E+01
0.40619E+01	0.91122E+01	0.12643E+02	0.15465E+02	0.17440E+02	0.17995E+02	0.32095E+01

FOR SUBSURFACE 25

-0.14686E+01	-0.10991E+02	-0.15012E+02	-0.16247E+02	-0.26509E+02	-0.21241E+02	-0.11787E+02
-0.44665E+01	-0.85895E+01	-0.11727E+02	-0.14334E+02	-0.16200E+02	-0.17808E+02	-0.97150E+01
0.33064E+01	0.63446E+01	0.07286E+01	0.11639E+02	0.11958E+02	0.12013E+02	0.61040E+01

The Distribution of the Velocity Potential

THE DISTRIBUTION OF THE VELOCITY POTENTIAL

FOR SUBSURFACE 24

0.57743E+02	0.12070E+03	0.13220E+03	0.13104E+03	0.12223E+03	0.16029E+03	0.94994E+02
0.11316E+03	0.14867E+03	0.15739E+03	0.16143E+03	0.15467E+03	0.13902E+03	0.11436E+03
0.11917E+03	0.19294E+03	0.17375E+03	0.18064E+03	0.17504E+03	0.15953E+03	0.12810E+03

FOR SUBSURFACE 25

0.6197E+02	0.64161E+02	0.19945E+02	0.12742E+02	0.29003E+02	0.10263E+02	0.27677E+02
0.49821E+02	0.40401E+02	0.39531E+02	0.23127E+02	0.34100E+01	0.62308E+01	0.10612E+02
0.44051E+02	0.42059E+02	0.20273E+02	0.12092E+02	0.70572E+01	0.13457E+02	0.61021E+01

Pressure Distribution

THE DISTRIBUTION OF CP

FOR SUBSURFACE 24

-.000766+00	-.13691E+01	-.14902E+01	-.25306E+01	-.20028E+01	-.20655E+01	-.43838E+01
-.12650E+01	-.19535E+00	-.20234E+00	-.36065E+00	-.41152E+00	-.30549E+00	-.21216E+00
-.22533E+00	-.35270E+00	-.51106E+00	-.65003E+00	-.73322E+00	-.69717E+00	-.20360E+00

FOR SUBSURFACE 25

-.02564E+00	-.12750E+01	-.10370E+01	-.23371E+01	-.26643E+01	-.25043E+01	-.42100E+01
-.01057E+01	-.13220E+00	-.19753E+00	-.25337E+00	-.27727E+00	-.24046E+00	-.07001E+01
-.26629E+00	-.10151E+00	-.14040E+00	-.69930E+00	-.79643E+00	-.76640E+00	-.35074E+00

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SAMPLE CASE 2:
XH-51A HELICOPTER ROTOR

Data Input

```

PROGRAM SHAPES
RUD FLOW SEPARATION
FOUR BLADED HELICOPTER ROTOR
KREAD 0
...
UNACP 0.000 359.132
ALFA 0.000 0.000
RUTOR 17.500 2.550 0.000 1.000 0.000 0.000 0.000
THETTS 0.000 0.000 0.000 0.000 90.000 0.000 0.000
RPITCH 10.000 7.000
KBLADE 0 1
NHAFT 0 0 0 1
SPIRAL 10 3.000 34.000
KPRINT 1 1 1 1 0 1 1 1 1
NROTOR 0 0 2 1 1

DATA

HELEN = 200

10 1 NX= 0 NY= 0 NXY= 25 ISPACE= 1 NY= 0 KNORML= 1 KWAKES= 1 KROTCS= 1
15 2 NX= 0 NY= 0 NXY= 25 ISPACE= 2 NY= 25 KNORML= -1 KWAKES= 1 KROTCS= 1
15 3 NX= 0 NY= 0 NXY= 25 ISPACE= 3 NY= 50 KNORML= 1 KWAKES= 1 KROTCS= 1
15 4 NX= 0 NY= 0 NXY= 25 ISPACE= 4 NY= 75 KNORML= -1 KWAKES= 1 KROTCS= 1
15 5 NX= 0 NY= 0 NXY= 25 ISPACE= 5 NY= 100 KNORML= 1 KWAKES= 1 KROTCS= 1
15 6 NX= 0 NY= 0 NXY= 25 ISPACE= 6 NY= 125 KNORML= -1 KWAKES= 1 KROTCS= 1
15 7 NX= 0 NY= 0 NXY= 25 ISPACE= 7 NY= 150 KNORML= 1 KWAKES= 1 KROTCS= 1
15 8 NX= 0 NY= 0 NXY= 25 ISPACE= 8 NY= 175 KNORML= -1 KWAKES= 1 KROTCS= 1

PREPRO
NMODE= 220

```

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Specifications of the Problem

FOR PART 24
NX= 5
NY= 5

FOR PART 25
NX= 5
NY= 5

FOR PART 27
NX= 5
NY= 5

FOR PART 28
NX= 5
NY= 5

FOR PART 30
NX= 5
NY= 5

FOR PART 31
NX= 5
NY= 5

FOR PART 33
NX= 5
NY= 5

FOR PART 34
NX= 5
NY= 5

NELEM=200

KSMMY= 0
KSMMZ= 0

X, Y, and Z Coordinates of the Nodes

NOCE=	X	Y	Z
1	0.00000	2.33000	0.00000
2	.04335	2.33000	-.00388
3	.17300	2.33000	-.01758
4	.38781	2.33000	-.04726
5	.68587	2.33000	-.10309
6	1.06448	2.33000	-.19941
7	0.00000	7.79120	0.00000
8	.04335	7.79120	-.00388
9	.17300	7.79120	-.01758
10	.38781	7.79120	-.04726
11	.68587	7.79120	-.10309
12	1.06448	7.79120	-.19941
13	0.00000	12.03880	0.00000
14	.04335	12.03880	-.00388
15	.17300	12.03880	-.01758
16	.38781	12.03880	-.04726
17	.68587	12.03880	-.10309
18	1.06448	12.03880	-.19941
19	0.00000	15.07280	0.00000
20	.04335	15.07280	-.00388
21	.17300	15.07280	-.01758
22	.38781	15.07280	-.04726
23	.68587	15.07280	-.10309
24	1.06448	15.07280	-.19941
25	0.00000	16.89320	0.00000
26	.04335	16.89320	-.00388
27	.17300	16.89320	-.01758
28	.38781	16.89320	-.04726
29	.68587	16.89320	-.10309
30	1.06448	16.89320	-.19941
31	0.00000	17.50000	0.00000
32	.04258	17.50000	-.00798
33	.17032	17.50000	-.03190
34	.38321	17.50000	-.07179
35	.68127	17.50000	-.12762
36	1.06448	17.50000	-.19941
37	.04131	2.33000	-.01207
38	.16763	2.33000	-.04623
39	.37862	2.33000	-.09632
40	.67667	2.33000	-.15215
41	.04181	7.79120	-.01207
42	.16763	7.79120	-.04623
43	.37862	7.79120	-.09632
44	.67667	7.79120	-.15215
45	.04181	12.03880	-.01207
46	.16763	12.03880	-.04623
47	.37862	12.03880	-.09632
48	.67667	12.03880	-.15215
49	.04181	15.07280	-.01207
50	.16763	15.07280	-.04623
51	.37862	15.07280	-.09632
52	.67667	15.07280	-.15215
53	.04181	16.89320	-.01207
54	.16763	16.89320	-.04623
55	.37862	16.89320	-.09632
56	.67667	16.89320	-.15215
57	-2.33000	.00000	0.00000
58	-2.33000	.04335	-.00388
59	-2.33000	.17300	-.01758
60	-2.33000	.38781	-.04726
61	-2.33000	.68587	-.10309
62	-2.33000	1.06448	-.19941
63	-7.79120	.00000	0.00000
64	-7.79120	.04335	-.00388
65	-7.79120	.17300	-.01758
66	-7.79120	.38781	-.04726

67	-7.79120	.68587	-.10309
68	-7.79120	1.06448	-.19941
69	-12.03880	.00000	0.00000
70	-12.03880	.04335	-.00388
71	-12.03880	.17300	-.01758
72	-12.03880	.38781	-.04726
73	-12.03880	.68587	-.10309
74	-12.03880	1.06448	-.19941
75	-15.07280	.00000	0.00000
76	-15.07280	.04335	-.00388
77	-15.07280	.17300	-.01758
78	-15.07280	.38781	-.04726
79	-15.07280	.68587	-.10309
80	-15.07280	1.06448	-.19941
81	-16.89320	.00000	0.00000
82	-16.89320	.04335	-.00388
83	-16.89320	.17300	-.01758
84	-16.89320	.38781	-.04726
85	-16.89320	.68587	-.10309
86	-16.89320	1.06448	-.19941
87	-17.50000	.00000	0.00000
88	-17.50000	.04258	-.00798
89	-17.50000	.17032	-.03190
90	-17.50000	.38321	-.07175
91	-17.50000	.68127	-.12762
92	-17.50000	1.06448	-.19941
93	-2.33000	.04131	-.01207
94	-2.33000	.16763	-.04623
95	-2.33000	.37862	-.09632
96	-2.33000	.67667	-.15215
97	-7.79120	.04181	-.01207
98	-7.79120	.16763	-.04623
99	-7.79120	.37862	-.09632
100	-7.79120	.67667	-.15215
101	-12.03880	.04181	-.01207
102	-12.03880	.16763	-.04623
103	-12.03880	.37862	-.09632
104	-12.03880	.67667	-.15215
105	-15.07280	.04181	-.01207
106	-15.07280	.16763	-.04623
107	-15.07280	.37862	-.09632
108	-15.07280	.67667	-.15215
109	-16.89320	.04181	-.01207
110	-16.89320	.16763	-.04623
111	-16.89320	.37862	-.09632
112	-16.89320	.67667	-.15215
113	-.00000	-2.33000	0.00000
114	-.04335	-2.33000	-.00388
115	-.17300	-2.33000	-.01758
116	-.38781	-2.33000	-.04726
117	-.68587	-2.33000	-.10309
118	-1.06448	-2.33000	-.19941
119	-.00000	-7.79120	0.00000
120	-.04335	-7.79120	-.00388
121	-.17300	-7.79120	-.01758
122	-.38781	-7.79120	-.04726
123	-.68587	-7.79120	-.10309
124	-1.06448	-7.79120	-.19941
125	-.00000	-12.03880	0.00000
126	-.04335	-12.03880	-.00388
127	-.17300	-12.03880	-.01758
128	-.38781	-12.03880	-.04726
129	-.68587	-12.03880	-.10309
130	-1.06448	-12.03880	-.19941
131	-.00000	-15.07280	0.00000
132	-.04335	-15.07280	-.00388
133	-.17300	-15.07280	-.01758
134	-.38781	-15.07280	-.04726
135	-.68587	-15.07280	-.10309
136	-1.06448	-15.07280	-.19941
137	-.00000	-16.89320	0.00000
138	-.04335	-16.89320	-.00388
139	-.17300	-16.89320	-.01758
140	-.38781	-16.89320	-.04726

141	-.63587	-13.89320	-.10309
142	-1.06448	-16.89320	-.19941
143	-.00000	-17.50000	0.00000
144	-.04258	-17.50000	-.00796
145	-.17032	-17.50000	-.03190
146	-.38321	-17.50000	-.07179
147	-.68127	-17.50000	-.12762
148	-1.06448	-17.50000	-.19941
149	-.04181	-2.33000	-.01207
150	-.16763	-2.33000	-.04623
151	-.37862	-2.33000	-.09632
152	-.67667	-2.33000	-.15215
153	-.04181	-7.79120	-.01207
154	-.16763	-7.79120	-.04623
155	-.37862	-7.79120	-.09632
156	-.67667	-7.79120	-.15215
157	-.04181	-12.03880	-.01207
158	-.16763	-12.03880	-.04623
159	-.37862	-12.03880	-.09632
160	-.67667	-12.03880	-.15215
161	-.04181	-15.07280	-.01207
162	-.16763	-15.07280	-.04623
163	-.37862	-15.07280	-.09632
164	-.67667	-15.07280	-.15215
165	-.04181	-16.89320	-.01207
166	-.16763	-16.89320	-.04623
167	-.37862	-16.89320	-.09632
168	-.67667	-16.89320	-.15215
169	2.33000	-.00000	0.00000
170	2.33000	-.04335	-.00388
171	2.33000	-.17300	-.01758
172	2.33000	-.38781	-.04726
173	2.33000	-.68587	-.10309
174	2.33000	-1.06448	-.19941
175	7.79120	-.00000	0.00000
176	7.79120	-.04335	-.00388
177	7.79120	-.17300	-.01758
178	7.79120	-.38781	-.04726
179	7.79120	-.68587	-.10309
180	7.79120	-1.06448	-.19941
181	12.03880	-.00000	0.00000
182	12.03880	-.04335	-.00388
183	12.03880	-.17300	-.01758
184	12.03880	-.38781	-.04726
185	12.03880	-.68587	-.10309
186	12.03880	-1.06448	-.19941
187	15.07280	-.00000	0.00000
188	15.07280	-.04335	-.00388
189	15.07280	-.17300	-.01758
190	15.07280	-.38781	-.04726
191	15.07280	-.68587	-.10309
192	15.07280	-1.06448	-.19941
193	16.89320	-.00000	0.00000
194	16.89320	-.04335	-.00388
195	16.89320	-.17300	-.01758
196	16.89320	-.38781	-.04726
197	16.89320	-.68587	-.10309
198	16.89320	-1.06448	-.19941
199	17.50000	-.00000	0.00000
200	17.50000	-.04258	-.00796
201	17.50000	-.17032	-.03190
202	17.50000	-.38321	-.07179
203	17.50000	-.68127	-.12762
204	17.50000	-1.06448	-.19941
205	2.33000	-.04181	-.01207
206	2.33000	-.16763	-.04623
207	2.33000	-.37862	-.09632
208	2.33000	-.67667	-.15215
209	7.79120	-.04181	-.01207
210	7.79120	-.16763	-.04623
211	7.79120	-.37862	-.09632
212	7.79120	-.67667	-.15215
213	12.03880	-.04181	-.01207
214	12.03880	-.16763	-.04623

215	12.03880	-.37862	-.09632
216	12.03880	-.67667	-.15215
217	15.07280	-.04131	-.01207
218	15.07280	-.16753	-.04623
219	15.07280	-.37862	-.09632
220	15.07280	-.67667	-.15215
221	16.89320	-.04131	-.01207
222	16.89320	-.16753	-.04623
223	16.89320	-.37862	-.09632
224	16.89320	-.67667	-.15215

X, Y, and Z Coordinates of the Centroid of Aerodynamic Panels

ELEM#	XPC	YPC	ZPC
1	.02167	5.06060	-.00194
2	.10817	5.06060	-.01073
3	.28041	5.06060	-.03242
4	.53684	5.06060	-.07517
5	.87517	5.06060	-.15125
6	.02167	9.91500	-.00194
7	.10817	9.91500	-.01073
8	.28041	9.91500	-.03242
9	.53684	9.91500	-.07517
10	.87517	9.91500	-.15125
11	.02167	13.55580	-.00194
12	.10817	13.55580	-.01073
13	.28041	13.55580	-.03242
14	.53684	13.55580	-.07517
15	.87517	13.55580	-.15125
16	.02167	15.98300	-.00194
17	.10817	15.98300	-.01073
18	.28041	15.98300	-.03242
19	.53684	15.98300	-.07517
20	.87517	15.98300	-.15125
21	.02148	17.19660	-.00296
22	.10731	17.19660	-.01934
23	.27859	17.19660	-.04213
24	.53454	17.19660	-.08744
25	.87403	17.19660	-.15738
26	.02091	5.06060	-.00604
27	.10472	5.06060	-.02915
28	.27313	5.06060	-.07127
29	.52765	5.06060	-.12423
30	.87058	5.06060	-.17578
31	.02091	9.91500	-.00614
32	.10472	9.91500	-.02915
33	.27313	9.91500	-.07127
34	.52765	9.91500	-.12423
35	.87058	9.91500	-.17578
36	.02091	13.55580	-.00614
37	.10472	13.55580	-.02915
38	.27313	13.55580	-.07127
39	.52765	13.55580	-.12423
40	.87058	13.55580	-.17578
41	.02091	15.98300	-.00604
42	.10472	15.98300	-.02915
43	.27313	15.98300	-.07127
44	.52765	15.98300	-.12423
45	.87058	15.98300	-.17578
46	.02110	17.19660	-.00501
47	.10559	17.19660	-.02455
48	.27455	17.19660	-.06156
49	.52994	17.19660	-.11197
50	.87173	17.19660	-.16984
51	-5.06060	.02167	-.00194
52	-5.06060	.10817	-.01073
53	-5.06060	.28041	-.03242
54	-5.06060	.53684	-.07517
55	-5.06060	.87517	-.15125
56	-9.91500	.02167	-.00194
57	-9.91500	.10817	-.01073
58	-9.91500	.28041	-.03242
59	-9.91500	.53684	-.07517
60	-9.91500	.87517	-.15125
61	-13.55580	.02167	-.00194
62	-13.55580	.10817	-.01073
63	-13.55580	.28041	-.03242
64	-13.55580	.53684	-.07517
65	-13.55580	.87517	-.15125
66	-15.98300	.02167	-.00194
67	-15.98300	.10817	-.01073
68	-15.98300	.28041	-.03242
69	-15.98300	.53684	-.07517
70	-15.98300	.87517	-.15125

71	-17.19660	.02148	-.00296
72	-17.19660	.10731	-.01934
73	-17.19660	.27859	-.04213
74	-17.19660	.53454	-.08744
75	-17.19660	.87403	-.15738
76	-5.06060	.02091	-.00604
77	-5.06060	.10472	-.02915
78	-5.06060	.27313	-.07127
79	-5.06060	.52765	-.12423
80	-5.06060	.87058	-.17578
81	-9.91500	.12091	-.00604
82	-9.91500	.10472	-.02915
83	-9.91500	.27313	-.07127
84	-9.91500	.52765	-.12423
85	-9.91500	.87058	-.17578
86	-13.55580	.02091	-.00604
87	-13.55580	.10472	-.02915
88	-13.55580	.27313	-.07127
89	-13.55580	.52765	-.12423
90	-13.55580	.87058	-.17578
91	-15.98300	.02091	-.00604
92	-15.98300	.10472	-.02915
93	-15.98300	.27313	-.07127
94	-15.98300	.52765	-.12423
95	-15.98300	.87058	-.17578
96	-17.19660	.02113	-.00501
97	-17.19660	.10559	-.02455
98	-17.19660	.27495	-.06156
99	-17.19660	.52994	-.11197
100	-17.19660	.87173	-.16964
101	-.02167	-5.06060	-.00194
102	-.10517	-9.08080	-.01073
103	-.28041	-5.06060	-.03242
104	-.53684	-9.08080	-.07917
105	-.87517	-5.06060	-.15125
106	-.02167	-9.91500	-.00194
107	-.10817	-9.91500	-.01073
108	-.28041	-9.91500	-.03242
109	-.53684	-9.91500	-.07917
110	-.87517	-9.91500	-.15125
111	-.02167	-13.55580	-.00194
112	-.10817	-13.55580	-.01073
113	-.28041	-13.55580	-.03242
114	-.53684	-13.55580	-.07917
115	-.87517	-13.55580	-.15125
116	-.02167	-15.98300	-.00194
117	-.10817	-15.98300	-.01073
118	-.28041	-15.98300	-.03242
119	-.53684	-15.98300	-.07917
120	-.87517	-15.98300	-.15125
121	-.02148	-17.19660	-.00296
122	-.10731	-17.19660	-.01934
123	-.27859	-17.19660	-.04213
124	-.53454	-17.19660	-.08744
125	-.87403	-17.19660	-.15738
126	-.02091	-5.06060	-.00604
127	-.10472	-5.06060	-.02915
128	-.27313	-5.06060	-.07127
129	-.52765	-5.06060	-.12423
130	-.87058	-5.06060	-.17578
131	-.02091	-9.91500	-.00604
132	-.10472	-9.91500	-.02915
133	-.27313	-9.91500	-.07127
134	-.52765	-9.91500	-.12423
135	-.87058	-9.91500	-.17578
136	-.02091	-13.55580	-.00604
137	-.10472	-13.55580	-.02915
138	-.27313	-13.55580	-.07127
139	-.52765	-13.55580	-.12423
140	-.87058	-13.55580	-.17578
141	-.02091	-15.98300	-.00604
142	-.10472	-15.98300	-.02915
143	-.27313	-15.98300	-.07127

144	-.52765	-15.98300	-.12423
145	-.87058	-15.98300	-.17578
146	-.02110	-17.19660	-.00501
147	-.10559	-17.19660	-.02455
148	-.27495	-17.19660	-.06156
149	-.52994	-17.19660	-.11197
150	-.87173	-17.19660	-.16964
151	5.06060	-.02167	-.00194
152	5.06060	-.10817	-.01073
153	5.06060	-.29041	-.03242
154	5.06060	-.53684	-.07517
155	5.06060	-.87517	-.15125
156	9.91500	-.02167	-.00194
157	9.91500	-.10817	-.01073
158	9.91500	-.29041	-.03242
159	9.91500	-.53684	-.07517
160	9.91500	-.87517	-.15125
161	13.55580	-.02167	-.00194
162	13.55580	-.10817	-.01073
163	13.55580	-.29041	-.03242
164	13.55580	-.53684	-.07517
165	13.55580	-.87517	-.15125
166	15.98300	-.02167	-.00194
167	15.98300	-.10817	-.01073
168	15.98300	-.29041	-.03242
169	15.98300	-.53684	-.07517
170	15.98300	-.87517	-.15125
171	17.19660	-.02148	-.00296
172	17.19660	-.10731	-.01536
173	17.19660	-.27859	-.04213
174	17.19660	-.53454	-.08746
175	17.19660	-.87403	-.15738
176	5.06060	-.02091	-.00604
177	5.06060	-.10472	-.02915
178	5.06060	-.27313	-.07127
179	5.06060	-.52765	-.12423
180	5.06060	-.87058	-.17578
181	9.91500	-.02091	-.00604
182	9.91500	-.10472	-.02915
183	9.91500	-.27313	-.07127
184	9.91500	-.52765	-.12423
185	9.91500	-.87058	-.17578
186	13.55580	-.02091	-.00604
187	13.55580	-.10472	-.02915
188	13.55580	-.27313	-.07127
189	13.55580	-.52765	-.12423
190	13.55580	-.87058	-.17578
191	15.98300	-.02091	-.00604
192	15.98300	-.10472	-.02915
193	15.98300	-.27313	-.07127
194	15.98300	-.52765	-.12423
195	15.98300	-.87058	-.17578
196	17.19660	-.02110	-.00501
197	17.19660	-.10559	-.02455
198	17.19660	-.27495	-.06156
199	17.19660	-.52994	-.11197
200	17.19660	-.87173	-.16964

Nodal Numbering for Surfaces

FOR SURFACE 24					
1	7	13	19	25	31
2	8	14	20	26	32
3	9	15	21	27	33
4	10	16	22	28	34
5	11	17	23	29	35
6	12	18	24	30	36

FOR SURFACE 25					
1	7	13	19	25	31
37	41	45	49	53	57
38	42	46	50	54	58
39	43	47	51	55	59
40	44	48	52	56	60
6	12	18	24	30	36

FOR SURFACE 27					
57	63	69	75	81	87
58	64	70	76	82	88
59	65	71	77	83	89
60	66	72	78	84	90
61	67	73	79	85	91
62	68	74	80	86	92

FOR SURFACE 28					
57	63	69	75	81	87
93	97	101	105	109	113
94	98	102	106	110	114
95	99	103	107	111	115
96	100	104	108	112	116
62	68	74	80	86	92

FOR SURFACE 30					
113	119	125	131	137	143
114	120	126	132	138	144
115	121	127	133	139	145
116	122	128	134	140	146
117	123	129	135	141	147
118	124	130	136	142	148

FOR SURFACE 31					
113	119	125	131	137	143
149	153	157	161	165	169
150	154	158	162	166	170
151	155	159	163	167	171
152	156	160	164	168	172
118	124	130	136	142	148

FOR SURFACE 33					
169	175	181	187	193	199
170	176	182	188	194	200
171	177	183	189	195	201
172	178	184	190	196	202
173	179	185	191	197	203
174	180	186	192	198	204

FOR SURFACE 34					
169	175	181	187	193	199
205	209	213	217	221	225
206	210	214	218	222	226
207	211	215	219	223	227
208	212	216	220	224	228
174	180	186	192	198	204

Nodal Numbering for Elements

ELEM	++	+-	-+	--
1	8	2	7	1
2	9	3	8	2
3	10	4	9	3
4	11	5	10	4
5	12	6	11	5
6	14	8	13	7
7	15	9	14	8
8	15	10	15	9
9	17	11	16	10
10	18	12	17	11
11	20	14	19	13
12	21	15	20	14
13	22	16	21	15
14	23	17	22	16
15	24	18	23	17
16	26	20	25	19
17	27	21	26	20
18	28	22	27	21
19	29	23	28	22
20	30	24	29	23
21	32	26	31	25
22	33	27	32	26
23	34	28	33	27
24	35	29	34	28
25	36	30	35	29
26	37	41	1	7
27	38	42	37	41
28	39	43	38	42
29	40	44	39	43
30	6	12	40	44
31	41	45	7	13
32	42	46	41	45
33	43	47	42	46
34	44	48	43	47
35	12	13	44	48
36	45	49	13	19
37	46	50	45	49
38	47	51	46	50
39	48	52	47	51
40	18	24	48	52
41	49	53	19	25
42	50	54	49	53
43	51	55	50	54
44	52	56	51	55
45	24	30	52	56
46	53	32	25	31
47	54	33	53	32
48	55	34	54	33
49	56	35	55	34
50	30	36	56	35
51	64	58	63	57
52	65	59	64	58
53	66	60	65	59
54	67	61	66	60
55	68	62	67	61
56	70	64	69	63
57	71	65	70	64
58	72	66	71	65
59	73	67	72	66
60	74	68	73	67
61	76	70	75	69
62	77	71	76	70
63	78	72	77	71
64	79	73	78	72
65	80	74	79	73
66	82	76	81	75
67	83	77	82	76
68	84	78	83	77

69	85	79	84	78
70	86	80	85	79
71	86	82	87	81
72	89	83	88	82
73	90	84	89	83
74	91	85	90	84
75	92	86	91	85
76	93	87	92	86
77	94	88	93	87
78	95	89	94	88
79	96	90	95	89
80	97	91	96	90
81	97	101	63	69
82	98	102	97	101
83	99	103	98	102
84	100	104	99	103
85	68	74	100	104
86	101	105	69	75
87	102	106	101	105
88	103	107	102	106
89	104	108	103	107
90	74	80	104	108
91	105	109	75	81
92	106	110	105	109
93	107	111	106	110
94	108	112	107	111
95	80	86	108	112
96	109	88	81	87
97	110	89	109	88
98	111	90	110	89
99	112	91	111	90
100	86	92	112	91
101	120	114	119	113
102	121	115	120	114
103	122	116	121	115
104	123	117	122	116
105	124	118	123	117
106	126	120	125	119
107	127	121	126	120
108	128	122	127	121
109	129	123	128	122
110	130	124	129	123
111	132	126	131	125
112	133	127	132	126
113	134	128	133	127
114	135	129	134	128
115	136	130	135	129
116	138	132	137	131
117	139	133	138	132
118	140	134	139	133
119	141	135	140	134
120	142	136	141	135
121	144	138	143	137
122	145	139	144	138
123	146	140	145	139
124	147	141	146	140
125	148	142	147	141
126	149	143	148	142
127	150	144	149	143
128	151	145	150	144
129	152	146	151	145
130	118	124	152	146
131	153	147	153	147
132	154	148	154	148
133	155	149	155	149
134	156	150	156	150
135	124	130	156	160
136	157	151	157	151
137	158	152	158	152
138	159	153	159	153
139	160	154	160	154
140	130	136	160	164
141	161	155	161	155

142	162	166	161	165
143	163	167	162	166
144	164	168	163	167
145	136	142	164	168
146	165	144	137	143
147	166	145	165	144
148	167	146	166	145
149	168	147	167	146
150	142	148	168	147
151	176	170	175	169
152	177	171	176	170
153	178	172	177	171
154	179	173	178	172
155	180	174	179	173
156	182	176	181	175
157	183	177	182	176
158	184	178	183	177
159	185	179	184	178
160	186	180	185	179
161	188	182	187	181
162	189	183	188	182
163	190	184	189	183
164	191	185	190	184
165	192	186	191	185
166	194	188	193	187
167	195	189	194	188
168	196	190	195	189
169	197	191	196	190
170	198	192	197	191
171	200	194	199	193
172	201	195	200	194
173	202	196	201	195
174	203	197	202	196
175	204	198	203	197
176	205	199	204	198
177	206	210	205	209
178	207	211	206	210
179	208	212	207	211
180	174	180	208	212
181	209	213	175	181
182	210	214	209	213
183	211	215	210	214
184	212	216	211	215
185	180	186	212	216
186	213	217	181	187
187	214	218	213	217
188	215	219	214	218
189	216	220	215	219
190	186	192	216	220
191	217	221	187	193
192	218	222	217	221
193	219	223	218	222
194	220	224	219	223
195	192	198	220	224
196	221	200	193	199
197	222	201	221	200
198	223	202	222	201
199	224	203	223	202
200	198	204	224	203

The Distribution of the Source

FOR SUBSURFACE 24				
-.67898E+01	-.12955E+02	-.17601E+02	-.20237E+02	-.11351E+02
-.64984E+01	-.12450E+02	-.16917E+02	-.19516E+02	-.10964E+02
-.36705E+01	-.69826E+01	-.94592E+01	-.10879E+02	-.62031E+01
.20676E+01	.40146E+01	.54635E+01	.63976E+01	.33652E+01
.76145E+01	.14806E+02	.20137E+02	.23241E+02	.12750E+02
FOR SUBSURFACE 25				
-.70504E+01	-.13521E+02	-.18387E+02	-.21175E+02	-.11844E+02
-.75670E+01	-.14784E+02	-.20220E+02	-.23463E+02	-.13102E+02
-.59701E+01	-.11792E+02	-.16203E+02	-.18950E+02	-.10664E+02
-.85895E+00	-.20238E+01	-.29820E+01	-.37337E+01	-.22639E+01
.60343E+01	.11586E+02	.15663E+02	.17933E+02	.98657E+01
FOR SUBSURFACE 27				
-.67898E+01	-.12955E+02	-.17601E+02	-.20237E+02	-.11351E+02
-.64984E+01	-.12450E+02	-.16917E+02	-.19516E+02	-.10964E+02
-.36705E+01	-.69826E+01	-.94592E+01	-.10879E+02	-.62031E+01
.20676E+01	.40146E+01	.54635E+01	.63976E+01	.33652E+01
.76145E+01	.14806E+02	.20137E+02	.23241E+02	.12750E+02
FOR SUBSURFACE 28				
-.70504E+01	-.13521E+02	-.18387E+02	-.21175E+02	-.11844E+02
-.75670E+01	-.14784E+02	-.20220E+02	-.23463E+02	-.13102E+02
-.59701E+01	-.11792E+02	-.16203E+02	-.18950E+02	-.10664E+02
-.85895E+00	-.20238E+01	-.29820E+01	-.37337E+01	-.22639E+01
.60343E+01	.11586E+02	.15663E+02	.17933E+02	.98657E+01

FOR SUBSURFACE 30

-.67898E+01	-.12965E+02	-.17601E+02	-.20237E+02	-.11351E+02
-.64984E+01	-.12450E+02	-.16917E+02	-.19516E+02	-.10964E+02
-.36705E+01	-.69326E+01	-.94592E+01	-.10879E+02	-.62031E+01
.20676E+01	.40148E+01	.54635E+01	.63976E+01	.33652E+01
.76145E+01	.14806E+02	.20137E+02	.23241E+02	.12750E+02

FOR SUBSURFACE 31

-.70504E+01	-.13521E+02	-.18387E+02	-.21175E+02	-.11844E+02
-.75670E+01	-.14784E+02	-.20220E+02	-.23463E+02	-.13102E+02
-.59701E+01	-.11792E+02	-.16203E+02	-.18950E+02	-.10664E+02
-.85895E+00	-.20238E+01	-.29820E+01	-.37337E+01	-.22639E+01
.60343E+01	.11586E+02	.15663E+02	.17933E+02	.98657E+01

FOR SUBSURFACE 33

-.67898E+01	-.12965E+02	-.17601E+02	-.20237E+02	-.11351E+02
-.64984E+01	-.12450E+02	-.16917E+02	-.19516E+02	-.10964E+02
-.36705E+01	-.69326E+01	-.94592E+01	-.10879E+02	-.62031E+01
.20676E+01	.40148E+01	.54635E+01	.63976E+01	.33652E+01
.76145E+01	.14806E+02	.20137E+02	.23241E+02	.12750E+02

FOR SUBSURFACE 34

-.70504E+01	-.13521E+02	-.18387E+02	-.21175E+02	-.11844E+02
-.75670E+01	-.14784E+02	-.20220E+02	-.23463E+02	-.13102E+02
-.59701E+01	-.11792E+02	-.16203E+02	-.18950E+02	-.10664E+02
-.85895E+00	-.20238E+01	-.29820E+01	-.37337E+01	-.22639E+01
.60343E+01	.11586E+02	.15663E+02	.17933E+02	.98657E+01

The Distribution of the Velocity Potential

FOR SUBSURFACE 24

.17602E+03	.20640E+03	.20732E+03	.18068E+03	.15468E+03
.17886E+03	.21339E+03	.21798E+03	.19379E+03	.16714E+03
.18380E+03	.22322E+03	.23153E+03	.20961E+03	.17963E+03
.18929E+03	.23356E+03	.24566E+03	.22568E+03	.18934E+03
.18643E+03	.23073E+03	.24566E+03	.22257E+03	.18346E+03

FOR SUBSURFACE 25

.16041E+03	.17883E+03	.17098E+03	.13619E+03	.11212E+03
.15183E+03	.16619E+03	.15586E+03	.11874E+03	.95400E+02
.14952E+03	.15728E+03	.14563E+03	.10694E+03	.82754E+02
.14380E+03	.15562E+03	.14404E+03	.10571E+03	.78885E+02
.14135E+03	.15756E+03	.14451E+03	.10988E+03	.82064E+02

FOR SUBSURFACE 27

.17602E+03	.20640E+03	.20732E+03	.18068E+03	.15468E+03
.17886E+03	.21339E+03	.21798E+03	.19379E+03	.16714E+03
.18380E+03	.22322E+03	.23153E+03	.20961E+03	.17963E+03
.18929E+03	.23356E+03	.24566E+03	.22568E+03	.18934E+03
.18643E+03	.23073E+03	.24566E+03	.22257E+03	.18346E+03

FOR SUBSURFACE 28

.16041E+03	.17883E+03	.17098E+03	.13619E+03	.11212E+03
.15183E+03	.16619E+03	.15586E+03	.11874E+03	.95400E+02
.14952E+03	.15728E+03	.14563E+03	.10694E+03	.82754E+02
.14380E+03	.15562E+03	.14404E+03	.10571E+03	.78885E+02
.14135E+03	.15756E+03	.14451E+03	.10988E+03	.82064E+02

FOR SURFACE 30

.17602E+03	.20641E+03	.20732E+03	.18068E+03	.15468E+03
.17886E+03	.21339E+03	.21798E+03	.19379E+03	.16714E+03
.18380E+03	.22322E+03	.23153E+03	.20961E+03	.17963E+03
.18929E+03	.23356E+03	.24566E+03	.22568E+03	.18934E+03
.18643E+03	.23073E+03	.24566E+03	.22257E+03	.18346E+03

FOR SURFACE 31

.16041E+03	.17883E+03	.17098E+03	.13619E+03	.11212E+03
.15183E+03	.16619E+03	.15586E+03	.11874E+03	.95400E+02
.14552E+03	.15728E+03	.14563E+03	.10694E+03	.82754E+02
.14380E+03	.15562E+03	.14404E+03	.10571E+03	.78885E+02
.14135E+03	.15756E+03	.14451E+03	.10988E+03	.82064E+02

FOR SURFACE 33

.17602E+03	.20540E+03	.20732E+03	.18068E+03	.15468E+03
.17886E+03	.21339E+03	.21798E+03	.19379E+03	.16714E+03
.18380E+03	.22322E+03	.23153E+03	.20961E+03	.17963E+03
.18929E+03	.23356E+03	.24566E+03	.22568E+03	.18934E+03
.18643E+03	.23073E+03	.24566E+03	.22257E+03	.18346E+03

FOR SURFACE 34

.16041E+03	.17883E+03	.17098E+03	.13619E+03	.11212E+03
.15183E+03	.16619E+03	.15586E+03	.11874E+03	.95400E+02
.14552E+03	.15728E+03	.14563E+03	.10694E+03	.82754E+02
.14380E+03	.15562E+03	.14404E+03	.10571E+03	.78885E+02
.14135E+03	.15756E+03	.14451E+03	.10988E+03	.82064E+02

Pressure Distribution

FOR SURFACE 24

-.10193E+01	-.18540E+01	-.29055E+01	-.36553E+01	-.18860E+01
-.15173E+00	-.30130E+00	-.48997E+00	-.60060E+00	-.28944E+00
-.11633E+00	-.21550E+00	-.33475E+00	-.38244E+00	-.21574E+00
-.24355E-01	-.61409E-01	-.10789E+00	-.10601E+00	-.65347E-01
.27068E+00	.45045E+00	.66623E+00	.79997E+00	.41744E+00

FOR SURFACE 25

.12332E+01	.20739E+01	.30870E+01	.38080E+01	.21446E+01
.24289E+00	.37140E+00	.51221E+00	.61583E+00	.35977E+00
.77155E-01	.11079E+00	.14419E+00	.17862E+00	.82484E-01
.19756E-01	.92388E-02	-.29301E-02	-.11323E-01	-.10274E-01
-.25524E+00	-.45014E+00	-.64576E+00	-.82444E+00	-.41975E+00

FOR SURFACE 27

-.22063E+00	-.66035E+00	-.12827E+01	-.17903E+01	-.10721E+01
-.24219E-01	-.94383E-01	-.22389E+00	-.33037E+00	-.39245E+00
-.14865E-01	-.60488E-01	-.15311E+00	-.22746E+00	-.42499E+00
-.69449E-02	-.19498E-02	-.51913E-01	-.99233E-01	-.39249E+00
.71613E-01	.17953E+00	.28145E+00	.32919E+00	-.22828E-01

FOR SURFACE 28

.28237E+00	.75515E+00	.13274E+01	.17690E+01	.10734E+01
.58637E-01	.13632E+00	.19970E+00	.26258E+00	.29798E+00
.20845E-01	.40475E-01	.37636E-01	.31767E-01	.21774E+00
.81468E-02	.36365E-02	-.26761E-01	-.60218E-01	.19615E+00
-.50783E-01	-.15666E+00	-.31931E+00	-.44820E+00	-.14959E+00

FOR SUBSURFACE 30				
.56203E+00	.51296E+00	.36899E+00	.16555E+00	.16322E-01
.03755E-01	.83474E-01	.62159E-01	.26930E-01	.99553E-03
.64417E-01	.59976E-01	.42390E-01	.16581E-01	-.31805E-02
.14005E-01	.17769E-01	.13533E-01	.32679E-02	-.10356E-01
-.14844E+00	-.12360E+00	-.89126E-01	-.38927E-01	-.14940E-01
FOR SUBSURFACE 31				
-.67996E+00	-.57377E+00	-.39208E+00	-.17259E+00	-.18741E-01
-.13386E+00	-.10274E+00	-.89213E-01	-.28222E-01	-.24223E-02
-.42457E-01	-.30642E-01	-.18754E-01	-.89582E-02	.20596E-02
-.10723E-01	-.25429E-02	-.47929E-03	-.11278E-02	.61449E-02
.14121E+00	.12492E+00	.86005E-01	.34585E-01	.65353E-02
FOR SUBSURFACE 33				
-.23683E+00	-.68066E+00	-.12939E+01	-.16995E+01	-.79758E+00
-.43758E-01	-.12314E+00	-.20396E+00	-.24330E+00	.10400E+00
-.37047E-01	-.95035E-01	-.13926E+00	-.13840E+00	.20607E+00
-.17294E-01	-.41695E-01	-.42407E-01	-.35046E-02	.31679E+00
.50636E-01	.14732E+00	.29965E+00	.43185E+00	.42533E+00
FOR SUBSURFACE 34				
.27089E+00	.74493E+00	.13675E+01	.18664E+01	.10525E+01
.50350E-01	.13253E+00	.24729E+00	.34503E+00	.59768E-01
.13853E-01	.39664E-01	.87800E-01	.13789E+00	-.13319E+00
.88585E-03	.30078E-02	.23352E-01	.47707E-01	-.20028E+00
-.63241E-01	-.16356E+00	-.28045E+00	-.34170E+00	-.26362E+00

SAMPLE CASE 3:

BO-105 FUSELAGE (NO PYLON, NO ROTOR) WITH EFFECTS OF SEPARATION

Data Input

```

3
PROGRAM SHAPES
HUB PYLON FLOW SEPARATION
FUSELAGE - WITH SEPARATION EFFECTS
KREAD      0
*          12      0      0
**          0      1      1      1      0      0      0      0      0
***         0      0
UAMCH      .204      0.000      -0.000
ALFA       0.000      0.000
NBODY      0.000      12.000      38.000      41.000
NBODY      0.000      0.000      0.000      0.000
NBODY      0.000      0.000      0.000      0.000
NBODY      7.250      5.250      7.250      8.250
NWAKE       1      0      0      0
NPYLON      1      1
CSTAG     -20.000      1.000
KPRINT      1      1      1      1      0      1      1      1      1      1
NBODY1      4      2      1      1
NBODY2      4      4      1      1      1
NBODY3      4      4      2      1      1
  
```

Specifications of the Problem

FOR PART 1
NX= 4
NY= 4

FOR PART 2
NX= 4
NY= 4

FOR PART 3
NX= 4
NY= 4

FOR PART 5
NX= 4
NY= 4

FOR PART 6
NX= 4
NY= 4

FOR PART 7
NX= 4
NY= 4

FOR PART 9
NX= 4
NY= 4

FOR PART 10
NX= 4
NY= 4

FOR PART 11
NX= 4
NY= 4

FOR PART 13
NX= 4
NY= 4

FOR PART 14
NX= 4
NY= 4

FOR PART 15
NX= 4
NY= 4

NELE=132

KSXMMY= 0
KSXMMZ= 0

X, Y, and Z Coordinates of the Nodes

NODE #	X	Y	Z
1	0.0000	0.0000	0.0000
2	.7500	-0.0000	2.0625
3	3.0000	-0.0000	-4.1250
4	6.7500	-0.0000	5.1875
5	12.0000	0.0000	8.2500
6	.7500	.5935	1.9055
7	3.0000	1.3672	3.8110
8	6.7500	2.0808	5.7165
9	12.0000	2.7745	7.6220
10	.7500	1.2913	1.4534
11	3.0000	2.5632	2.5162
12	6.7500	3.8449	-4.3752
13	12.0000	5.1262	5.8333
14	.7500	1.3745	.7892
15	3.0000	3.3496	1.5747
16	6.7500	5.0239	2.3675
17	12.0000	6.5981	3.1571
18	.7500	1.8125	0.0000
19	3.0000	3.5250	0.0000
20	6.7500	5.4375	0.0000
21	12.0000	7.2500	0.0000
22	18.5000	-0.0000	8.2500
23	25.0000	-0.0000	9.2500
24	31.5000	-0.0000	9.2500
25	38.0000	-0.0000	9.2500
26	18.5000	2.7745	7.6220
27	25.0000	2.7745	7.6220
28	31.5000	2.7745	7.6220
29	38.0000	2.7745	7.6220
30	18.5000	5.1262	5.8333
31	25.0000	5.1262	5.8333
32	31.5000	5.1262	5.8333
33	38.0000	5.1262	5.8333
34	18.5000	6.5981	3.1571
35	25.0000	6.5981	3.1571
36	31.5000	6.5981	3.1571
37	38.0000	6.5981	3.1571
38	18.5000	7.2500	0.0000
39	25.0000	7.2500	0.0000
40	31.5000	7.2500	0.0000
41	38.0000	7.2500	0.0000
42	39.3125	-0.0000	8.1875
43	40.2500	-0.0000	-4.1250
44	40.3125	-0.0000	2.0625
45	40.0000	0.0000	0.0000
46	39.3125	2.0808	5.7165
47	40.2500	1.3672	3.8110
48	40.3125	.5935	1.9055
49	39.3125	3.8449	-4.3752
50	40.2500	2.5632	2.9162
51	40.3125	1.2913	1.4534
52	39.3125	5.0239	2.3675
53	40.2500	3.3496	1.5747
54	40.3125	1.6745	.7892
55	39.3125	5.4375	0.0000
56	40.2500	3.5250	0.0000
57	40.3125	1.8125	0.0000
58	.7500	-0.0000	-2.0625
59	3.0000	-0.0000	-4.1250
60	6.7500	-0.0000	-5.1875
61	12.0000	-0.0000	-8.2500
62	.7500	.5935	-1.9055
63	3.0000	1.3672	-3.8110
64	6.7500	2.0808	-5.7165
65	12.0000	2.7745	-7.6220
66	.7500	1.2913	-1.4534
67	3.0000	2.5632	-2.5162
68	6.7500	3.8449	-4.3752

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69	12.00000	5.12552	-5.63363
70	.75000	1.57153	-7.74928
71	3.00000	3.54905	-1.57357
72	6.75000	5.02359	-2.36765
73	12.00000	6.59913	-3.15714
74	18.00000	-0.00000	-3.25000
75	25.00000	-0.00000	-3.25000
76	31.50000	-0.00000	-3.25000
77	38.00000	-0.00000	-3.25000
78	44.50000	2.77445	-7.62201
79	51.00000	2.77445	-7.62201
80	57.50000	2.77445	-7.62201
81	64.00000	2.77445	-7.62201
82	70.50000	5.12552	-5.63363
83	77.00000	5.12552	-5.63363
84	83.50000	5.12552	-5.63363
85	90.00000	5.12552	-5.63363
86	96.50000	5.59813	-3.15714
87	103.00000	5.59813	-3.15714
88	109.50000	5.59813	-3.15714
89	116.00000	5.59813	-3.15714
90	122.50000	-0.00000	-0.00000
91	129.00000	-0.00000	-0.00000
92	135.50000	-0.00000	-2.05250
93	142.00000	2.05250	-5.71550
94	148.50000	1.33723	-3.81100
95	155.00000	5.59813	-1.93550
96	161.50000	3.84419	-4.37522
97	168.00000	2.56326	-2.91582
98	174.50000	1.28163	-1.45841
99	181.00000	5.12359	-2.36785
100	187.50000	3.34906	-1.57087
101	194.00000	1.57453	-0.78928
102	200.50000	-0.63361	1.95557
103	207.00000	-1.32723	3.81100
104	213.50000	-2.08084	5.71550
105	220.00000	-2.77445	7.62201
106	226.50000	-1.28163	1.45841
107	233.00000	-2.56326	2.91582
108	239.50000	-3.84419	4.37522
109	246.00000	-5.12552	5.63363
110	252.50000	-1.57453	7.92201
111	259.00000	-3.34906	1.57087
112	265.50000	-5.02359	2.36785
113	272.00000	-6.59913	3.15714
114	278.50000	-1.51250	0.00000
115	285.00000	-3.62500	0.00000
116	291.50000	-5.43750	0.00000
117	298.00000	-7.25000	0.00000
118	304.50000	-2.77445	7.62201
119	311.00000	-2.77445	7.62201
120	317.50000	-2.77445	7.62201
121	324.00000	-2.77445	7.62201
122	330.50000	-5.12552	5.63363
123	337.00000	-5.12552	5.63363
124	343.50000	-5.12552	5.63363
125	350.00000	-5.12552	5.63363
126	356.50000	-6.59913	3.15714
127	363.00000	-5.59813	3.15714
128	369.50000	-5.59813	3.15714
129	376.00000	-5.59813	3.15714
130	382.50000	-7.25000	0.00000
131	389.00000	-7.25000	0.00000
132	395.50000	-7.25000	0.00000
133	402.00000	-7.25000	0.00000
134	408.50000	-2.05250	5.71550
135	415.00000	-1.33723	3.81100
136	421.50000	-0.63361	1.95557
137	428.00000	-3.84419	4.37522
138	434.50000	-2.56326	2.91582
139	441.00000	-1.28163	1.45841
140	447.50000	-0.63361	2.36785

141	-0.25000	-3.3-906	1.57057
142	-0.81250	-1.57493	.78928
143	39.31250	-3.43740	0.00000
144	-0.25000	-3.32510	1.00000
145	40.81250	-1.31240	0.00000
146	.75000	-.33361	-1.40550
147	3.00000	-1.38723	-3.61100
148	6.75000	-2.09034	-5.71650
149	12.00000	-2.77445	-7.02201
150	.75000	-1.25163	-1.45841
151	3.00000	-2.35326	-2.41682
152	6.75000	-3.34439	-4.37522
153	12.00000	-3.12362	-3.63363
154	.75000	-1.57453	-.78928
155	3.00000	-3.34306	-1.57657
156	6.75000	-4.02379	-2.36749
157	12.00000	-5.39113	-3.15714
158	18.00000	-2.77445	-7.02201
159	24.00000	-2.77445	-7.02201
160	31.50000	-2.77445	-7.02201
161	38.00000	-2.77445	-7.02201
162	44.50000	-3.12362	-3.63363
163	51.00000	-3.12362	-3.63363
164	57.50000	-3.12362	-3.63363
165	64.00000	-3.12362	-3.63363
166	70.50000	-3.59413	-3.15714
167	77.00000	-3.59413	-3.15714
168	83.50000	-3.59413	-3.15714
169	90.00000	-3.59413	-3.15714
170	96.50000	-2.35326	-2.41682
171	103.00000	-1.31240	-1.00000
172	109.50000	-.33361	-1.40550
173	116.00000	-3.34439	-4.37522
174	-0.25000	-2.35326	-2.41682
175	-0.81250	-1.25163	-1.45841
176	39.31250	-3.43740	-2.36749
177	40.81250	-1.31240	-1.57657
178	-0.81250	-1.57493	-.78928

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X, Y, and Z Coordinates of the Centroid of Aerodynamic Panels

ELEM#	XPC	YPC	ZPC
1	.3306	.17340	.33200
2	1.91528	.52021	2.97800
3	4.97972	.35702	4.35000
4	9.57536	1.21332	6.34400
5	.38306	.73914	.84000
6	1.91528	1.48143	2.52203
7	4.97972	2.45905	4.20409
8	9.57536	3.43667	5.88611
9	.38306	.73914	.84000
10	1.91528	2.21712	1.68577
11	4.97972	3.59520	2.80912
12	9.57536	4.97328	3.93345
13	.38306	.87175	.19732
14	1.91528	2.51527	.59196
15	4.97972	4.35079	.93661
16	9.57536	6.10231	1.35125
17	15.57758	1.38723	7.93610
18	22.21721	1.38723	7.93610
19	28.85683	1.38723	7.93610
20	35.49646	1.38723	7.93610
21	15.57758	3.35049	6.72702
22	22.21721	3.35049	6.72702
23	28.85683	3.35049	6.72702
24	35.49646	3.35049	6.72702
25	15.57758	5.31233	4.49539
26	22.21721	5.31233	4.49539
27	28.85683	5.31233	4.49539
28	35.49646	5.31233	4.49539
29	15.57758	6.37406	1.57857
30	22.21721	6.37406	1.57857
31	28.85683	6.37406	1.57857
32	35.49646	6.37406	1.57857
33	39.48662	1.21332	5.94410
34	40.63578	.35702	.96000
35	41.40190	.52021	2.97800
36	41.78495	.17340	.33200
37	39.48662	3.43667	5.88611
38	40.63578	2.45905	4.20409
39	41.40190	1.48143	2.52203
40	41.78495	.73914	.84000
41	39.48662	5.17320	3.93345
42	40.63578	3.59520	2.80912
43	41.40190	2.21712	1.68577
44	41.78495	.73914	.84000
45	39.48662	5.11231	1.35125
46	40.63578	4.35079	.93661
47	41.40190	2.51527	.59196
48	41.78495	.87175	.19732
49	.38306	.17340	.33200
50	1.91528	.52021	2.97800
51	4.97972	.35702	4.35000
52	9.57536	1.21332	6.34400
53	.38306	.45381	.34000
54	1.91528	1.48143	2.52203
55	4.97972	2.45905	4.20409
56	9.57536	3.43667	5.88611
57	.38306	.73914	.84000
58	1.91528	2.21712	1.68577
59	4.97972	3.59520	2.80912
60	9.57536	4.97328	3.93345
61	.38306	.87175	.19732
62	1.91528	2.51527	.59196
63	4.97972	4.35079	.93661
64	9.57536	6.10231	1.35125

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65	15.57758	1.33723	-7.93600
66	22.21721	1.38723	-7.93600
67	28.85683	1.38723	-7.93600
68	35.49646	1.38723	-7.93600
69	15.57758	3.95049	-6.72782
70	22.21721	3.95049	-6.72782
71	28.85683	3.95049	-6.72782
72	35.49646	3.95049	-6.72782
73	15.57758	5.31233	-4.49538
74	22.21721	5.31233	-4.49538
75	28.85683	5.31233	-4.49538
76	35.49646	5.31233	-4.49538
77	15.57758	6.37405	-1.57857
78	22.21721	6.37405	-1.57857
79	28.85683	6.37405	-1.57857
80	35.49646	6.37405	-1.57857
81	39.48652	1.21332	-6.94400
82	-0.63578	3.95049	-6.72782
83	41.40190	5.31233	-4.49538
84	41.78495	6.37405	-1.57857
85	39.48652	1.21332	-6.94400
86	-0.63578	3.95049	-6.72782
87	41.40190	5.31233	-4.49538
88	-1.78495	6.37405	-1.57857
89	39.48652	1.21332	-6.94400
90	40.63578	3.95049	-6.72782
91	-1.40190	2.21712	-1.63517
92	41.78495	6.37405	-1.57857
93	39.48652	1.21332	-6.94400
94	40.63578	3.95049	-6.72782
95	-1.40190	2.21712	-1.63517
96	41.78495	6.37405	-1.57857
97	38306	-1.7340	99200
98	1.91228	-2.21712	2.97000
99	4.97972	-6.37405	1.57857
100	9.57538	-1.21332	6.94400
101	3.3806	-4.3351	3.04000
102	1.91228	-2.21712	2.97000
103	4.97972	-6.37405	1.57857
104	9.57538	-1.21332	6.94400
105	38306	-1.7340	99200
106	1.91228	-2.21712	2.97000
107	4.97972	-6.37405	1.57857
108	9.57538	-1.21332	6.94400
109	38306	-1.7340	99200
110	1.91228	-2.21712	2.97000
111	4.97972	-6.37405	1.57857
112	9.57538	-1.21332	6.94400
113	15.57758	-1.38723	7.93600
114	22.21721	-1.38723	7.93600
115	28.85683	-1.38723	7.93600
116	35.49646	-1.38723	7.93600
117	15.57758	-3.95049	-6.72782
118	22.21721	-3.95049	-6.72782
119	28.85683	-3.95049	-6.72782
120	35.49646	-3.95049	-6.72782
121	15.57758	-5.31233	-4.49538
122	22.21721	-5.31233	-4.49538
123	28.85683	-5.31233	-4.49538
124	35.49646	-5.31233	-4.49538
125	15.57758	-6.37405	-1.57857
126	22.21721	-6.37405	-1.57857
127	28.85683	-6.37405	-1.57857
128	35.49646	-6.37405	-1.57857
129	39.48652	-1.21332	-6.94400
130	40.63578	-3.95049	-6.72782
131	41.40190	-5.31233	-4.49538
132	41.78495	-6.37405	-1.57857
133	39.48652	-1.21332	-6.94400
134	-0.63578	-3.95049	-6.72782
135	41.40190	-5.31233	-4.49538

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136	41.78495	-4.4331	.34098
137	39.48662	-5.17323	3.93346
138	40.63573	-3.55520	2.30962
139	41.40190	-2.21712	1.86577
140	41.78495	-4.73904	.56152
141	39.48662	-6.10231	1.36125
142	40.63578	-4.35874	.55501
143	41.40190	-2.51527	.55155
144	41.78495	-3.37175	.19732
145	39.48662	-4.17340	-.33200
146	40.63578	-5.32021	-2.97600
147	41.78495	-6.55702	-4.33000
148	39.48662	-7.81352	-5.94400
149	40.63578	-9.09001	-7.64000
150	41.78495	-10.38643	-9.32253
151	39.48662	-11.70285	-11.00000
152	40.63578	-13.03927	-12.68253
153	41.78495	-14.39569	-14.36500
154	39.48662	-15.77211	-16.04753
155	40.63578	-17.16853	-17.73000
156	41.78495	-18.58495	-19.41253
157	39.48662	-20.02137	-21.09500
158	40.63578	-21.47779	-22.77753
159	41.78495	-22.95421	-24.46000
160	39.48662	-24.45063	-26.14253
161	40.63578	-25.96705	-27.82500
162	41.78495	-27.50347	-29.50753
163	39.48662	-29.05989	-31.19000
164	40.63578	-30.63631	-32.87253
165	41.78495	-32.23273	-34.55500
166	39.48662	-33.84915	-36.23753
167	40.63578	-35.48557	-37.92000
168	41.78495	-37.14199	-39.60253
169	39.48662	-38.81841	-41.28500
170	40.63578	-40.51483	-42.96753
171	41.78495	-42.23125	-44.65000
172	39.48662	-43.96767	-46.33253
173	40.63578	-45.72409	-48.01500
174	41.78495	-47.50051	-49.69753
175	39.48662	-49.29693	-51.38000
176	40.63578	-51.11335	-53.06253
177	41.78495	-52.94977	-54.74500
178	39.48662	-54.80619	-56.42753
179	40.63578	-56.68261	-58.11000
180	41.78495	-58.57903	-59.79253
181	39.48662	-60.49545	-61.47500
182	40.63578	-62.43187	-63.15753
183	41.78495	-64.38829	-64.84000
184	39.48662	-66.36471	-66.52253
185	40.63578	-68.36113	-68.20500
186	41.78495	-70.37755	-69.88753
187	39.48662	-72.41397	-71.57000
188	40.63578	-74.47039	-73.25253
189	41.78495	-76.54681	-74.93500
190	39.48662	-78.64323	-76.61753
191	40.63578	-80.75965	-78.30000
192	41.78495	-82.89607	-80.00000

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Nodal Numbering for Surfaces

FOR SURFACE 1

1	1	1	1	1
2	6	10	14	18
3	7	11	15	19
4	8	12	16	20
5	9	13	17	21

FOR SURFACE 2

5	9	13	17	21
22	26	30	34	38
23	27	31	35	39
24	28	32	36	40
25	29	33	37	41

FOR SURFACE 3

25	29	33	37	41
42	46	50	54	58
43	47	51	55	59
44	48	52	56	60
45	49	53	57	61

FOR SURFACE 5

1	1	1	1	1
58	62	66	70	74
59	63	67	71	75
60	64	68	72	76
61	65	69	73	77

FOR SURFACE 6

61	65	69	73	77
74	78	82	86	90
75	79	83	87	91
76	80	84	88	92
77	81	85	89	93

FOR SURFACE 7

77	81	85	89	93
90	94	98	102	106
91	95	99	103	107
92	96	100	104	108
93	97	101	105	109

FOR SURFACE 9

1	1	1	1	1
2	102	106	110	114
3	103	107	111	115
4	104	108	112	116
5	105	109	113	117

FOR SURFACE 10

5	105	109	113	117
22	118	122	126	130
23	119	123	127	131
24	120	124	128	132
25	121	125	129	133

FOR SURFACE 11

25	121	125	129	133
42	134	137	140	143
43	135	138	141	144
44	136	139	142	145
45	45	45	45	45

FOR SURFACE 13

1	1	1	1	1
58	146	150	154	114
59	147	151	155	115
60	148	152	156	116
61	149	153	157	117

FOR SURFACE 14

61	149	153	157	117
74	158	162	166	130
75	159	163	167	131
76	160	164	168	132
77	161	165	169	133

FOR SURFACE 15

77	161	165	169	133
90	170	173	175	143
91	171	174	177	144
92	172	175	178	145
45	45	45	45	45

Nodal Numbering for Elements

ELEM	++	+-	-+	--
1	1	2	1	1
2	7	5	5	2
3	9	4	7	3
4	9	7	5	4
5	10	6	1	1
6	11	7	11	6
7	12	8	11	7
8	13	9	12	8
9	14	10	1	1
10	15	11	14	10
11	15	12	15	11
12	17	13	16	12
13	18	14	1	1
14	19	15	19	14
15	20	16	19	15
16	21	17	20	16
17	23	22	3	3
18	27	23	25	22
19	28	24	27	23
20	29	25	28	24
21	30	26	13	9
22	31	27	30	26
23	32	28	31	27
24	33	29	32	28
25	34	30	17	13
26	35	31	34	30
27	36	32	35	31
28	37	33	36	32
29	38	34	37	33
30	39	35	38	34
31	40	36	39	35
32	41	37	40	36
33	42	38	41	37
34	43	39	42	38
35	44	40	43	39
36	45	41	44	40
37	46	42	45	41
38	50	47	49	46
39	51	48	50	47
40	52	49	51	48
41	53	50	52	49
42	54	51	53	50
43	55	52	54	51
44	56	53	55	52
45	57	54	56	53
46	58	55	57	54
47	59	56	58	55
48	60	57	59	56
49	61	58	60	57
50	62	59	61	58
51	63	60	62	59
52	64	61	63	60
53	65	62	64	61
54	66	63	65	62
55	67	64	66	63
56	68	65	67	64
57	69	66	68	65
58	70	67	69	66
59	71	68	70	67
60	72	69	71	68
61	73	70	72	69
62	74	71	73	70
63	75	72	74	71
64	76	73	75	72

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65	74	78	81	85
66	75	79	82	86
67	76	80	83	87
68	77	81	84	88
69	78	82	85	89
70	79	83	86	90
71	80	84	87	91
72	81	85	88	92
73	82	86	89	93
74	83	87	90	94
75	84	88	91	95
76	85	89	92	96
77	86	90	93	97
78	87	91	94	98
79	88	92	95	99
80	89	93	96	100
81	90	94	97	101
82	91	95	98	102
83	92	96	99	103
84	93	97	100	104
85	94	98	101	105
86	95	99	102	106
87	96	100	103	107
88	97	101	104	108
89	98	102	105	109
90	99	103	106	110
91	100	104	107	111
92	101	105	108	112
93	102	106	109	113
94	103	107	110	114
95	104	108	111	115
96	105	109	112	116
97	106	110	113	117
98	107	111	114	118
99	108	112	115	119
100	109	113	116	120
101	110	114	117	121
102	111	115	118	122
103	112	116	119	123
104	113	117	120	124
105	114	118	121	125
106	115	119	122	126
107	116	120	123	127
108	117	121	124	128
109	118	122	125	129
110	119	123	126	130
111	120	124	127	131
112	121	125	128	132
113	122	126	129	133
114	123	127	130	134
115	124	128	131	135
116	125	129	132	136
117	126	130	133	137
118	127	131	134	138
119	128	132	135	139
120	129	133	136	140

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129	42	134	25	121
130	43	135	42	134
131	44	136	43	135
132	45	45	44	136
133	134	137	121	122
134	135	138	136	137
135	136	139	135	138
136	45	45	136	139
137	137	140	125	129
138	138	141	137	140
139	139	142	138	141
140	45	45	139	142
141	140	143	124	133
142	141	144	140	143
143	142	145	141	144
144	45	45	142	145
145	145	146	1	1
146	147	147	145	146
147	146	148	147	147
148	149	149	148	148
149	150	149	1	1
150	151	147	150	149
151	152	148	151	150
152	153	149	152	151
153	154	150	1	1
154	155	151	154	153
155	156	152	155	154
156	157	153	156	155
157	154	154	1	1
158	113	145	114	144
159	115	156	115	155
160	117	157	116	156
161	153	74	142	51
162	159	75	153	72
163	161	73	173	75
164	161	77	150	76
165	162	158	153	149
166	163	159	152	150
167	164	150	153	151
168	165	161	164	152
169	166	162	157	153
170	167	163	155	152
171	168	164	157	153
172	169	165	159	154
173	130	166	117	157
174	131	167	130	156
175	132	168	131	157
176	133	169	132	158
177	170	90	151	77
178	171	91	170	90
179	172	92	171	91
180	45	45	172	92
181	173	171	165	151
182	174	171	173	170
183	175	172	174	171
184	45	45	175	172
185	176	173	159	155
186	177	174	175	173
187	178	175	177	174
188	45	45	178	175
189	143	176	133	159
190	144	177	143	175
191	145	178	144	177
192	45	45	145	178

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The Distribution of the Source

FOR SUBSURFACE 1

- .11944E+04	- .11943E+04	- .11941E+04	- .11940E+04
- .11322E+04	- .11317E+04	- .11309E+04	- .11304E+04
- .10005E+04	- .99937E+03	- .99827E+03	- .99730E+03
- .75270E+03	- .75175E+03	- .75051E+03	- .74969E+03

FOR SUBSURFACE 2

- .29311E+03	- .29549E+03	- .29875E+03	- .30098E+03
- .41211E+02	- .41335E+02	- .41983E+02	- .42293E+02
- .18245E+03	- .18456E+03	- .18757E+03	- .18973E+03
- .50453E+03	- .51193E+03	- .51987E+03	- .52610E+03

FOR SUBSURFACE 3

- .10697E+04	- .10742E+04	- .10805E+04	- .10848E+04
- .13099E+04	- .13115E+04	- .13137E+04	- .13153E+04
- .14415E+04	- .14419E+04	- .14425E+04	- .14431E+04
- .15021E+04	- .15122E+04	- .15022E+04	- .15023E+04

FOR SUBSURFACE 5

- .11944E+04	- .11943E+04	- .11941E+04	- .11940E+04
- .11322E+04	- .11317E+04	- .11309E+04	- .11304E+04
- .10005E+04	- .99937E+03	- .99827E+03	- .99730E+03
- .75270E+03	- .75175E+03	- .75051E+03	- .74969E+03

FOR SUBSURFACE 6

-0.29311E+03	-0.29549E+03	-0.29875E+03	-0.30398E+03
-0.41211E+02	-0.41535E+02	-0.41983E+02	-0.42293E+02
.18245E+03	.18436E+03	.18757E+03	.18973E+03
.50453E+03	.51033E+03	.51987E+03	.52610E+03

FOR SUBSURFACE 7

.10697E+04	.10742E+04	.10805E+04	.10846E+04
.13099E+04	.13115E+04	.13137E+04	.13153E+04
.14415E+04	.14419E+04	.14426E+04	.14431E+04
.15021E+04	.15022E+04	.15022E+04	.15023E+04

FOR SUBSURFACE 9

-0.11944E+04	-0.11943E+04	-0.11941E+04	-0.11940E+04
-0.11322E+04	-0.11317E+04	-0.11309E+04	-0.11304E+04
-0.10005E+04	-0.99957E+03	-0.99827E+03	-0.99738E+03
-0.75270E+03	-0.75175E+03	-0.75051E+03	-0.74909E+03

FOR SUBSURFACE 10

-0.29311E+03	-0.29549E+03	-0.29875E+03	-0.30098E+03
-0.41211E+02	-0.41535E+02	-0.41983E+02	-0.42293E+02
.18245E+03	.18436E+03	.18757E+03	.18973E+03
.50453E+03	.51033E+03	.51987E+03	.52610E+03

FOR SUBSURFACE 11

.10697E+04	.10742E+04	.10805E+04	.10840E+04
.13099E+04	.13115E+04	.13137E+04	.13153E+04
.14415E+04	.14419E+04	.14426E+04	.14431E+04
.15021E+04	.15022E+04	.15022E+04	.15023E+04

FOR SUBSURFACE 13

-.11944E+04	-.11943E+04	-.11941E+04	-.11940E+04
-.11322E+04	-.11317E+04	-.11309E+04	-.11304E+04
-.49955E+03	-.49957E+03	-.49927E+03	-.49973E+03
-.75270E+03	-.75175E+03	-.75051E+03	-.74969E+03

FOR SUBSURFACE 14

-.29311E+03	-.29549E+03	-.29875E+03	-.30098E+03
-.41211E+02	-.41335E+02	-.41983E+02	-.42293E+02
.18245E+03	.18455E+03	.18757E+03	.18973E+03
.50453E+03	.51133E+03	.51987E+03	.52510E+03

FOR SUBSURFACE 15

.10697E+04	.10742E+04	.10805E+04	.10840E+04
.13099E+04	.13115E+04	.13137E+04	.13153E+04
.14415E+04	.14419E+04	.14426E+04	.14431E+04
.15021E+04	.15022E+04	.15022E+04	.15023E+04

The Distribution of the Velocity Potential

FOR SUBSURFACE 1			
$-.67872E+03$	$-.67879E+03$	$-.67892E+03$	$-.67915E+03$
$-.64670E+03$	$-.64671E+03$	$-.64690E+03$	$-.64760E+03$
$-.58307E+03$	$-.58329E+03$	$-.58396E+03$	$-.58536E+03$
$-.45087E+03$	$-.45151E+03$	$-.45303E+03$	$-.45560E+03$
FOR SUBSURFACE 2			
$-.12407E+03$	$-.12732E+03$	$-.13420E+03$	$-.14102E+03$
$-.11810E+02$	$-.15937E+02$	$-.22830E+02$	$-.31136E+02$
$.78425E+02$	$.72959E+02$	$.63175E+02$	$.51499E+02$
$.21893E+03$	$.21115E+03$	$.19549E+03$	$.17049E+03$
FOR SUBSURFACE 3			
$.76572E+03$	$.75131E+03$	$.72782E+03$	$.70411E+03$
$.90653E+03$	$.89511E+03$	$.87721E+03$	$.85861E+03$
$.96299E+03$	$.95337E+03$	$.94101E+03$	$.92914E+03$
$.96505E+03$	$.96313E+03$	$.95990E+03$	$.95621E+03$
FOR SUBSURFACE 5			
$-.68045E+03$	$-.68025E+03$	$-.67989E+03$	$-.67949E+03$
$-.65243E+03$	$-.65137E+03$	$-.65018E+03$	$-.64874E+03$
$-.59367E+03$	$-.59226E+03$	$-.58995E+03$	$-.58746E+03$
$-.46828E+03$	$-.46626E+03$	$-.46289E+03$	$-.45906E+03$

FOR SUBSURFACE 6

- .15193E+03	- .15151E+03	- .14998E+03	- .14894E+03
- .52254E+02	- .50039E+02	- .45609E+02	- .33118E+02
.18535E+02	.22-24E+02	.29785E+02	.33300E+02
.12757E+03	.13-28E+03	.14625E+03	.15155E+03

FOR SUBSURFACE 7

.65944E+03	.65364E+03	.67205E+03	.68527E+03
.82571E+03	.82937E+03	.83416E+03	.84398E+03
.90704E+03	.90935E+03	.91333E+03	.91267E+03
.94695E+03	.94735E+03	.94991E+03	.95274E+03

FOR SUBSURFACE 9

- .67872E+03	- .67379E+03	- .67692E+03	- .67919E+03
- .64670E+03	- .64671E+03	- .64694E+03	- .64760E+03
- .56307E+03	- .56329E+03	- .56396E+03	- .56536E+03
- .45087E+03	- .45181E+03	- .45303E+03	- .45560E+03

FOR SUBSURFACE 10

- .12407E+03	- .12732E+03	- .13424E+03	- .14102E+03
- .11810E+02	- .15437E+02	- .22830E+02	- .31136E+02
.78425E+02	.72953E+02	.63175E+02	.51499E+02
.21893E+03	.21019E+03	.19949E+03	.17649E+03

FOR SUBSURFACE 11

.76572E+03	.75131E+03	.72782E+03	.70411E+03
.90453E+03	.89511E+03	.87721E+03	.85361E+03
.96298E+03	.95357E+03	.94101E+03	.92914E+03
.96503E+03	.95313E+03	.95950E+03	.95621E+03

FOR SUBSURFACE 13

-.68049E+03	-.53025E+03	-.67985E+03	-.67349E+03
-.65243E+03	-.65157E+03	-.65016E+03	-.64374E+03
-.59367E+03	-.53226E+03	-.58995E+03	-.53746E+03
-.46828E+03	-.46626E+03	-.46289E+03	-.45906E+03

FOR SUBSURFACE 14

-.15193E+03	-.15151E+03	-.14998E+03	-.14654E+03
-.52254E+02	-.31133E+02	-.45609E+02	-.33116E+02
.18535E+02	.22424E+02	.29785E+02	.39350E+02
.12757E+03	.13429E+03	.14625E+03	.16155E+03

FOR SUBSURFACE 15

.65948E+03	.65334E+03	.67205E+03	.63527E+03
.82571E+03	.82837E+03	.83416E+03	.84398E+03
.90764E+03	.91135E+03	.91303E+03	.91367E+03
.94696E+03	.94795E+03	.94991E+03	.95274E+03

Pressure Distribution

FOR SUBSURFACE 1

.61577E+00	.10273E+01	.11106E+01	.11020E+01
.66014E+00	-.10644E+00	-.10991E+00	-.11134E+00
-.17570E+00	-.17734E+00	-.17959E+00	-.18145E+00
-.32859E+00	-.32903E+00	-.32882E+00	-.32753E+00

FOR SUBSURFACE 2

-.28964E+00	-.28751E+00	-.28430E+00	-.28075E+00
-.13356E+00	-.13243E+00	-.13023E+00	-.12704E+00
-.15172E+00	-.14859E+00	-.14413E+00	-.13851E+00
-.45281E+00	-.44751E+00	-.43959E+00	-.43215E+00

FOR SUBSURFACE 3

-.69056E+00	-.72971E+00	-.77607E+00	-.80326E+00
-.16853E+00	-.15559E+00	-.21161E+00	-.23123E+00
-.36355E-01	-.45608E-01	-.58911E-01	-.71302E-01
.28684E-02	.19030E-03	-.34147E-02	-.67667E-02

FOR SUBSURFACE 5

.96689E+00	.10318E+01	.11214E+01	.11330E+01
-.94236E-01	-.98972E-01	-.10516E+00	-.10972E+00
-.16570E+00	-.16370E+00	-.17483E+00	-.17870E+00
-.31676E+00	-.31937E+00	-.32244E+00	-.32543E+00

FOR SUBSURFACE 6

$-2.7501E+00$	$-2.7525E+00$	$-2.7607E+00$	$-2.7787E+00$
$-1.1324E+00$	$-1.1536E+00$	$-1.1695E+00$	$-1.2311E+00$
$-1.1960E+00$	$-1.2233E+00$	$-1.2702E+00$	$-1.3266E+00$
$-4.2368E+00$	$-4.2335E+00$	$-4.2460E+00$	$-4.2726E+00$

FOR SUBSURFACE 7

$-7.0167E+00$	$-7.325E+00$	$-7.7709E+00$	$-8.0523E+00$
$-2.0899E+00$	$-2.1340E+00$	$-2.3233E+00$	$-2.3817E+00$
$-6.9518E-01$	$-7.2507E-01$	$-7.6396E-01$	$-8.0379E-01$
$-1.1631E-01$	$-1.1401E-01$	$-1.0677E-01$	$-9.3713E-02$

FOR SUBSURFACE 9

$6.1577E+00$	$7.275E+00$	$1.1136E+01$	$1.1420E+01$
$6.6014E+00$	$-1.0544E+00$	$-1.0991E+00$	$-1.1134E+00$
$-1.17570E+00$	$-1.17734E+00$	$-1.17959E+00$	$-1.18045E+00$
$-3.2859E+00$	$-3.2903E+00$	$-3.2882E+00$	$-3.2753E+00$

FOR SUBSURFACE 10

$-2.8964E+00$	$-2.9751E+00$	$-2.8430E+00$	$-2.9075E+00$
$-1.3356E+00$	$-1.3243E+00$	$-1.3023E+00$	$-1.2704E+00$
$-1.15172E+00$	$-1.14399E+00$	$-1.14413E+00$	$-1.13651E+00$
$-4.5281E+00$	$-4.4751E+00$	$-4.4959E+00$	$-4.4715E+00$

FOR SUBSURFACE 11

$-.69056E+00$	$-.72371E+00$	$-.77507E+00$	$-.80526E+00$
$-.16858E+00$	$-.18538E+00$	$-.21101E+00$	$-.23123E+00$
$-.30355E-01$	$-.45504E-01$	$-.55911E-01$	$-.70362E-01$
$.28684E-02$	$.19090E-03$	$-.34147E-02$	$-.67367E-02$

FOR SUBSURFACE 13

$.96689E+00$	$.10318E+01$	$.11214E+01$	$.11630E+01$
$-.94236E-01$	$-.98472E-01$	$-.10516E+00$	$-.10972E+00$
$-.16570E+00$	$-.16970E+00$	$-.17483E+00$	$-.17070E+00$
$-.31676E+00$	$-.31937E+00$	$-.32266E+00$	$-.32543E+00$

FOR SUBSURFACE 14

$-.27501E+00$	$-.27525E+00$	$-.27607E+00$	$-.27787E+00$
$-.11324E+00$	$-.11536E+00$	$-.11895E+00$	$-.12311E+00$
$-.11960E+00$	$-.12233E+00$	$-.12702E+00$	$-.13266E+00$
$-.42368E+00$	$-.42395E+00$	$-.42480E+00$	$-.42726E+00$

FOR SUBSURFACE 15

$-.70167E+00$	$-.75425E+00$	$-.77709E+00$	$-.804523E+00$
$-.21099E+01$	$-.21944E+01$	$-.23233E+01$	$-.23517E+01$
$-.69518E-01$	$-.72907E-01$	$-.76396E-01$	$-.75379E-01$
$-.11431E-01$	$-.11401E-01$	$-.11877E-01$	$-.93713E-02$

AD-A055 767

AEROSPACE SYSTEMS INC BURLINGTON MASS

F/G 20/4

ROTOR WAKE EFFECTS ON HUB/PYLON FLOW. VOLUME II. PROGRAM SHAPES--ETC(U)

MAY 78 P 500H00, R B NOLL, L MORINO, N D HAMM DAAJ02-75-C-0041

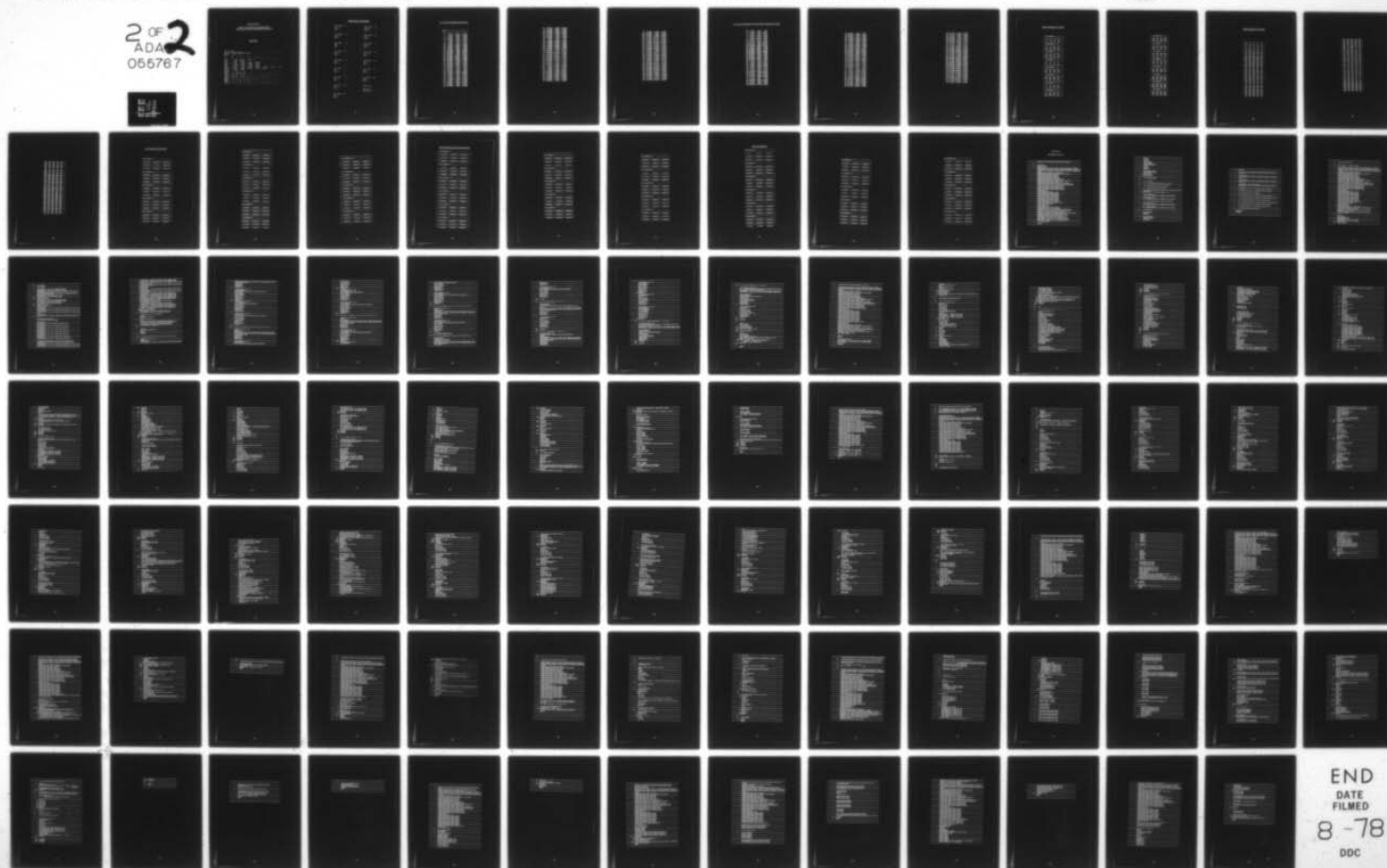
UNCLASSIFIED

ASI-TR-76-38-VOL-2

USARTL-TR-78-1B

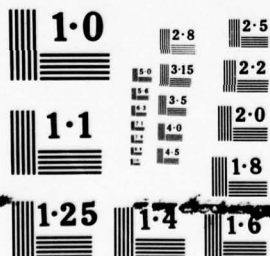
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2 OF 2
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2 OF 2
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055767



NATIONAL BUREAU OF STANDARDS

SAMPLE CASE 4:
MODEL 1 HELICOPTER CONFIGURATION
WITH ROTOR WAKE AND SEPARATION EFFECTS

Data Input

```

1
PROGRAM SHAPES
HUB PYLON FLOW SEPARATION
FUSELAGE - SINGLE ROTOR (TWO BLADES)
KREAD      0
*          16      0      0
**         0      1      1      1      0      0      0      0      1
***        0      0
UMACH      .047    3600.000    -0.000
ALFA       0.000    0.000
NBODY      1.000    9.000    18.000    36.000
NBODY      0.000    0.000    0.000    0.000
NBODY      0.000    0.000    0.000    0.000
NBODY      1.450    3.250    1.450    2.900
ROTOR      20.000    8.040    11.550    15.050    0.000    0.000    .121
IHET75     0.000    0.000    0.000    0.000    90.000
RPITCH     0.000    0.000
KBLADE     2      1
NWAKE      1      0      0      1
SPIRAL     18      3.000 450.000
NPYLON     1      1
CSIAG      -60.000    1.000
KPRINT     1      1      1      1      0      1      1      1      1      1
NBODY      1      3      2      1      1
NBODY      3      3      1      1      1
NBODY      3      3      2      1      1
NROTOR     3      3      2      1      1

```

Specifications of the Problem

FOR PART 1
NX= 3
NY= 3

FOR PART 13
NX= 3
NY= 3

FOR PART 2
NX= 3
NY= 3

FOR PART 14
NX= 3
NY= 3

FOR PART 3
NX= 3
NY= 3

FOR PART 15
NX= 3
NY= 3

FOR PART 5
NX= 3
NY= 3

FOR PART 24
NX= 3
NY= 3

FOR PART 6
NX= 3
NY= 3

FOR PART 25
NX= 3
NY= 3

FOR PART 7
NX= 3
NY= 3

FOR PART 27
NX= 3
NY= 3

FOR PART 9
NX= 3
NY= 3

FOR PART 28
NX= 3
NY= 3

FOR PART 10
NX= 3
NY= 3

NELEM=144
KSYM= 0
KSYMZ= 0

FOR PART 11
NX= 3
NY= 3

X, Y, and Z Coordinates of the Nodes

NODE*	X	Y	Z
1	0.00000	0.00000	0.00000
2	1.00000	-0.00000	1.00333
3	4.00000	-0.00000	2.16667
4	3.00000	0.00000	3.25000
5	1.00000	.24167	.93819
6	4.00000	.48333	1.07639
7	3.00000	.72500	2.01458
8	1.00000	.41858	.54167
9	4.00000	.83716	1.00333
10	3.00000	1.25574	1.62500
11	1.00000	.48333	-0.00000
12	4.00000	.96667	-0.00000
13	3.00000	1.45000	-0.00000
14	12.00000	-0.00000	3.13333
15	15.00000	-0.00000	3.01667
16	19.00000	0.00000	2.90000
17	12.00000	.72500	2.71355
18	15.00000	.72500	2.61251
19	19.00000	.72500	2.51147
20	12.00000	1.25574	1.56667
21	15.00000	1.25574	1.50033
22	18.00000	1.25574	1.45000
23	12.00000	1.45000	-0.00000
24	15.00000	1.45000	-0.00000
25	18.00000	1.45000	-0.00000
26	24.00000	-0.00000	1.93333
27	34.00000	-0.00000	.96667
28	36.00000	0.00000	0.00000
29	28.00000	.48333	1.67432
30	34.00000	.24167	.83716
31	23.00000	.83716	.96667
32	34.00000	.41858	.48333
33	28.00000	.96667	-0.00000
34	34.00000	.48333	-0.00000
35	1.00000	-0.00000	-1.00333
36	4.00000	-0.00000	-2.16667
37	9.00000	0.00000	-3.25000
38	1.00000	.24167	-.93819
39	4.00000	.48333	-1.07639
40	9.00000	.72500	-2.01458
41	1.00000	.41858	-.54167
42	4.00000	.83716	-1.00333
43	3.00000	1.25574	-1.62500
44	12.00000	-0.00000	-3.13333
45	15.00000	-0.00000	-3.01667
46	19.00000	0.00000	-2.90000
47	12.00000	.72500	-2.71355
48	15.00000	.72500	-2.61251

49	15.00000	.72500	-2.51147
50	12.00000	1.25574	-1.56667
51	15.00000	1.25574	-1.50033
52	15.00000	1.25574	-1.45000
53	25.00000	-.90000	-1.93333
54	34.00000	-.00000	-.96667
55	25.00000	.40333	-1.67432
56	34.00000	.24167	-.83716
57	25.00000	.83716	-.96667
58	34.00000	.41058	-.40333
59	1.00000	-.24167	.93019
60	4.00000	-.40333	1.07639
61	3.00000	-.72500	2.01458
62	1.00000	-.41058	.54167
63	4.00000	-.83716	1.00333
64	9.00000	-1.25574	1.62500
65	1.00000	-.40333	-.00000
66	4.00000	-.96667	-.00000
67	9.00000	-1.45000	-.00000
68	12.00000	-.72500	2.71355
69	15.00000	-.72500	2.61251
70	10.00000	-.72500	2.51147
71	12.00000	-1.25574	1.56667
72	15.00000	-1.25574	1.50033
73	15.00000	-1.25574	1.45000
74	12.00000	-1.45000	-.00000
75	15.00000	-1.45000	-.00000
76	15.00000	-1.45000	-.00000
77	25.00000	-.40333	1.67432
78	34.00000	-.24167	.83716
79	25.00000	-.83716	.96667
80	34.00000	-.41058	.40333
81	25.00000	-.96667	-.00000
82	34.00000	-.40333	-.00000
83	1.00000	-.24167	-.93019
84	4.00000	-.40333	-1.07639
85	3.00000	-.72500	-2.01458
86	1.00000	-.41058	-.54167
87	4.00000	-.83716	-1.00333
88	9.00000	-1.25574	-1.62500
89	12.00000	-.72500	-2.71355
90	15.00000	-.72500	-2.61251
91	10.00000	-.72500	-2.51147
92	12.00000	-1.25574	-1.56667
93	15.00000	-1.25574	-1.50033
94	15.00000	-1.25574	-1.45000
95	25.00000	-.40333	-1.67432
96	34.00000	-.24167	-.83716
97	25.00000	-.83716	-.96667

99	74.00000	-0.41858	-0.48333
99	11.55000	3.75000	6.67000
100	11.93889	3.75000	6.70462
101	13.10556	3.75000	6.75642
102	15.05000	3.75000	6.67000
103	11.55000	12.77778	6.67000
104	11.93889	12.77778	6.70462
105	13.10556	12.77778	6.75642
106	15.05000	12.77778	6.67000
107	11.55000	18.19444	6.67000
108	11.93889	18.19444	6.70462
109	13.10556	18.19444	6.75642
110	15.05000	18.19444	6.67000
111	11.55000	20.00000	6.67000
112	11.93889	20.00000	6.67000
113	13.10556	20.00000	6.67000
114	15.05000	20.00000	6.67000
115	11.93889	3.75000	6.63538
116	13.10556	3.75000	6.58358
117	11.93889	12.77778	6.63538
118	13.10556	12.77778	6.58358
119	11.93889	18.19444	6.63538
120	13.10556	18.19444	6.58358
121	-11.55000	-3.75000	6.67000
122	-11.93889	-3.75000	6.70462
123	-13.10556	-3.75000	6.75642
124	-15.05000	-3.75000	6.67000
125	-11.55000	-12.77778	6.67000
126	-11.93889	-12.77778	6.70462
127	-13.10556	-12.77778	6.75642
128	-15.05000	-12.77778	6.67000
129	-11.55000	-18.19444	6.67000
130	-11.93889	-18.19444	6.70462
131	-13.10556	-18.19444	6.75642
132	-15.05000	-18.19444	6.67000
133	-11.55000	-20.00000	6.67000
134	-11.93889	-20.00000	6.67000
135	-13.10556	-20.00000	6.67000
136	-15.05000	-20.00000	6.67000
137	-11.93889	-3.75000	6.63538
138	-13.10556	-3.75000	6.58358
139	-11.93889	-12.77778	6.63538
140	-13.10556	-12.77778	6.58358
141	-11.93889	-18.19444	6.63538
142	-13.10556	-18.19444	6.58358

X, Y, and Z Coordinates of the Centroid of Aerodynamic Panels

ELEM#	XPC	YPC	ZPC
1	.50055	.06042	.50538
2	2.50277	.18125	1.51615
3	6.50719	.30208	2.52691
4	.50055	.16506	.36997
5	2.50277	.49518	1.10390
6	6.50719	.82531	1.84983
7	.50055	.22548	.13542
8	2.50277	.67643	.40625
9	6.50719	1.12739	.67708
10	10.51162	.36250	2.97787
11	13.51494	.36250	2.86901
12	16.51825	.36250	2.76016
13	10.51162	.99037	2.17995
14	13.51494	.99037	2.10026
15	16.51825	.99037	2.02058
16	10.51162	1.35287	.79792
17	13.51494	1.35287	.76875
18	16.51825	1.35287	.73958
19	23.02545	.30208	2.25478
20	31.03438	.18125	1.35287
21	35.03872	.06042	.45096
22	23.02545	.82531	1.65061
23	31.03438	.49518	.99037
24	35.03872	.16506	.33012
25	23.02545	1.12739	.60417
26	31.03438	.67643	.36250
27	35.03872	.22548	.12083
28	.50055	.06042	-.50538
29	2.50277	.18125	-1.51615
30	6.50719	.30208	-2.52691
31	.50055	.16506	-.36997
32	2.50277	.49518	-1.10390
33	6.50719	.82531	-1.84983
34	.50055	.22548	-.13542
35	2.50277	.67643	-.40625
36	6.50719	1.12739	-.67708
37	10.51162	.36250	-2.97787
38	13.51494	.36250	-2.86901
39	16.51825	.36250	-2.76016
40	10.51162	.99037	-2.17995
41	13.51494	.99037	-2.10026
42	16.51825	.99037	-2.02058
43	10.51162	1.35287	-.79792
44	13.51494	1.35287	-.76875
45	16.51825	1.35287	-.73958
46	23.02545	.30208	-2.25478
47	31.03438	.18125	-1.35287
48	35.03872	.06042	-.45096
49	23.02545	.82531	-1.65061

50	31.03430	.49518	-.99037
51	35.03872	.16506	-.33012
52	23.02545	1.12739	-.60417
53	31.03430	.67643	-.36250
54	35.03872	.22548	-.12083
55	.50055	-.06042	-.50538
56	2.50277	-.18125	1.51615
57	6.50719	-.30208	2.52691
58	.50055	-.16506	.36997
59	2.50277	-.49518	1.10990
60	6.50719	-.82531	1.84983
61	.50055	-.22548	.13542
62	2.50277	-.67643	.40625
63	6.50719	-1.12739	.67708
64	10.51162	-.36250	2.97787
65	13.51494	-.36250	2.86901
66	16.51825	-.36250	2.76016
67	19.51162	-.99037	2.17995
68	13.51494	-.99037	2.18026
69	16.51825	-.99037	2.02050
70	10.51162	-1.35297	.79792
71	13.51494	-1.35297	.76875
72	16.51825	-1.35297	.73958
73	23.02545	-.30208	2.25678
74	31.03430	-.18125	1.35287
75	35.03872	-.06042	.45096
76	23.02545	-.82531	1.65061
77	31.03430	-.49518	.99037
78	35.03872	-.16506	.33012
79	23.02545	-1.12739	.60417
80	31.03430	-.67643	.36250
81	35.03872	-.22548	.12083
82	.50055	-.06042	-.50538
83	2.50277	-.18125	-1.51615
84	6.50719	-.30208	-2.52691
85	.50055	-.16506	-.36997
86	2.50277	-.49518	-1.10990
87	6.50719	-.82531	-1.84983
88	.50055	-.22548	-.13542
89	2.50277	-.67643	-.40625
90	6.50719	-1.12739	-.67708
91	10.51162	-.36250	-2.97787
92	13.51494	-.36250	-2.86901
93	16.51825	-.36250	-2.76016
94	10.51162	-.99037	-2.17995
95	13.51494	-.99037	-2.18026
96	16.51825	-.99037	-2.02050
97	10.51162	-1.35297	-.79792
98	13.51494	-1.35297	-.76875

99	16.11925	-1.35287	-0.73358
100	23.12945	-0.30208	-2.25479
101	31.13430	-0.18125	-1.35267
102	39.13872	-0.06042	-0.45096
103	23.02545	-0.82531	-1.65061
104	31.03430	-0.49518	-0.99037
105	39.03872	-0.16506	-0.33012
106	23.02545	-1.12739	-0.60417
107	31.03430	-0.67663	-0.36250
108	39.03872	-0.22548	-0.12083
109	11.75744	8.26389	6.68731
110	12.53608	8.26389	6.73052
111	14.19335	8.26389	6.71321
112	11.75744	15.48611	6.68731
113	12.53608	15.48611	6.73052
114	14.09335	15.48611	6.71321
115	11.75744	19.09722	6.67866
116	12.53608	19.09722	6.70026
117	14.19335	19.09722	6.69161
118	11.75744	8.26389	6.65269
119	12.53608	8.26389	6.60348
120	14.19335	8.26389	6.62679
121	11.75744	15.48611	6.65269
122	12.53608	15.48611	6.60948
123	14.09335	15.48611	6.62679
124	11.75744	19.09722	6.66134
125	12.53608	19.09722	6.63974
126	14.19335	19.09722	6.64839
127	-11.75744	-8.26389	6.68731
128	-12.53608	-8.26389	6.73052
129	-14.09335	-8.26389	6.71321
130	-11.75744	-15.48611	6.68731
131	-12.53608	-15.48611	6.73052
132	-14.09335	-15.48611	6.71321
133	-11.75744	-19.09722	6.67866
134	-12.53608	-19.09722	6.70026
135	-14.09335	-19.09722	6.69161
136	-11.75744	-8.26389	6.65269
137	-12.53608	-8.26389	6.60348
138	-14.09335	-8.26389	6.62679
139	-11.75744	-15.48611	6.65269
140	-12.53608	-15.48611	6.60948
141	-14.09335	-15.48611	6.62679
142	-11.75744	-19.09722	6.66134
143	-12.53608	-19.09722	6.63974
144	-14.09335	-19.09722	6.64839

Nodal Numbering for Surfaces

FOR SURFACE 1			
1	1	1	1
2	5	8	11
3	6	9	12
4	7	10	13

FOR SURFACE 2			
4	7	10	13
14	17	20	23
15	18	21	24
16	19	22	25

FOR SURFACE 3			
14	15	22	25
25	29	31	33
27	30	32	34
23	28	26	28

FOR SURFACE 5			
1	1	1	1
35	38	41	44
36	39	42	45
37	40	43	46

FOR SURFACE 6			
37	40	43	46
44	47	50	53
45	48	51	54
46	49	52	55

FOR SURFACE 7			
44	49	52	55
53	56	57	60
54	58	59	62
23	28	26	28

FOR SURFACE 9			
1	1	1	1
2	59	62	65
3	60	63	66
4	61	64	67

FOR SURFACE 10			
4	61	64	67
14	68	71	74
15	69	72	75
16	70	73	76

FOR SURFACE 11			
16	70	73	76
26	77	79	81
27	78	80	82
28	28	28	28

FOR SURFACE 13			
1	1	1	1
75	83	86	89
36	84	87	88
37	85	88	87

FOR SURFACE 14			
37	85	88	87
44	89	92	74
45	90	93	79
46	91	94	76

FOR SURFACE 15			
46	91	94	76
53	95	97	81
54	96	98	82
28	28	28	28

FOR SURFACE 24			
99	103	107	111
109	104	108	112
101	105	109	113
102	106	110	114

FOR SURFACE 25			
99	107	107	111
115	117	119	112
116	118	120	113
102	106	110	114

FOR SURFACE 27			
121	125	129	133
122	126	130	134
123	127	131	135
124	128	132	136

FOR SURFACE 28			
121	125	129	133
137	139	141	134
138	140	142	135
124	128	132	136

Nodal Numbering for Elements

ELEM	++	+-	-+	--
1	5	2	1	1
2	6	3	5	2
3	7	4	6	3
4	8	5	1	1
5	9	6	8	5
6	10	7	9	6
7	11	8	1	1
8	12	9	11	8
9	13	10	12	9
10	17	14	7	4
11	18	15	17	14
12	19	16	18	15
13	20	17	18	7
14	21	18	20	17
15	22	19	21	18
16	23	20	13	10
17	24	21	23	20
18	25	22	24	21
19	26	23	19	16
20	27	27	29	26
21	28	28	30	27
22	31	29	22	19
23	32	30	31	29
24	33	31	32	30
25	34	32	25	22
26	35	33	33	31
27	36	34	34	32
28	37	35	1	1
29	38	36	35	38
30	39	37	36	39
31	40	38	1	1
32	41	39	40	41
33	42	40	39	42
34	43	11	1	1
35	44	12	41	11
36	45	13	42	12
37	46	47	37	40
38	47	48	44	47
39	48	49	45	48
40	49	50	40	43
41	50	51	47	50
42	51	52	48	51
43	52	23	43	13
44	53	24	50	23
45	54	25	51	24
46	55	55	46	49
47	56	56	53	55
48	28	28	54	56

43	45	57	49	52
50	56	58	55	57
51	28	28	56	58
52	57	33	52	29
53	58	34	57	33
54	28	28	58	34
55	2	59	1	1
56	9	60	2	59
57	4	61	3	60
58	59	62	1	1
59	60	63	59	62
60	61	64	60	63
61	52	65	1	1
62	63	66	62	65
63	64	67	63	66
64	14	68	4	61
65	15	69	14	68
66	16	70	15	69
67	68	71	61	66
68	69	72	58	71
69	70	73	59	72
70	71	74	64	67
71	72	75	71	74
72	73	76	72	75
73	26	77	16	70
74	27	78	26	77
75	28	28	27	78
76	77	79	70	73
77	78	80	77	79
79	28	28	78	80
79	79	81	73	76
80	80	82	79	81
81	28	28	80	82
82	83	35	1	1
83	84	36	83	35
84	85	37	84	36
85	86	83	1	1
86	87	84	86	83
87	88	85	87	84
88	89	86	1	1
89	88	87	85	86
90	87	88	86	87
91	88	88	85	87
92	89	89	89	86
93	88	88	88	85
94	82	89	88	85
95	83	88	82	88
96	94	91	93	90

97	74	92	67	88
98	75	93	74	92
99	76	94	75	93
100	95	53	91	46
101	46	54	95	53
102	28	28	96	54
103	97	95	94	91
104	98	96	97	95
105	28	28	98	96
106	81	97	76	94
107	82	98	81	97
108	24	28	82	98
109	105	100	103	99
110	109	101	104	100
111	106	102	105	101
112	108	104	107	103
113	109	105	108	104
114	110	106	109	105
115	112	108	111	107
116	113	109	112	108
117	114	110	113	109
118	115	117	99	103
119	116	118	115	117
120	102	106	116	118
121	117	119	103	107
122	118	120	117	119
123	106	110	118	120
124	119	112	107	111
125	120	113	119	112
126	110	114	120	113
127	126	122	125	121
128	127	123	126	122
129	128	124	127	123
130	130	126	129	125
131	131	127	130	126
132	132	128	131	127
133	133	130	133	129
134	135	131	134	130
135	136	132	135	131
136	137	139	121	125
137	138	140	137	139
138	124	128	138	140
139	139	141	125	129
140	140	142	139	141
141	128	132	140	142
142	141	134	129	133
143	142	135	141	134
144	132	136	142	135

The Distribution of the Source

FOR SURFACE 1

-0.89135E+02	-0.89462E+02	-0.89131E+02
--------------	--------------	--------------

-0.84427E+02	-0.84701E+02	-0.84594E+02
--------------	--------------	--------------

-0.74571E+02	-0.74639E+02	-0.74282E+02
--------------	--------------	--------------

FOR SURFACE 2

-0.47538E+02	-0.49261E+02	-0.48983E+02
--------------	--------------	--------------

-0.27588E+02	-0.28720E+02	-0.30053E+02
--------------	--------------	--------------

-0.11036E+02	-0.11957E+02	-0.14521E+02
--------------	--------------	--------------

FOR SURFACE 3

0.75639E+01	0.69589E+01	0.54540E+01
-------------	-------------	-------------

0.13844E+02	0.13474E+02	0.12740E+02
-------------	-------------	-------------

0.16507E+02	0.16315E+02	0.15939E+02
-------------	-------------	-------------

FOR SURFACE 4

-0.89536E+02	-0.89430E+02	-0.89141E+02
--------------	--------------	--------------

-0.84723E+02	-0.84573E+02	-0.84537E+02
--------------	--------------	--------------

-0.72623E+02	-0.72787E+02	-0.73400E+02
--------------	--------------	--------------

FOR SURFACE 5

-0.42652E+02	-0.44604E+02	-0.47102E+02
--------------	--------------	--------------

-0.29142E+02	-0.29854E+02	-0.30444E+02
--------------	--------------	--------------

-0.18342E+02	-0.17929E+02	-0.16803E+02
--------------	--------------	--------------

FOR SUBSURFACE 7

.10734E+01 .20296E+01 .35994E+01

.10713E+02 .11148E+02 .11893E+02

.15577E+02 .15562E+02 .15663E+02

FOR SUBSURFACE 9

-.39783E+02 -.89429E+02 -.89089E+02

-.94614E+02 -.84210E+02 -.84007E+02

-.73652E+02 -.72497E+02 -.71870E+02

FOR SUBSURFACE 10

-.46084E+02 -.46123E+02 -.46406E+02

-.27711E+02 -.29855E+02 -.30431E+02

-.12567E+02 -.14895E+02 -.17301E+02

FOR SUBSURFACE 11

.70612E+01 .56619E+01 .38513E+01

.13799E+02 .13237E+02 .12415E+02

.16538E+02 .16263E+02 .15865E+02

FOR SUBSURFACE 13

-.89829E+02 -.89462E+02 -.89108E+02

-.84522E+02 -.84266E+02 -.84043E+02

-.72382E+02 -.71951E+02 -.71744E+02

FOR SUBSURFACE 14

-.42542E+02 -.44183E+02 -.45755E+02

-.29117E+02 -.30135E+02 -.30047E+02

-.18788E+02 -.19842E+02 -.18739E+02

FOR SURFACE 15

.74244E+00 .10670E+01 .21650E+01

.10617E+02 .10890E+02 .11551E+02

.15596E+02 .15506E+02 .15509E+02

FOR SURFACE 24

-.78755E+03 -.70861E+03 -.62415E+03

-.26131E+03 -.48756E+03 -.61623E+03

.23480E+03 .48777E+03 -.42148E+02

FOR SURFACE 25

-.38756E+03 -.70861E+03 -.62415E+03

-.26133E+03 -.48756E+03 -.61628E+03

.23479E+03 .48777E+03 -.42148E+02

FOR SURFACE 27

-.37486E+03 -.69827E+03 -.61925E+03

-.25512E+03 -.48144E+03 -.61353E+03

.22337E+03 .39747E+03 -.48037E+02

FOR SURFACE 28

-.37646E+03 -.69828E+03 -.61925E+03

-.25517E+03 -.48144E+03 -.61353E+03

.22336E+03 .39747E+03 -.48039E+02

The Distribution of the Velocity Potential

FOR SURFACE 1

- .46059E+02	- .45837E+02	- .45642E+02
--------------	--------------	--------------

- .43304E+02	- .43535E+02	- .43832E+02
--------------	--------------	--------------

- .38208E+02	- .39314E+02	- .39933E+02
--------------	--------------	--------------

FOR SURFACE 2

- .20751E+02	- .23836E+02	- .25505E+02
--------------	--------------	--------------

- .96652E+01	- .11712E+02	- .15051E+02
--------------	--------------	--------------

.59479E+01	.58202E+01	.19663E+01
------------	------------	------------

FOR SURFACE 3

- .10816E+03	- .10755E+03	- .81939E+02
--------------	--------------	--------------

- .50172E+03	- .35268E+03	- .23162E+03
--------------	--------------	--------------

- .28712E+03	- .26490E+03	- .23473E+03
--------------	--------------	--------------

FOR SURFACE 4

- .46449E+02	- .46103E+02	- .45735E+02
--------------	--------------	--------------

- .44569E+02	- .44330E+02	- .44107E+02
--------------	--------------	--------------

- .40363E+02	- .40151E+02	- .40099E+02
--------------	--------------	--------------

FOR SURFACE 5

- .24928E+02	- .25525E+02	- .25893E+02
--------------	--------------	--------------

- .20842E+02	- .20185E+02	- .18347E+02
--------------	--------------	--------------

- .17573E+02	- .14880E+02	- .10502E+02
--------------	--------------	--------------

FOR SURFACE 6

- .46017E+02	- .51944E+02	- .68332E+02
--------------	--------------	--------------

- .11458E+03	- .12897E+03	- .16636E+03
--------------	--------------	--------------

- .17639E+03	- .18723E+03	- .28728E+03
--------------	--------------	--------------

FOR SURFACE 9

- .46016E+02 - .45697E+02 - .45453E+02

- .42909E+02 - .42573E+02 - .42661E+02

- .36572E+02 - .35876E+02 - .36314E+02

FOR SURFACE 10

- .18557E+02 - .19743E+02 - .22044E+02

- .96158E+01 - .12030E+02 - .15413E+02

.41598E+01 .20712E+01 - .17663E+01

FOR SURFACE 11

- .10339E+03 - .10960E+03 - .84478E+02

- .50095E+03 - .35233E+03 - .23248E+03

- .28715E+03 - .26507E+03 - .23491E+03

FOR SURFACE 13

- .46401E+02 - .45972E+02 - .45552E+02

- .44297E+02 - .43636E+02 - .43068E+02

- .39852E+02 - .38630E+02 - .37418E+02

FOR SURFACE 14

- .24641E+02 - .24636E+02 - .23897E+02

- .21848E+02 - .20633E+02 - .18778E+02

- .18526E+02 - .16667E+02 - .13421E+02

FOR SURFACE 15		
- .46536E+02	- .53573E+02	- .62687E+02
- .11372E+03	- .12969E+03	- .16475E+03
- .17643E+03	- .18733E+03	- .20732E+03
FOR SURFACE 24		
- .19901E+03	- .36608E+03	- .31439E+03
- .13719E+03	- .26042E+03	- .31484E+03
.13121E+03	.22146E+03	- .16031E+02
FOR SURFACE 25		
- .20731E+03	- .36731E+03	- .31523E+03
- .14058E+03	- .26242E+03	- .31620E+03
.12759E+03	.21921E+03	- .17550E+02
FOR SURFACE 27		
- .19701E+03	- .36264E+03	- .31327E+03
- .13848E+03	- .25951E+03	- .31511E+03
.11989E+03	.21306E+03	- .21094E+02
FOR SURFACE 28		
- .19725E+03	- .36280E+03	- .31340E+03
- .13844E+03	- .25976E+03	- .31532E+03
.11955E+03	.21280E+03	- .21302E+02

Pressure Distribution

FOR SUBSURFACE 1

.16013E+01	.12411E+01	.13861E+01
.47136E+00	-.37578E-01	- .35702E-01
-.75973E-01	-.71136E-01	-.69669E-01

FOR SUBSURFACE 2

- .17921E+00	- .17405E+00	- .15750E+00
-.16858E+00	-.18174E+00	-.15948E+00
.62716E+00	.56760E+00	.43009E+00

FOR SUBSURFACE 3

.91196E+00	.75819E+00	.48350E+00
.73212E+00	.86923E+00	.57373E+00
- .15981E+01	.89266E-01	.15728E+00

FOR SUBSURFACE 5

.92616E+00	.12525E+01	.13079E+01
- .35608E-01	-.38367E-01	-.36135E-01
-.70614E-01	-.70751E-01	-.69405E-01

FOR SUBSURFACE 6

-.12149E+00	-.12867E+00	-.13996E+00
-.48501E-01	-.68291E-01	-.10844E+00
.17118E+00	.28746E+00	.28982E+00

FOR SUBSURFACE 7

.18616E+00	.21073E+00	.38861E+00
.38819E+00	.34409E+00	.40358E+00
.11580E+01	.73242E+00	.39221E+00

FOR SUBSURFACE 9

.17426E+01 .12271E+01 .13663E+01

.45739E+00 -.59901E-01 -.55051E-01

-.A9429E-01 -.A3759E-01 - 77312E-01

FOR SUBSURFACE 10

-.16483E+00 -.15273E+00 -.17413E+00

-.14938E+00 -.13943E+00 - 11648E+00

.52453E+00 .57705E+00 .44364E+00

FOR SUBSURFACE 11

.31436E+00 .75143E+00 .47793E+00

.72772E+00 .86170E+00 .56648E+00

-.15614E+01 .81267E-01 .15059E+00

FOR SUBSURFACE 13

.91495E+00 .12334E+01 .13684E+01

.44118E-01 -.52030E-01 -.52583E-01

- 74141E-01 -.75231E-01 - 74709E-01

FOR SUBSURFACE 14

-.11879E+00 -.11990E+00 -.12045E+00

- 43102E-01 -.40677E-01 -.77182E-01

.17265E+00 .21433E+00 .30114E+00

FOR SUBSURFACE 15

.18181E+00	.20744E+00	.29630E+00
.37629E+00	.33818E+00	.39673E+00
.11291E+01	.72403E+00	.38526E+00

FOR SUBSURFACE 24

-.24559E+03	-.41632E+03	-.15643E+03
-.40284E+03	-.87233E+03	-.90483E+03
-.17987E+03	-.47176E+03	-.66969E+03

FOR SUBSURFACE 25

-.23212E+03	-.39809E+03	-.14613E+03
-.40121E+03	-.86989E+03	-.90090E+03
-.18311E+03	-.47636E+03	-.67019E+03

FOR SUBSURFACE 27

-.22548E+03	-.39161E+03	-.14203E+03
-.37132E+03	-.83780E+03	-.87557E+03
-.16408E+03	-.45538E+03	-.65340E+03

FOR SUBSURFACE 28

-.22492E+03	-.38923E+03	-.14061E+03
-.37129E+03	-.83753E+03	-.87584E+03
-.16944E+03	-.45653E+03	-.65346E+03

SECTION 6

PROGRAM LISTING

```

PROGRAM MAIN(INPUT,OUTPUT,TAPE5=INPUT,TAPE6=OUTPUT)
C
C
C      NS(MAX)=34
C      NELEH(MAX)=400
C      NMODE(MAX)=350
COMMON/ZZZ1/NX(34),NY(34),NXV(34),KSY4MY,KSYHMZ,NSYMHY,NSYHMZ
COMMON/ZZZ2/NSFY,NSBODY,NS,NT(34),TSEACF(34),KNORHL(34),KNAKES(34)
COMMON/ZZZ3/NPYLON,NBODY1,NBODY2,NBODY3,NVTAIL,NSHAFT,NHUB,NSHANK,
1 NBLADE
COMMON/ZZZ4/UMACH,OMEGA,ALFA,ABETA,AREA
COMMON/ZZZ5/VBYCTR,VBYCT2,ZBYCTR,BYBY1,BYBY2,BYBY3
COMMON/ZZZ6/XNOSE,XBD1,X302,XTAIL
COMMON/ZZZ7/YNOSE,YBD1,Y302,YTAIL
COMMON/ZZZ8/ZNOSE,ZBD1,Z302,ZTAIL
COMMON/ZZZ9/ZYBD1,ZZBD1,ZYBD2,ZZBD2
COMMON/ZZZ10/RSHAFT,LSHAFT,RSHANK,LSHANK
COMMON/ZZZ11/XMUSCR,YMUSCR,ZMUSCR,XMUS,YMUS,ZMUS
COMMON/ZZZ12/RROTOR,BCHORD,TAU8L,ALFA9
COMMON/ZZZ13/THET75,THET10,THET15,COSINC,ASTHUTH
COMMON/ZZZ14/KBLADE,TANLEB,TANTEB,XBLE,X3TE,KROTOR(34)
COMMON/ZZZ15/MSRAN,XLEZV,XTEZV,TANLEV,TANTEV,TAU,ZVTAIL
COMMON/ZZZ16/NWAKPY,NWAK1B,NWAKSK,NWAKBL
COMMON/ZZZ17/WAKPY,WAK1B,WAKSK,WAKBL
COMMON/ZZZ18/WANGPY,WANG1B,WANGSK,WANGBL
COMMON/ZZZ19/KPRINT(18),JREAD,NWRITE,KREAD
COMMON/ZZZ20/PI
COMMON/ZZZ21/KPY1,KPY2
COMMON/ZZZ22/KNSELE,KNSS4P,KNSTYP
COMMON/ZZZ23/KRDELE,KRDS4P,KROTV2
COMMON/ZZZ24/KTNELE,KTNS4P,KTNTYP
COMMON/ZZZ25/KPYELE,KPVS4P,KPYTYP
COMMON/ZZZ26/KVTELE,KVTS4P,KVTYP
COMMON/ZZZ27/KSWELE,KSHS4P,KSHTYP
COMMON/ZZZ28/KHBELE,KHBS4P,KHBTYP
COMMON/ZZZ29/KSKELE,KSKS4P,KSKTYP
COMMON/ZZZ30/KBLELE,KBLS4P,KBLTYP
COMMON/ZZZ31/MSIAG,NVORT,MSPTAL,SPTRAL
COMMON/ZZZ32/CSTAG,CVORT
COMMON/ZZZ33/UMAKE
COMMON/ZZZ34/YCUT
COMMON/ZZZ35/TINIST,BOTICH,TMIST
COMMON/ZZZ36/XCTR,YCTR,ZCTR,RX,RY,RZ
COMMON/ZZZ37/MSRAN,XLEZV,XTEZV,TANLEV,TANTEV,TAU,ZP
DIMENSION VELY(250),VELZ(250),PHI3(250),KROTOR(250)
DIMENSION CP(250),VELX(250),CG(2),ANG(250)
DIMENSION PC(3,250),P1(3,250),P2(3,250),P3(3,250),K(3,250)
DIMENSION KMAK(250),MODE(4,250),MODET(40,34)
DIMENSION PHIC(250),PHI1(250),PHI2(250),GC(250)
DIMENSION AA(62500),SOUCF(250),SQR(250)
EQUIVALENCE (AA(1),PHIC(1)),(AA(401),PHI1(1))
EQUIVALENCE (AA(401),PHI2(1)),(AA(1201),PHI3(1))
EQUIVALENCE (AA(1601),V_X(1)),(AA(1201),VELY(1))
EQUIVALENCE (AA(1201),VELZ(1)),(AA(1201),CP(1))
REAL LSHAFT,LSHANK
C
NREAD=9

```



```

      NWRITE=6
      NYMAX=6
      NYMAX=6
      NTHAX=400
      NXMAXP=NXMAX+1
      NYMAXP=NYMAX+1
      NXYMP=NXMAXP*NYMAXP
      NSTAG=0
      NVORT=0
      NSPIRAL=0
      NNAKBL=0
C
      READ(NREAD,2) NCASE
      WRITE(NWRITE,2) NCASE
      2 FORMAT(10I5)
      3 FORMAT(10F8,3)
      4 FORMAT(2A4,2I5)
C
      DO 999 ICASE=1,NCASE
C
C      CALL DATA(MELEM)
C
C      CALL PREPRO(MNODE,NXYMP,NOFCT,MELEM,NTHAX)
C
C      CALL COORDT(MELEM,NXYMP,NOFCT,XK,MNODE)
C
C      CALL CHECK(MELEM,NXMAX,NYMAX,NTHAX)
C
C      CALL GEOMET(MELEM,NXYMP,NOFCT,MNODE,XK,MNODE,KNAKE,KRATOR)
      WRITE(6,60)
      60 FORMAT(10X,'---- NAME FOR THE GEOMET ----')
C
      IF(KPRINT(1).EQ.1)
      1 CALL PRINTA(MELEM,NXYMP,XK,MNODE,PC,NOFCT,MNODE,1)
C
      IF(KPRINT(2).EQ.1)
      1CALL PRINTA(MELEM,NXYMP,XK,MNODE,PC,NOFCT,MNODE,2)
C
      CALL VEC123(MELEM,MNODE,PC,D1,D2,D3,XK,MNODE)
C
      IF(KPRINT(3).EQ.1)
      1CALL PRINTA(MELEM,NXYMP,XK,MNODE,PC,NOFCT,MNODE,3)
C
      IF (KPRINT(4).EQ.1)
      1CALL PRINTA(MELEM,NXYMP,XK,MNODE,PC,NOFCT,MNODE,4)
C
      MESQ=MELEM**2
C
      DO 6 NN=1,MESQ
      AA(NN)=0.0
      6 CONTINUE
C
      DO 0 I=1,MELEM
      NNN=I+(I-1)*MELEM
      SOURCE(I)=0.0
      AA(NNN)=1.0

```

```

9 CONTINUE
C
  CALL COEFF(NLEN,PC,NNODE,XK,NODE,KWAKE,NESQ,AA,SOURCE,BC,
1 KROTOR,1)
C
  IF(MSTAG.NE.0)
1 CALL COEFF(NLEN,PC,NNODE,XK,NODE,KWAKE,NESQ,AA,SOURCE,BC,
2 KROTOR,2)
C
  IF(MVORT.NE.0)
1 CALL COEFF(NLEN,PC,NNODE,XK,NODE,KWAKE,NESQ,AA,SOURCE,BC,
2 KROTOR,3)
C
  IF(MBLADE.EQ.1.AND.MWACBL.NE.0)
1 CALL COEFF(NLEN,PC,NNODE,XK,NODE,KWAKE,NESQ,AA,SOURCE,BC,
2 KROTOR,4)
C
  IF(KPRINT(5).EQ.1)CALL 2TNTB(NLEN,NESQ,AA,SOURCE,1)
C
  IF(KPRINT(6).EQ.1)CALL 2TNTB(NLEN,NESQ,AA,SOURCE,2)
C
  CALL SOLUTIN(NLEN,NESQ,1A,SOURCE)
C
  IF(KPRINT(7).EQ.1)CALL 2TNTB(NLEN,NESQ,AA,SOURCE,3)
C
  CALL AVERAG(SOURCE,SOR,2C,NLEN,NODE,NOECT,NXYNP,NNODE,AVG)
C
  CALL RMT(SOR,NNODE,NODE,2MTC,RMT1,RMT2,RMT3,NLEN)
C
  CALL VELXYZ(VELX,VELY,VELZ,RMT1,RMT2,RMT3,PC,R1,R2,R3,NLEN)
C
  CALL CPTMRICR(VELX,VELY,VELZ,RMT3,NLEN,PC,KROTOR)
C
  IF(KPRINT(8).EQ.1)CALL 2TNTB(NLEN,NESQ,AA,CP,4)
C
  CALL FCRCE(NNODE,XK,NLEN,NODE,C2)
C
999 CONTINUE
1000 STOP
END

```

```

C
SUBROUTINE DATA(MFILEM)
C
C
C DATE CREATED : MARCH 31, 1975
C
COMMON/ZZZ1/IX(34),NY(34),NX(34),KSYMMY,KSYMMZ,NSYMMY,NSYMMZ
COMMON/ZZZ2/NSFX,NSBOY,NS,NT(34),TSEAC(34),KNORM(34),KNAKES(34)
COMMON/ZZZ3/NPYLON,NBOY1,NBOY2,NBOY3,NVTAI,NSHAFT,NHUB,NSHANK,
1 NBLADE
COMMON/ZZZ4/UMACH,OMEGA,ALFA,ABETA
COMMON/ZZZ5/YDYCTR,YDYCTR,ZDYCTR,RXRYL,ZRYL,RZRYL
COMMON/ZZZ6/INOSE,XB01,XB02,XTAIL
COMMON/ZZZ7/YNOSE,YB01,YB02,YTAIL
COMMON/ZZZ8/ZNOSE,ZB01,ZB02,ZTAIL
COMMON/ZZZ9/RX001,RZ001,RZ002,RZ003
COMMON/ZZZ10/RSHAFT,LSHAFT,RSNANK,LSHANK
COMMON/ZZZ11/XMUSCA,YMUSCA,ZMUSCA,RXMUS,XYMUS,RZMUS
COMMON/ZZZ12/RROTOR,BCH RD,TAU8L,ALFA3
COMMON/ZZZ13/TMET75,TMET1C,TMET1S,CONING,AZIMUTH
COMMON/ZZZ14/KBLADE,TAN EB,TANTEB,XBLE,X9TE,KROTORS(34)
COMMON/ZZZ15/XSPAN,XLEZV,XTEZH,TANLEH,TANTEH,TAU,ZVTATL
COMMON/ZZZ16/NWAKPY,NWAK1B,NWAKSK,NWAKBL
COMMON/ZZZ17/NAK1PY,NAK1B,NAK1SK,NAK1BL
COMMON/ZZZ18/HANGPY,HANGHB,HANGSK,HANGBL
COMMON/ZZZ19/KPRINT(18),NREAD,NWRITE,KREAD
COMMON/ZZZ20/PI
COMMON/ZZZ21/KRY1,KRY2
COMMON/ZZZ22/KNSELE,KNST1P,KNSTYP
COMMON/ZZZ23/KDBELE,KDBS1P,KDBTYP
COMMON/ZZZ24/KTNELE,KTNS1P,KTNTYP
COMMON/ZZZ25/KRYELE,KRYS1P,KRYTYP
COMMON/ZZZ26/KVTELE,KVTS1P,KVTYP
COMMON/ZZZ27/KSMELE,KSMS1P,KSMTYP
COMMON/ZZZ28/KHBELE,KHBSHP,KHBTP
COMMON/ZZZ29/KSKELE,KSKSHR,KSKTY2
COMMON/ZZZ30/KBLELE,KBL1P,KBLTYP
COMMON/ZZZ31/NSTAG,NVORT,NSPIRAL,SPTRAL
COMMON/ZZZ32/CSTAG,CVORT
COMMON/ZZZ33/VCHUT
COMMON/ZZZ33/UWAKE
COMMON/ZZZ34/YCTR,YCTR,ZCTR,RX,RZ,RZ
COMMON/ZZZ35/HSPAN,XLEZV,XTEZH,TANLEH,TANTEH,TAU,ZP
COMMON/ZZZ36/TMTST,RTTCH,TMTST
DIMENSION AC4ORD(20),WNP1(2),WNP4(2),WNP7(2),WNP10(2)
DIMENSION GG(20),KSEAC(20)
DIMENSION TCHORD(10),TAKIS(10),VCHORD(10),VAXIS(10)
REAL LSHAFT,LSHANK
C
NSFX= 8
DO 18 I=1,3
READ(NREAD,18) GG
19 WRITE(NWRITE,20)GG
READ(NREAD,18) GG(1),GG(2),KREAD
WRITE(NWRITE,20)GG(1),GG(2),KREAD
18 FORMAT(28A1)
20 FORMAT(1X,20A4)

```



```

C
C      USE KSYMMY=0
C      USE KSYMMZ=0
C
      READ(NREAD,18) GG(1),GG(2),NS,KSYMMY,KSYMMZ
      WRITE(NWRITE,28)GG(1),GG(2),NS,KSYMMY,KSYMMZ
      READ(NREAD,19) GG(1),GG(2),NPYLON,NBODY1,NBODY2,NBODY3,NVAIL,
1 NSHAFT,NHUB,NSHANK,NBLADE
      WRITE(NWRITE,28)GG(1),GG(2),NPYLON,NBODY1,NBODY2,NBODY3,NVAIL,
1 NSHAFT,NHUB,NSHANK,NBLADE
      READ(NREAD,19) GG(1),GG(2),KPVL1,KPVL2
      WRITE(NWRITE,28)GG(1),GG(2),KPVL1,KPVL2
18  FORMAT(2A4,10I5)
28  FORMAT(1X,2A4,10I5)
      READ(NREAD,12) GG(1),GG(2),UMACH,OMEGA,AREA
      WRITE(NWRITE,22)GG(1),GG(2),UMACH,OMEGA,AREA
      READ(NREAD,12) GG(1),GG(2),ALFA,ABETA
      WRITE(NWRITE,22)GG(1),GG(2),ALFA,ABETA
12  FORMAT(2A4,7F8.3)
22  FORMAT(1X,2A4,7F10.3)
      IF(NPYLON.EQ.1)
1 READ(NREAD,12) GG(1),GG(2),XRYCTR,YRYCTR,ZRYCTR,RXPYL,RPYL,RZPYL
      IF(NPYLON.EQ.1)
1 WRITE(NWRITE,22)GG(1),GG(2),XRYCTR,YRYCTR,ZRYCTR,RXPYL,RPYL,RZPYL
      IF(NVAIL.EQ.1)
1 READ(NREAD,12) GG(1),GG(2),WSPAN,XLEZV,XTEZV,TANLEV,TANTEV,TAUV
2 ,ZPV
      IF(NVAIL.EQ.1)
1 WRITE(NWRITE,22) GG(1),GG(2),WSPAN,XLEZV,XTEZV,TANLEV,TANTEV,TAUV
2 ,ZPV
C
      NTBD=NBODY1+NBODY2+NBODY3
      NROTOR=NSHAFT+NHUB+NSHANK+NBLADE
C
      IF(NTBD.NE.0)
1 READ(NREAD,12)GG(1),GG(2),XNOSE,Y801,Y802,XTAIL
      IF(NTBD.NE.0)
1 WRITE(NWRITE,22)GG(1),GG(2),XNOSE,Y801,Y802,XTAIL
      IF(NTBD.NE.0)
1 READ(NREAD,12) GG(1),GG(2),YNOSE,Y801,Y802,YTAIL
      IF(NTBD.NE.0)
1 WRITE(NWRITE,22)GG(1),GG(2),YNOSE,Y801,Y802,YTAIL
      IF(NTBD.NE.0)
1 READ(NREAD,12) GG(1),GG(2),ZNOSE,Z801,Z802,ZTAIL
      IF(NTBD.NE.0)
1 WRITE(NWRITE,22)GG(1),GG(2),ZNOSE,Z801,Z802,ZTAIL
      IF(NTBD.NE.0)
1 READ(NREAD,12) GG(1),GG(2),RX801,R7801,RX802,R7802
      IF(NTBD.NE.0)
1 WRITE(NWRITE,22)GG(1),GG(2),RX801,R7801,RX802,R7802
C
      IF(NSHAFT.EQ.1)READ(NREAD,12) GG(1),GG(2),RSHAFT,LSHAFT
      IF(NSHAFT.EQ.1)WRITE(NWRITE,22)GG(1),GG(2),RSHAFT,LSHAFT
      IF(NHUB.EQ.1)
1 READ(NREAD,12)GG(1),GG(2),XHUBCR,YHUBCR,ZHUBCR,RXHUB,RYHUB,RZHUB
      IF(NHUB.EQ.1)
1 WRITE(NWRITE,22)GG(1),GG(2),XHUBCR,YHUBCR,ZHUBCR,RXHUB,RYHUB,RZHUB

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```

IF(NSHANK.EQ.1) READ(NREAD,12)GG(1),GG(2),RSHANK,LSHANK
IF(NSHANK.EQ.1)WRITE(NWRITE,22)GG(1),GG(2),RSHANK,LSHANK
IF(NBLADE.EQ.1) READ(NREAD,12) GG(1),GG(2),RROTOR,YCUT,XBLE,XBTE,
1 TANGLE,TANSTE,TAU9L
IF(NBLADE.EQ.1)WRITE(NWRITE,22)GG(1),GG(2),RROTOR,YCUT,XBLE,XBTE,
1 TANGLE,TANSTE,TAU9L
TANLEB=TANGLE
TANTEB=TANSTE
IF(NBLADE.EQ.1) READ(NREAD,12)GG(1),GG(2),THET75,THET1C,THET1S,
1 CONING,AZIMUTH
IF(NBLADE.EQ.1)WRITE(NWRITE,22)GG(1),GG(2),THET75,THET1C,THET1S,
1 CONING,AZIMUTH
IF(NBLADE.EQ.1) READ(NREAD,12)GG(1),GG(2),RPITCH,TWIST
IF(NBLADE.EQ.1)WRITE(NWRITE,22)GG(1),GG(2),RPITCH,TWIST
IF(NBLADE.EQ.1) READ(NREAD,12)GG(1),GG(2),KBLADE,ITWIST
IF(NBLADE.EQ.1)WRITE(NWRITE,22)GG(1),GG(2),KBLADE,ITWIST
READ(NREAD,13) GG(1),G(2),NNAKPY,NNAKMR,NNAKSK,NNAKBL
WRITE(NWRITE,22)GG(1),G(2),NNAKPY,NNAKMR,NNAKSK,NNAKBL
IF((NNAKMB+NNAKSK+NNAKBL).NE.0)
1 READ(NREAD,14) GG(1),GG(2),NSPIRAL,SPIRAL,UNAKE
IF((NNAKMB+NNAKSK+NNAKBL).NE.0)
1 WRITE(NWRITE,22)GG(1),GG(2),NSPIRAL,SPIRAL,UNAKE
IF(NNAKPY.EQ.1) READ(NREAD,18)GG(1),GG(2),NSTAG,NVORT
IF(NNAKPY.EQ.1)WRITE(NWRITE,22)GG(1),GG(2),NSTAG,NVORT
IF(NNAKPY.EQ.1) READ(NREAD,12)GG(1),GG(2),CSTAG,CVORT
IF(NNAKPY.EQ.1)WRITE(NWRITE,22)GG(1),GG(2),CSTAG,CVORT
16 FORMAT( 2A4,I5,2F8.3)
26 FORMAT(1X,2A4,I5,2F8.3)
READ(NREAD,19) GG(1),G(2),(KPRINT(K),K=1,10)
WRITE(NWRITE,22)GG(1),G(2),(KPRINT(K),K=1,10)

C
IF(UNACH.EQ.1.0) CALL DEBUC(100)
MULTY=1
IF(KSYMMX.EQ.0)MULTY=2
MULT=1
IF(KSYMMZ.EQ.0)MULT=2
MS=0
IF(NYBD.NE.0)MS=MS+(NBODY1+NBODY2+NBODY3)*MULT
IF(NPYLON.NE.0.OR.NVTAIL.NE.0)MS=MS+(NPYLON+NVTAIL)*MULT
IF(NMUB.NE.0)MS=MS+NSM*STMULT+NMMUB*MULT*MULT
IF(NROTOR.NE.0)MS=MS+K3LADE*(NSHANK+NBLADE*MULT)
IF(MS.NE.MS) CALL DEBUC(200)

C
C
REFLEN=1.
BETA=SQRT(ABS(UNACH**2-1.))
KS=0
NSBODY=0
NSBOT=0

C
C
C ***** NOSE *****
C
IF(NBODY1.EQ.0)GO TO 100
KS=KS+1
NSBODY=NSBODY+1
READ(NREAD,18) GG(1),G(2),NX(KS),NY(KS),KNSELE,KNSSHP,KNSTYP

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WRITE (NWRITE, 28) GG(1), GG(2), NX(KS), NY(KS), KNSELE, KNSSHP, KNSTYP
NXY(KS) = NX(KS) * NY(KS)
ISFACE(KS) = 1
KNORHL(KS) = 1
KNAKES(KS) = 0
KROTORS(KS) = 0
3
IF (KSYMNY.NE. 0) GO TO 170
NSBODY = NSBODY + 1
JS = KS + (NBODY1 + NBODY2 + NBODY3) * MULT + NPYLON + NVTAIL
NX(JS) = NX(KS)
NY(JS) = NY(KS)
NXY(JS) = NXY(KS)
ISFACE(JS) = 0
KNORHL(JS) = 1
KNAKES(JS) = 0
KROTORS(JS) = 0
170
CONTINUE
IF (KSYMZ.NE. 0) GO TO 199
NSBODY = NSBODY + 1
KSL = KS + NBODY1 + NBODY2 + NBODY3 * MULT + NPYLON
NX(KSL) = NX(KS)
NY(KSL) = NY(KS)
NXY(KSL) = NXY(KS)
ISFACE(KSL) = 0
KNORHL(KSL) = 1
KROTORS(KSL) = 0
C
IF (KSYMNY.NE. 0) GO TO 192
NSBODY = NSBODY + 1
JSL = KSL + (NBODY1 + NBODY2 + NBODY3) * MULT + NPYLON + NVTAIL
NX(JSL) = NX(KS)
NY(JSL) = NY(KS)
NXY(JSL) = NXY(KS)
ISFACE(JSL) = 1
KNORHL(JSL) = 1
KNAKES(JSL) = 0
KROTORS(JSL) = 0
199
CONTINUE
C
C ----- FUSLAGE -----
C
IF (NBODY2.EQ. 0) GO TO 292
KS = KS + 1
NSBODY = NSBODY + 1
READ (NREAD, 18) GG(1), GG(2), NX(KS), NY(KS), K8DELE, K8DSHP, K8DTYP
WRITE (NWRITE, 28) GG(1), GG(2), NX(KS), NY(KS), K8DELE, K8DSHP, K8DTYP
NXY(KS) = NX(KS) * NY(KS)
ISFACE(KS) = 2
KNORHL(KS) = 1
KROTORS(KS) = 0
KNAKES(KS) = 0
C
IF (KSYMNY.NE. 0) GO TO 271
NSBODY = NSBODY + 1
JS = KS + (NBODY1 + NBODY2 + NBODY3) * MULT + NPYLON + NVTAIL

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      NX(JS)=NX(KS)
      NY(JS)=NY(KS)
      NXY(JS)=NXY(KS)
      ISFACE(JS)=10
      KWAKES(JS)=0
      KNORML(JS)=1
      KROTORS(JS)=0
270  CONTINUE
      IF(KSYMHZ.NE.0)GO TO 299
      NSBODY=NSBODY+1
      KSL=KS+NBODY1+NBODY2+NBODY3+NPYLON
      NX(KSL)=NX(KS)
      NY(KSL)=NY(KS)
      NXY(KSL)=NXY(KS)
      ISFACE(KSL)=5
      KWAKES(KSL)=0
      KNORML(KSL)=1
      KROTORS(KSL)=0
      C
      IF(KSYMHY.NE.0)GO TO 299
      NSBODY=NSBODY+1
      JSL=KSL+(NBODY1+NBODY2+NBODY3)*MULT+NPYLON+NVTAIL
      NX(JSL)=NX(KS)
      NY(JSL)=NY(KS)
      NXY(JSL)=NXY(KS)
      ISFACE(JSL)=10
      KWAKES(JSL)=0
      KNORML(JSL)=1
      KROTORS(JSL)=0
280  CONTINUE
      C
      C ----- AFT=30DY -----
      C
      IF(NBODY3.EQ.0)GO TO 300
      KS=KS+1
      NSBODY=NSBODY+1
      READ(NREAD,10) GG(1),GG(2),NX(KS),NY(KS),KTNELE,KTNSHP,KTNTYP
      WRITE(NWRITE,20)GG(1),GG(2),NX(KS),NY(KS),KTNELE,KTNSHP,KTNTYP
      NXY(KS)=NX(KS)*NY(KS)
      ISFACE(KS)=3
      KNORML(KS)=1
      KWAKES(KS)=0
      KROTORS(KS)=0
      C
      IF(KSYMHY.NE.0)GO TO 370
      NSBODY=NSBODY+1
      JS=KS+(NBODY1+NBODY2+NBODY3)*MULT+NPYLON+NVTAIL
      NX(JS)=NX(KS)
      NY(JS)=NY(KS)
      NXY(JS)=NXY(KS)
      ISFACE(JS)=11
      KWAKES(JS)=0
      KNORML(JS)=1
      KROTORS(JS)=0
370  CONTINUE
      IF(KSYMHZ.NE.0)GO TO 30
      NSBODY=NSBODY+1

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KSL=KS+N80DY1+N80DY2+N80DY3+NPYLON
NX(KSL)=NX(KS)
NY(KSL)=NY(KS)
NXY(KSL)=NXY(KS)
ISFACE(KSL)=7
KNAKES(KSL)=0
KNORML(KSL)=-1
KROTORS(KSL)=0
C
IF(KSYM*NY.NE.0)GO TO 199
NSBODY=NSBODY+1
JSL=KSL+(N80DY1+N80DY2+N80DY3)*MULT+NPYLON+NVTAIL
NX(JSL)=NX(KS)
NY(JSL)=NY(KS)
NXY(JSL)=NXY(KS)
ISFACE(JSL)=15
KNAKES(JSL)=0
KNORML(JSL)=-1
KROTORS(JSL)=0
199 CONTINUE
C
C ----- PYLON -----
C
IF(NPYLON.EQ.0)GO TO 499
KS=KS+1
NSBODY=NSBODY+1
READ(NREAD,18) GG(1),GG(2),NX(KS),NY(KS),KPYELE,KPYSHP,KPYTYP
WRITE(NWRITE,28)GG(1),GG(2),NX(KS),NY(KS),KPYELE,KPYSHP,KPYTYP
NXY(KS)=NX(KS)*NY(KS)
ISFACE(KS)=4
KNORML(KS)=1
KNAKES(KS)=1
KROTORS(KS)=0
C
IF(KSYM*NY.NE.0)GO TO 499
NSBODY=NSBODY+1
JS=KS+(N80DY1+N80DY2+N80DY3)*MULT+NPYLON+NVTAIL
NX(JS)=NX(KS)
NY(JS)=NY(KS)
NXY(JS)=NXY(KS)
ISFACE(JS)=12
KNAKES(JS)=1
KNORML(JS)=-1
KROTORS(JS)=0
499 CONTINUE
C
N80DYS=N80DY1+N80DY2+N80DY3
C
C ----- VERTICAL TAIL -----
C
NSBODY=NSBODY+1
IF(NVTAIL.EQ.0)GO TO 599
KS=N80DYS*MULT+NPYLON+1
READ(NREAD,18) GG(1),GG(2),NX(KS),NY(KS),KVTELE,KVTSHP,KVTYP
WRITE(NWRITE,28)GG(1),GG(2),NX(KS),NY(KS),KVTELE,KVTSHP,KVTYP
NXY(KS)=NX(KS)*NY(KS)
ISFACE(KS)=8

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```

KNORML(KS)=-1
KMAKES(KS)=1
KROTORS(KS)=0
C
IF(KSYMMY.NE.0)GO TO 599
NSBODY=NSBODY+1
JS=KS+(NBODY1+NBODY2+NBODY3)*MULT+NPYLON+NVTAIL
NX(JS)=NX(KS)
NY(JS)=NY(KS)
NXY(JS)=NXY(KS)
ISFACE(JS)=16
KMAKES(JS)=1
KNORML(JS)=+1
KROTORS(JS)=0
C
599 CONTINUE
C
C ----- ROTOR SHAFT -----
C
IF(NSHAFT.EQ.0)GO TO 699
NSBODY=NSBODY+1
KS=(NBODY1+NBODY2+NBODY3)*MULT+NPYLON+NVTAIL
KS=KS+1
READ(NREAD,13) GG(1),GG(2),NX(KS),NY(KS),KSHELE,KSHSHP,KSHSTYP
WRITE(NWRITE,28)GG(1),GG(2),NX(KS),NY(KS),KSHELE,KSHSHP,KSHSTYP
NXY(KS)=NX(KS)*NY(KS)
ISFACE(KS)=17
KNORML(KS)=1
KMAKES(KS)=0
KROTORS(KS)=1
C
IF(KSYMMY.NE.0)GO TO 699
NSBODY=NSBODY+1
JS=KS+1
NX(JS)=NX(KS)
NY(JS)=NY(KS)
NXY(JS)=NXY(KS)
ISFACE(JS)=18
KMAKES(JS)=0
KNORML(JS)=+1
KROTORS(JS)=1
C
699 CONTINUE
C
C ----- ROTOR HUB -----
C
IF(NHUB.EQ.0)GO TO 799
KS=NBODY1+NPYLON+NVTAIL+NSHAFT)*MULT
KS=KS+1
NSBODY=NSBODY+1
READ(NREAD,13) GG(1),GG(2),NX(KS),NY(KS),KSHELE,KSHSHP,KSHSTYP
WRITE(NWRITE,28)GG(1),GG(2),NX(KS),NY(KS),KSHELE,KSHSHP,KSHSTYP
NXY(KS)=NX(KS)*NY(KS)
ISFACE(KS)=19
KNORML(KS)=1
KMAKES(KS)=1
KROTORS(KS)=1

```

```

C      IF(KSYMNY.NE.0)GO TO 778
      NSBODY=NSBODY+1
      JS=KS+NHUB*MULT
      NX(JS)=NX(KS)
      NY(JS)=NY(KS)
      NXY(JS)=NXY(KS)
      ISFACE(JS)=21
      KWAKES(JS)=1
      KNORML(JS)=1
      KROTORS(JS)=1
778  CONTINUE
      IF(KSYMNZ.NE.0)GO TO 793
      NSBODY=NSBODY+1
      KSL=KS+1
      NX(KSL)=NX(KS)
      NY(KSL)=NY(KS)
      NXY(KSL)=NXY(KS)
      ISFACE(KSL)=20
      KWAKES(KSL)=1
      KNORML(KSL)=1
      KROTORS(KSL)=1
2
      IF(KSYMNY.NE.0)GO TO 793
      NSBODY=NSBODY+1
      JSL=JS+NHUB*MULT
      JSL=KSL+NHUB*MULT
      NX(JSL)=NX(KS)
      NY(JSL)=NY(KS)
      NXY(JSL)=NXY(KS)
      ISFACE(JSL)=22
      KWAKES(JSL)=1
      KNORML(JSL)=1
      KROTORS(JSL)=1
799  CONTINUE
2
C      ----- ROTOR BLADE SHANK -----
C
      IF(NSHANK.EQ.0)GO TO 899
      KS=(NSBODY1+NSBODY2+NSBODY)*MULT*MULT*(NBYLONANNTAIL)*MULT*
      INSHAFT*MULT+NHUB*MULT*MULT*JLT*1
      READ(NREAD,4)  GG(1),GG(2),NX(KS),NY(KS),KSKELE,KSKSHP,KSKTYP
      WRITE(NWRITE,20)GG(1),GG(2),NX(KS),NY(KS),KSKELE,KSKSHP,KSKTYP
C
      DO 810 K=1,KBLADE
      NSBODY=NSBODY+1
      KSS=KS+(K-1)*(NSHANK+NB.4DE*MULT)
      NX(KSS)=NX(KS)
      NY(KSS)=NY(KS)
      NXY(KSS)=NXY(KS)*NY(KS)
      ISFACE(KSS)=23+(K-1)*3
      KNORML(KSS)=1
      KWAKES(KSS)=1
      KROTORS(KSS)=1
810  CONTINUE
C
899  CONTINUE

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```

C ----- ROTOR BLADE -----
C
IF (NBLADE.EQ.0) GO TO 99
KS= (NBOOY1+NBOOY2+NBOOY3)*MULT*MULTY+(NPYLON+NVTAIL)*MULTY+
1 NSHAFTMULTYANNUBERMIN*TMULTYANSHANKA1
READ(NREAD,10) GG(1),GG(2),NX(KS),NY(KS),KBLELE,K3LSHP,KBLTYP
WRITE(NWRITE,20)GG(1),GG(2),NX(KS),NY(KS),KBLELE,K3LSHP,KBLTYP
C
DO 910 K=1,KBLADE
NSBOOY=NSBOOY+1
KSS=KSA+(K-1)*NSHAFTMULTYANSHANKA1
NX(KSS)=NX(KS)
NY(KSS)=NY(KS)
NXY(KSS)=NX(KS)*NY(KS)
ISFACE(KSS)=2A*(K-1)*3
KNORML(KSS)=1
KMAKES(KSS)=1
KROTORS(KSS)=1
C
IF (KSYMHZ.NE.0) GO TO 919
NSBOOY=NSBOOY+1
KSSL=KSS+1
NX(KSSL)=NX(KSS)
NY(KSSL)=NY(KSS)
NXY(KSSL)=NXY(KSS)
ISFACE(KSSL)=25*(K-1)*3
KMAKES(KSSL)=1
KNORML(KSSL)=-1
KROTORS(KSSL)=1
910 CONTINUE
C
999 CONTINUE
C
C
NELEN=0
WRITE(6,8002)
DO 1000 IS=1,NS
1000 NELEN=NELEN+NXY(IS)
WRITE(6,8001)NELEN
8001 FORMAT(/5X,"NELEN = ",IS/)
C
8002 FORMAT(/10X,"NDATA")
C
NSBOTOT=0
DO 1100 IS=1,NS
NT(IS)=NSBOTOT
NSBOTOT=NSBOTOT+NXY(IS)+NY(IS)
WRITE(6,8003)IS,NX(IS),VF(IS),NXY(IS),ISFACE(IS),NT(IS),
1KNORML(IS),KMAKES(IS)
8003 FORMAT(5X,"IS= ",IS,2X,"NX=",IS,2X,"NY=",IS,
1 " NXY=",IS," ISFACE=",IS," NT=",IS,
2 " KNORML=",IS," KMAKES=",IS)
1100 CONTINUE
C
C
RETURN
END

```



```

REFLEN=1.
BETA=SQRT(ABS(UMACH**2-1.))
MULT=1
IF(KSYMHZ.EQ.0)MULT=2
MULTY=1
IF(KSYMHY.EQ.0)MULTY=2
15 FORMAT(10F8.3)
25 FORMAT(1X,10F8.3)
PI=3.14159265
300 FORMAT(2X,A15.8,IS,2X,A15.8,IS,2X,A15.8,IS,2X,A15.8,IS,2X,
1 *NOFCT=*,IS)
C
C
KFACE=NSOBY1+NSOBY2+NSOBY3+NRYLON
C
C
C
C
IF(NRYLON.EQ.0)GO TO 10.
KS=KFACE
DXX=1./NX(KS)
DYY=1./NY(KS)
NXP=NX(KS)+1
NYP=NY(KS)+1
LPVELE=KPYELE
IF(LPVELE.NE.0)GO TO 102
IF(LPVELE.NE.0)GO TO 102
LPVELE=1
READ(INREAD,15) (HCSI(IX),IX=1,NXP)
WRITE(NWRITE,25) (HCSI(IX),IX=1,NXP)
READ(INREAD,15) (META(IY),IY=1,NYP)
WRITE(NWRITE,25) (META(IY),IY=1,NYP)
102 CONTINUE
DO 110 IX=1,NXP
DO 110 IY=1,NYP
XX=(IX-1)*DX
YY=(IY-1)*DY
IF(KPYELE.EQ.0)XX=HCSI(IX)
IF(KPYELE.EQ.0)YY=META(IY)
GO TO(131,132,133),LPVELE
131 CONTINUE
CSI=XX
ETA=YY
GO TO 113
132 CONTINUE
CSI=XX*XX
ETA=YY
133 CONTINUE
CSI=1./(1.-XX)**2
ETA=YY
113 CONTINUE
THETA=PI*ETA
RX=CSI/RXSVL
RY=CSI*RYPYL
YB=RX*COB(THETA)
YB=RY*SIN(THETA)
ZB=RX*ZSVL+SQRT(1.-(YB/RXSVL)**2-(YB/RYPYL)**2)
IXY=IX+(IY-1)*NXP

```

```

      INODE=NOFCT(IXY,KS)
      XK(1,INODE)=XB+XPYCTR
      XK(2,INODE)=YB+YPYCTR
      XK(3,INODE)=ZB+ZPYCTR
      WRITE(6,140)IX,IV,IXY,CSI,ETA,INODE
      WRITE(6,141)TETA,ZY,RV
      WRITE(6,142)XB,YB,ZB
      WRITE(6,143)(XK(I,INODE),I=1,3)
140  FORMAT(10X,'IX=',I5,2X,'IV=',I5,2X,'IXY=',I5,2X,'CSI=',E12.6,2X,
      1PETA=',E12.6,2X,'INODE=',I5)
141  FORMAT(10X,'TETA=',E12.6,2X,'RX=',E12.6,2X,'RY=',E12.6)
142  FORMAT(10X,'XB=',E12.6,2X,'YB=',E12.6,2X,'ZB=',E12.6)
143  FORMAT(10X,'XK=',3(E12.6,2X))
113  CONTINUE
199  CONTINUE
C
C
C      KS=0
C
C
C      =====NOSE =====
C
      IF(NBODY1.EQ.8)GO TO 590
      KS=KS+1
      DO 500 IADY1=1,MULT
      IF(IBODY1.EQ.1)SIGNZ=+1.
      IF(IADY1.EQ.2)SIGNZ=-1.
      NX=NX(KS)+1
      NY=NY(KS)+1
      DX=1./NX(KS)
      TYNCR=0.5*DT/NY(KS)
      DO 550 IX=1,NX
      XY=(IX-1)*DX
      IF(KNSELE.EQ.1)CSI=XX
      IF(KNSELE.EQ.2)CSI=XY*XX
      X=XNOSE+(XB01-XNOSE)*CSI
      IF(KNSSHP.EQ.1)RRZ=RYB01*SQRT(CSI)
      IF(KNSSHP.EQ.1)RRZ=RZB01*SQRT(CSI)
      IF(KNSSHP.EQ.2)RRZ=RYB01*(CSI)**.333333
      IF(KNSSHP.EQ.2)RRZ=RZB01*(CSI)**.333333
      IF(KNSSHP.EQ.3)RRZ=RYB01*(CSI)**.25
      IF(KNSSHP.EQ.3)RRZ=RZB01*(CSI)**.25
      DO 550 IY=1,NY
      THET=(IY-1)*TYNCR
      TETA=(AB.5*PI-TMET)
      ETA=COS(THETA)
      VV=RRV*ETA
      ZZ=SIGNZ*RRZ*SIN(THETA)
      DELZ=(ZB01-ZNOSE)
      DDMZ=DELZ-DELZ*CSI
      ZZ=ZZ+ZB01
C
C
      IXY=IX+(IY-1)*MXP
      IF(IBODY1.EQ.1)IS=KS
      IF(IADY1.EQ.2)IS=KS+KPI*F
      WRITE(6,140)IX,IV,IXY,CSI,ETA,NOFCT(IXY,IS)

```

```

WRITE(6,142)X,YY,ZZ
KK(1,NOFCT(IXV,IS))=X
KK(2,NOFCT(IXV,IS))=YY
KK(3,NOFCT(IXV,IS))=ZZ
550 CONTINUE
598 CONTINUE
599 CONTINUE
C -----BODY-----
C
IF(NBODY2.EQ.8)GO TO 69
KS=KS+1
DO 698 IBODY2=1,MULT
IF(IBODY2.EQ.1)SIGNZ=+1.
IF(IBODY2.EQ.2)SIGNZ=-1.
NXP=NX(KS)+1
NYP=NY(KS)+1
TINCR=8.5*PI/NY(KS)
OXX=1./NX(KS)
DO 631 IX=1,NXP
XXX=(IX-1)*OXX
IF(KBDELE.EQ.1)CSI=XXX
IF(KBDELE.EQ.2)CSI=XXX*(X
R1=RY801+(RZ802-RZ801)*CSI
R2=RZ801+(RZ802-RZ801)*CSI
DELZ=Z802-Z801
ZZZ=DELZ*CSI
XY=X801+(X802-X801)*CSI
DO 631 IY=1,NYP
THETA=(8.5*PI) - (IX-1)*TINCR
YY=R1*COS(THETA)
ZZ=SIGNZ*R2*STN(THETA)
Z=Z+ZZ+Z801
IY=IY+(IY-1)*NYP
IF(IBODY2.EQ.1)IS=KS
IF(IBODY2.EQ.2)IS=KS+KBDE
KK(1,NOFCT(IXV,IS))=XX
KK(2,NOFCT(IXV,IS))=YY
KK(3,NOFCT(IXV,IS))=ZZ
531 CONTINUE
698 CONTINUE
699 CONTINUE
C
C -----TAIL NOSE-----
C
IF(NBODY3.EQ.8)GO TO 899
KS=KS+1
DO 898 IBODY3=1,MULT
IF(IBODY3.EQ.1)SIGNZ=+1.
IF(IBODY3.EQ.2)SIGNZ=-1.
NXP=NX(KS)+1
NYP=NY(KS)+1
OXX=1./NX(KS)
TINCR=8.5*PI/NY(KS)
DO 858 IX=1,NXP
XX=(IX-1)*OXX

```



```

      XX=1.-XX
      IF(KYNELE.EQ.1)CST=XX
      IF(KYNELE.EQ.2)CSI=XX*XX
      IF(KYNSMP.EQ.1)RRZ=RZBD2*SQRT(CSI)
      IF(KYNSMP.EQ.2)RRZ=RZBD2*SQRT(CSI)
      IF(KYNSMP.EQ.2)RRZ=RZBD2*CSI
      CST=1.-CST
      X=XBD2+(XTAIL-XBD2)*CSI
      DO 888 IY=1,NYP
      THET=(IY-1)*TINCR
      THETA=(.88592T-THET)
      ETA=COS(THETA)
      YY=RRY*ETA
      ZZ=SIGNZ*RRZ*SIN(THETA)
      C
      DELZ=ZTATI-ZBD2
      DOWNZ=DELZ*CSI
      ZZ=ZZ+DOWNZ*ZBD2
      C
      C
      IXY=IX+(IY-1)*NXP
      IF(I80DY3.EQ.1)IS=KS
      IF(I80DY3.EQ.2)IS=KS+KFACE
      XK(1,NOFCT(IXY,IS))=YY
      XK(2,NOFCT(IXY,IS))=YY
      XK(3,NOFCT(IXY,IS))=ZZ
      858 CONTINUE
      888 CONTINUE
      899 CONTINUE
      C
      C ----- VERTICAL TAIL -----
      C
      IF(NVTAIL.EQ.0)GO TO 3170
      KS=(N80DY1+N80DY2+N80DY3)*MULTAN2YLOM+1
      DO 398 IYTL=1,1
      C
      IF(KVTTYP.EQ.1)GO TO 3170
      READ(NREAD,15) GG(1),GG(2),WNPP,WNPH,WNPD,WNMH
      WRITE(NWRITE,25)GG(1),GG(2),WNPP,WNPH,WNPD,WNMH
      3170 CONTINUE
      SIGNZ=+1.
      TATIL=NWSPAN-2.*D
      TAILWD=TATILN/2.
      PLEN=8.
      RTE=0.
      DXX=1./NY(KS)
      DYY=1./NY(KS)
      NXP=NY(KS)+1
      NYP=NY(KS)+1
      LVTELE=KVTELE
      IF(LVTELE.NE.0)GO TO 3130
      LVTELE=1
      READ(NREAD,15) GG(1),GG(2),(HCSI(IX),IX=1,NXP)
      WRITE(NWRITE,25)GG(1),GG(2),(HCSI(IX),IX=1,NXP)
      READ(NREAD,15) GG(1),GG(2),(HETA(IY),IY=1,NYP)

```



```

WRITE(NWRITE,25)GG(1),GG(2),(META(IY),IV=1,NYP)
3108 CONTINUE
DO 318 IX=1,NXP
DO 318 IY=1,NYP
XX=(IX-1)*DX
YY=(IY-1)*DY
IF(KVTELE.EQ.0)XX=HCSI(I,X)
IF(KVTELE.EQ.0)YY=META(IY)
GO TO(3131,3132,3133,3134),LVTELE
3131 CONTINUE
CSI=XX
ETA=YY
GO TO 313
3132 CONTINUE
CSI=XX*XX
ETA=1.-(1.-YY)**2
GO TO 313
3133 CONTINUE
CSI=XX
ETA=1.-(1.-YY)**2
GO TO 313
3134 CONTINUE
CSI=XX*XX
ETA=YY
313 CONTINUE
IF(KVTTYP.NE.1)GO TO 3173
C
Y=TAILWO*ETA
XLE=XLEZV+TANLEV*(Y-RLD)
XTE=XTEZV+TANTEV*(Y-RTE)
VCHORD(IY)=XTE-XLE
VAXIS(IY)=XLE+VCHORD(IY)*0.5
VXLE=(XTE-XLE)*COST
3139 CONTINUE
IF(KVTTYP.NE.2)GO TO 3143
X1=(WNPP(1)-WNMP(1))*CST+WNMP(1)
Y1=(WNPP(2)-WNMP(2))*CST+WNMP(2)
X2=(WNPH(1)-WNMH(1))*CST+WNMH(1)
Y2=(WNPH(2)-WNMH(2))*CST+WNMH(2)
X3=(WNPP(1)-WNMP(1))*ETA+WNMP(1)
Y3=(WNPP(2)-WNMP(2))*ETI+WNMP(2)
X4=(WNPH(1)-WNMH(1))*ETI+WNMH(1)
Y4=(WNPH(2)-WNMH(2))*ETI+WNMH(2)
DET=(X1-Y2)*(Y3-Y4)-(X3-Y4)*(Y1-Y2)
IF(DET.EQ.0.)GO TO 3147
X=(X1-Y2)*(X4*Y3-X3*Y4)-(X3-Y4)*(X2*Y1-X1*Y2)/DET
Y=((Y1-Y2)*(X4*Y3-X3*Y4)-(Y3-Y4)*(X2*Y1-X1*Y2))/DET
GO TO 3149
3147 CONTINUE
X=X4
Y=Y4
3149 CONTINUE
C
GO TO(3151,3152,3153),/TSMR
3151 CONTINUE
C
FOR CIRCULAR BICONVEX

```

```

C
XC=0.5*(XLE+XTE)
PL=0.5*(XTE-XLE)
M=TAU/PL
ATAU=2.*M
ETACR=1.-ATAU/VSPAN
XXC=X-XC
Z=0.
IF(M.EQ.0..OR.IY.EQ.NYP..OR.IX.EQ.1..OR.IX.EQ.NXP)GO TO 315
Z=SIGNZ*(SQRT((1/PL*(PL*PL+1)/(2.*M+1)+2.-XXC**2)-(M*PL-M*PL)/(2.*M))
IF(ETA.GE.ETACR)Z=Z*SQRT(1.-((ETA-ETACR)*VSPAN/ATAU)**2)
GO TO 315
3152 CONTINUE
TAUBAR=TAU/PL*Z*SQRT(1.-XXC**2)
Z=SIGNZ*TAUBAR*SQRT(CSD*(1.-CSI)*SQRT(1.-ETA**2)
GO TO 315
3193 CONTINUE
Z=SIGNZ*TAU/PL*(XTE-XLE)*SQRT(1.-CSI)*SQRT(1.-ETA**2)
315 CONTINUE
C
IXY=IX+(IY-1)*NXP
XX(1,NOFCT(IY,KS))=X
XX(2,NOFCT(IY,KS))=Z
XX(3,NOFCT(IY,KS))=V*V*TAU
318 CONTINUE
398 CONTINUE
399 CONTINUE
C
C ----- SHAFT -----
C
IF(NSHAFT.EQ.0)GO TO 299
KS=(NBODY1+NBODY2+NBODY3)*MULT*MULTY*(NPY1*ON*NV*TAU)*MULTY
KS=KS+1
NXX=1./NX(KS)
OYY=1./NY(KS)
NYP=NY(KS)+1
NYP=NY(KS)+1
LSHELE=KSHELE
IF(LSHELE.NE.0)GO TO 211
IF(LSHELE.NE.0)GO TO 201
LSHELE=1
READ(MREAD,15) (MCSI(IY),IY=1,NYP)
WRITE(MWRITE,25) (MCSI(IY),IY=1,NXP)
READ(MREAD,15) (META(IY),IY=1,NYP)
WRITE(MWRITE,25) (META(IY),IY=1,NXP)
201 CONTINUE
DO 210 IX=1,NXP
DO 210 IY=1,NYP
XX=(IX-1)*OXX
YY=(IY-1)*OYY
IF(KSHELE.EQ.0) XX=MCSI(IX)
IF(KSHELE.EQ.0) YY=META(IY)
GO TO (231,232,233),LSHELE
231 CONTINUE
CSI=XX
FY=YY
GO TO 213

```

```

232 CONTINUE
CST=XX*YY
ETA=YY
GO TO 213
233 CONTINUE
CST=1./1.-XX*YY
ETA=YY
217 CONTINUE
THETA=PI*ETA
R=RSNART
XB=R*COS(THETA)
YB=RSIN(THETA)
ZB=CSI*LSHAFT
IXV=IX+(IX-1)*NXP
INODE=NOFCT(IXY,KS)
KK(1,INODE)=XB*VPYCTR
KK(2,INODE)=YB*VPYCTR
KK(3,INODE)=ZB*VPYCTR-20*ZB*ZL
WRITE(6,61)KS,IX,IY,IXY,INODE
WRITE(6,62)XB,YB,ZB
WRITE(6,63)(KK(L,INODE),L=1,3)
61 FORMAT(10X,'KS=',IS,' ',IS,IS,' IV=',IS,' IXV=',IS,
1 * INODE=',IS)
62 FORMAT(10X,'XB=',E12.6,' YB=',E12.6,' ZB=',E12.6)
63 FORMAT(10X,' KK= ',3(E12.6,2X))
218 CONTINUE
299 CONTINUE
C
IF(NHUB.EQ.0) GO TO 499
KS=(NBOOY1+NBOOY2+NBOOY3)*MULT*NU*TV*(NBYLONANNTATL)*MULT*V
1 NSHAFT*MULT
KS=KS+1
DO 498 INULT=1,MULT
C
IF(INULT.EQ.1) SIGNZ= 1
IF(INULT.EQ.2) SIGNZ=-1
C
DXX=1./NX(KS)
DYY=1./NY(KS)
NXB=NX(KS)+1
NYP=NY(KS)+1
LMBELE=KHBELE
IF(LHBELE.NE.0) GO TO 400
LMBELE=1
READ(NREAD,15) (HCST(I),I=1,NXP)
WRITE(NWRITE,25) (HCST(IY),IY=1,NXP)
READ(NREAD,15) (META(IY),IY=1,NYP)
WRITE(NWRITE,25) (META(IY),IY=1,NYP)
400 CONTINUE
DO 410 IY=1,NYP
DO 410 IX=1,NXP
XX=(IX-1)*DXX
YY=(IY-1)*DYY
IF(KHBELE.EQ.0) XX=HCST(IY)
IF(KHBELE.EQ.0) YY=META(IY)
GO TO (431,432,433),LMBELE
431 CONTINUE

```

```

      CSI=XX
      ETABYY
      GO TO 413
412  CONTINUE
      CSI=XX*XX
      ETABYY
      GO TO 413
411  CONTINUE
      CSI=1.-(1.-XX)**2
      ETABYY
413  CONTINUE
      TETA=DT*ETA
      RX=CSI*RXHUB
      RY=CSI*RYHUB
      X0=RX*COS(TETA)
      Y0=RY*SIN(TETA)
      Z0=SIGNZ*RMJ8*SQRT(1.-X0/RXPYL)**2-(Y0/RYPYL)**2)
      IXY=IX*(IY-1)*NXP
      IS=KS+(IMULT-1)
      INODE=NOECT(IXY,IS)
      XK(1,INODE)=X0+XHUBCR
      XK(2,INODE)=Y0+YHUBCR
      XK(3,INODE)=Z0+ZHUBCR
      WRITE(6,61)IS,IX,IY,IXY,INODE
      WRITE(6,62)X,Y,Z0
      WRITE(6,63)XK(1,INODE),XK(2,INODE),XK(3,INODE)
418  CONTINUE
498  CONTINUE
499  CONTINUE
C
C
900  CONTINUE
C
      NSS=(N80DY1+N80DY2+N80DY3)*MULTANRYLON
      I=NVTAIL
      DO 910 IS=1,NSS
      JS=IS+NSS
      NXP=NX(IS)+1
      NYP=NY(IS)+1
      DO 910 IX=1,NXP
      DO 910 IY=1,NYP
      IXY=IX*(IY-1)*NXP
      XK(1,NOECT(IXY,JS))=XK(1,NOECT(IXY,IS))
      XK(2,NOECT(IXY,JS))=XK(2,NOECT(IXY,IS))
      XK(3,NOECT(IXY,JS))=XK(3,NOECT(IXY,IS))
      WRITE(6,54)IXY,IS
54  FORMAT(10X,'IXY=',IS,2X,'IS=',IS)
910  CONTINUE
C
      IF(MSHAFT.EQ.0) GO TO 911
      IS=NSS*MULTY+1
      JS=IS+1
      NXP=NX(IS)+1
      NYP=NY(JS)+1
      DO 912 IX=1,NXP
      DO 912 IY=1,NYP
      IXY=IX*(IY-1)*NXP

```



```

ETA=YY
GO TO 713
732 CONTINUE
CST=1.-11.-XX)007
ETA=YY
GO TO 713
733 CONTINUE
CST=XX*YY
ETA=YY
713 CONTINUE
THETA=2.*PI*ETA
R=RSNAK
X0=R*COS(THETA)
Y0=R*STH(THETA)
Y0=CST*LSHANK
C
IXY=IX+(IY-1)*NXP
IS=KKS+(IS-1)*(NBLADE*MULT*NSHANK)
INODE=NOFCT(IXY,IS)
XX(1,INODE)=MUSCR*XB
XX(2,INODE)=SIGN*(YHUBCR+RYHUB*LSHANK-Y0)
XX(3,INODE)=2*MUSCR*Z0
WRITE(6,61)IS,IX,IY,IXY,INODE
WRITE(6,62)XB,Y0,Z0
WRITE(6,63)(XX(L,INODE),L=1,3)
718 CONTINUE
798 CONTINUE
799 CONTINUE
C
C
C
C
C ----- ROTOR BLADE -----
C
IF(NBLADE.EQ.0) GO TO 1039
KKS=(MBOV1+MBOV2+MBOV3)*MULT*MULTY*(MRY1+MRY2+MRY3)*MULTY
1 +NSHAFT*MULTY+MHUB*MULT*MULTY+NSHANK
DO 1098 IB=1,KBLADE
KS=KKS+1+(IB-1)*(NBLADE*MULT*NSHANK)
DO 1097 IMULT=1,MULT
WRITE(6,55)IB,IMULT,IXY,IS,X,Y,Z
C
SIGNV=1.
IF(IMULT.EQ.1)SIGNZ=1.
IF(IMULT.EQ.2)SIGNZ=-1.
C
GXX=1./MX(KS)
GYY=1./MY(KS)
NXP=MX(KS)+1
NYP=MY(KS)+1
LBLELE=KBLELE
IF(LBLELE.NE.0)GO TO 1000
LBLELE=1
READ(NREAD,15) (HCST(IY),IY=1,NYP)
WRITE(NWRITE,25) (CST(IY),IY=1,NXP)
READ(NREAD,15) (HETA(IY),IY=1,NYP)
WRITE(NWRITE,25) (HETA(IY),IY=1,NYP)

```

```

1000 CONTINUE
DO 1010 IX=1,NXP
DO 1010 IY=1,NYP
XX=(IX-1)*DXX
YY=(IY-1)*DYY
IF(KBLE.EQ.0) XX=MCST*IX
IF(KBLE.EQ.0) YY=META(IY)
GO TO (1031,1032,1033,1034),LBLE
1031 CONTINUE
CSI=XX
ETA=YY
GO TO 1013
1032 CONTINUE
CSI=XX*YY
ETA=1.-(1.-YY)**2
GO TO 1013
1033 CONTINUE
CSI=XX
ETA=1.-(1.-YY)**2
GO TO 1013
1034 CONTINUE
CSI=XX*YY
ETA=YY
1013 CONTINUE
BCMOD=XSTE-XLE
XLEZ=XBLE
XTEZ=XSTE
TANBLE=TANLE
TANSTE=TANSE
SPAN=2.*RROTOR
Y=(RROTOR-YCUT)*ETA+YCUT
XLE=XLEZ+TANBLE*(Y-YCUT)
XTE=XTEZ+TANSTE*(Y-YCUT)
FCMOD=XTE-XLE
X=XLE+FCMOD*CSI
C
C
GO TO (1051,1052,1053),C31SWP
1051 CONTINUE
C
C FOR CIRCULAR BICONVEX
C
XC=0.5*(XLE+XTE)
PL=0.5*(XTE-XLE)
TAUOL=.050
TAU=TAUOL
H=TAU*PL
ATAU=2.*H
ETACR=1.-ATAU/SPAN
XXC=X-XC
Z=0.
IF(N.EQ.0..OR.IY.EQ.NYP..OR.IX.EQ.1..OR.IX.EQ.NXP)GO TO 115
Z=SIGNZ*(SQRT(((PL*PL+H*H)/(2.*H))**2-XXC**2)-(PL*PL-H*H)/(2.*H))
IF(ETA-GE-ETACR)Z=Z*SQRT(1.-((ETA-ETACR)*SPAN/ATAU)**2)
GO TO 115
1052 CONTINUE
TAUBAR=TAU*.75*SQRT(3.)*(XTEZ-XLEZ)

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```

Z=SIGNZ*TAUBAR*SQRT(CSI)*(1.-CSI)*SQRT(1.-ETA**2)
GO TO 115
1053 CONTINUE
Z=SIGNZ*TAUBAR*(XTEZ-XLIZ)*CST*(1.-CSI)*SQRT(1.-ETA**2)
115 CONTINUE
C
IXY=IX+(IY-1)*NXP
IS=KS
IF (INULT.EQ.2) IS=KS+1
INODE=MOECY(IYV,IS)
XK(1,INODE)=X
XK(2,INODE)=Y*STCNY
XK(3,INODE)=Z*ZHUBCR
C
AZIN=AZINUT*PI/180.
GO TO (381,382),TWIST
C
381 CONTINUE
PITCHR=RPITCH*PI/180.
PITCHT=(RPITCH*TWIST)*PI/180.
X1=VCUT
X2=RROTOR
XX=XK(1,INODE)
YY=YK(2,INODE)
ZZ=XK(3,INODE)
C1=(YY-X2)/(X1-X2)
C2=(YY-X1)/(X2-X1)
DX=Y2-X1
PITCH=C1*PITCHR+C2*PITCHT
GO TO 383
382 CONTINUE
PITCHR=RPITCH*PI/180.
PIT75=(THET75+THET1C*COB(AZIN)+THET1S*SIN(AZIN))*PI/180.
X1=VCUT
X2=.75*RROTOR
XX=XK(1,INODE)
YY=XK(2,INODE)
ZZ=XK(3,INODE)
C1=(YY-X2)/(X1-X2)
C2=(YY-X1)/(X2-X1)
DX=X2-X1
PITCH=C1*PITCHR+C2*PIT75
383 CONTINUE
C
C BLADE TWIST
C
COSPIY=COS(PITCH)
SINPIY=SIN(PITCH)
C
XK1=YK(1,INODE)
XK3=XK(3,INODE)
XK(1,INODE)=XK1*COSPIY+XK3*SINPIY
XK(3,INODE)=XK1*SINPIY+XK3*COSPIY
C
C CONING ANGLE
C
CONE=CONING*PI/180.

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```

      COSC=COS(CONE)
      SINC=SIN(CONE)
C
      XK2=XK(2,INODE)
      XK3=XK(3,INODE)
      XK(2,INODE)= XK2*COSC-XK3*SINC
      XK(3,INODE)= XK2*SINC+XK3*COSC
C
C AZIMUTH
C
      HZIM=(AZIMUTH-90.)*PI/180.
      COSMZ=COS(HZIM)
      SINMZ=SIN(HZIM)
C
      XK1=XK(1,INODE)
      XK2=XK(2,INODE)
      XK(1,INODE)=XK1*COSMZ-XK2*SINMZ
      XK(2,INODE)= XK1*SINMZ+XK2*COSMZ
C
      ANG=2.*PI/KBL*ADF
      ANGR=ANG*(IB-1)
C
      XK1=XK(1,INODE)
      XK2=XK(2,INODE)
C
      XK(1,INODE)= XK1*COS(ANGR)-XK2*SIN(ANGR)
      XK(2,INODE)= XK1*SIN(ANGR)+XK2*COS(ANGR)
C
      WRITE(6,55)IB,IMULT,IXY,IS,X,Y,Z
55  FORMAT(18X,2I8=2,IS,2X,2IMULT=2,IS,2X,2IXY=2,IS,2X,2IS=2,IS,2X,
1  *XYZ=*,3(E12.6,2X))
1018 CONTINUE
1097 CONTINUE
1098 CONTINUE
1099 CONTINUE
C
      WRITE(6,60)
60  FORMAT(18X,2I8=2,END OF CCOORD ==2)
C
      RETURN
      END

```

```

C
SUBROUTINE CHECK(MELEM,MYMAX,NYMAX,NTHAX)
COMMON/ZZZ1/XY(34),NY(34),NXY(34),KSYMNY,KSYMHZ,NSYMHV,NSYMHZ
COMMON/ZZZ2/NSFX,NSBODY,NS,NT(34),TSPACE(34),KNORM(34),KNAKES(34)
COMMON/ZZZ3/NPYLON,NBODY1,NBODY2,NBODY3,NVTAIL,NSHAFT,NHUB,NSHANK,
1 NBLADE
COMMON/ZZZ4/OMACH,OMEGA,ALFA,ABETA
COMMON/ZZZ5/XPYCTR,YPYCTR,ZPYCTR,XPYVL,YPYVL,ZPYVL
COMMON/ZZZ6/XNOSE,XBD1,XBD2,XTAIL
COMMON/ZZZ7/YNOSE,YBD1,YBD2,YTAIL
COMMON/ZZZ8/ZNOSE,ZBD1,ZBD2,ZTAIL
COMMON/ZZZ9/RXBD1,RZBD1,RXBD2,RZBD2
COMMON/ZZZ10/RSHAFT,LSHFT,RSHANK,LSHANK
COMMON/ZZZ11/YHUBCR,YHUBCR,ZHUBCR,ZHUBCR,RHUB,RHUB
COMMON/ZZZ12/RROTOR,BCH RD,TAUBL,ALFA
COMMON/ZZZ13/TWETZ,TWETZC,TWETZC,CONING,AZIMUTH
COMMON/ZZZ14/KBLADE,TANLEB,TANLEB,XBLE,XBTE,KROTORS(34)
COMMON/ZZZ15/NSBAN,XLEB,XLEB,TANLEB,TANLEB,TAU,ZVTAIL
COMMON/ZZZ16/NWAKPY,NWAKB,NWAKS,NWAKB
COMMON/ZZZ17/NWAKPY,NWAKB,NWAKS,NWAKB
COMMON/ZZZ18/NWAKPY,NWAKB,NWAKS,NWAKB
COMMON/ZZZ19/KROTNT(18),NREAD,NWRITE,XREAD
COMMON/ZZZ20/PI
COMMON/ZZZ21/KDY1,KDY2
COMMON/ZZZ22/KNSELE,KNS4P,KNSTYP
COMMON/ZZZ23/KBLELE,KBL4P,KBLTYP
COMMON/ZZZ24/KTNELE,KTN4P,KTNTYP
COMMON/ZZZ25/KPYELE,KPY4P,KPYTYP
COMMON/ZZZ26/KVTELE,KVT4P,KVTYP
COMMON/ZZZ27/KSMELE,KSM4P,KSMTYP
COMMON/ZZZ28/KHBELE,KHB4P,KHBTYP
COMMON/ZZZ29/KSKELE,KSK4P,KSKTYP
COMMON/ZZZ30/KBLELE,KBL4P,KBLTYP
COMMON/ZZZ31/NSSTAG,NVORT,NSPTRAL,SPTRAL
REAL LSHAFT,LSHANK
C
DO 100 IS=1,NS
IF(NY(IS).GT.MYMAX) CALL DEBUG(300)
IF(NY(IS).GT.NYMAX) CALL DEBUG(300)
100 CONTINUE
IF(MELEM.GT.NTHAX) CALL DEBUG(500)
WRITE(6,600)
600 FORMAT(10X,"--- END OF CHECK ---")
RETURN
END

```

```

C
SUBROUTINE B2EPRO(NMODE,NXTMP,NOFCT,NSELM,NTHAKE)
C
C THIS SUBROUTINE FUNCTIONED AS A P2E-PROCESSOR. ON RETURN,
C THE CO-ORDINATES OF NODES IN THE GLOBAL NUMBERING SYSTEM
C WILL BE RE-CONSTRUCTED TO GIVE CO-ORDINATES IN THE LOCAL
C NUMBERING SYSTEM FOR INDIVIDUAL SURFACES.
C
C
INTEGER PP,PM,MR,MH
DIMENSION NOFCT(NXTMP,34)
COMMON/ZZZ1/XY(34),NY(34),MZ(34),KSYM1,KSYM2,NSYMM1,NSYMM2
COMMON/ZZZ2/VSFX,NSBODY,VS,NT(34),ISFACE(34),KNORML(34),KNAKES(34)
COMMON/ZZZ3/XPYLON,NBODY1,NBODY2,NBODY3,NXTAIL,NSHAFT,NHUB,NSHANK,
1 NBLADE
COMMON/ZZZ4/OMEGA,ALFA,ABETA
COMMON/ZZZ5/XPYCTR,YPYCTR,ZPYCTR,RXPYL,RPYVL,RZPYVL
COMMON/ZZZ6/YNOSE,YB01,Y302,YTAIL
COMMON/ZZZ7/YNOSE,YB01,Y302,YTAIL
COMMON/ZZZ8/ZNOSE,ZB01,Z302,ZTAIL
COMMON/ZZZ9/RVB01,RZB01,RVB02,RZB02
COMMON/ZZZ10/LSHAFT,LSHAFT,LSHANK,LSHANK
COMMON/ZZZ11/XHUBCR,YHUBCR,ZHUBCR,RXHUB,RYHUB,RZ4U9
COMMON/ZZZ12/PROTOR,BCH1D,TAU8L,ALFA2
COMMON/ZZZ13/THET75,THET1C,THET1S,CONING,AZINHUTH
COMMON/ZZZ14/KBLADE,TAN1B,TAN1E,XBL1,X2E,KROTORS(34)
COMMON/ZZZ15/VSPAN,XLEZV,XTEZV,TANLEV,TANTEV,TAU,ZVTAIL
COMMON/ZZZ16/NMAKPY,NMAK1B,NMAKSK,NMAKBL
COMMON/ZZZ17/MAKPY,MAK1B,MAKLSK,MAKBL
COMMON/ZZZ18/MANGPY,MANG1B,MANGSK,MANGBL
COMMON/ZZZ19/KPRINT(10),VREAD,NWRITE,KREAD
COMMON/ZZZ20/PT
COMMON/ZZZ21/KPYL1,KPYL2
COMMON/ZZZ22/KNSELE,KNS14P,KNSTYP
COMMON/ZZZ23/K8DELE,K8D54P,K8D7Y2
COMMON/ZZZ24/KTNLE,KTN54P,KTNTYP
COMMON/ZZZ25/KPYELE,KPY54P,KPYTYP
COMMON/ZZZ26/KVTELE,KVT14P,KVTTYP
COMMON/ZZZ27/KSHELE,KSHE4P,KSHTYP
COMMON/ZZZ28/KNBELE,KNSH4P,KNSTYP
COMMON/ZZZ29/KSKELE,KSK54P,KSKTYP
COMMON/ZZZ30/KBLELE,KBL54P,KBLTYP
COMMON/ZZZ31/NSTAG,NVORT,NSPIRAL,SPIRAL
C
C
DO 24 I=1,NS
C24 WRITE(6,234)NX(I),NY(I),VT(I),KNORML(I),ISFACE(I)
CC
MULT=1
IF (KSYM2.EQ.0) MULT=2
MULTY=1
IF (KSYM1.EQ.0) MULTY=2
CC
CC
CC
NTBODY=NBODY1+NBODY2+NBODY3

```

```

CC      NODEX=0
      NODEU=0
      IF (NTBODY.EQ.0) GO TO 17
      NODEX=1
      DO 20 I=1,NTBODY
20      NODEX=NODEX+NX(I)
18      CONTINUE
CC      IF (NTBODY.NE.0)
      1 NODEU=NODEU+NODEX*(NY(NTBODY)+1) - (NTBODY-1)*NY(NTBODY)
CC
CC      NODEX=NUMBER OF NODES ALONG AIRCRAFT CENTERLINE
CC
CC      NODEU=NUMBER OF NODES ON UPPER RHS FUSELAGE BODY
CC
CC
      IS=0
      NODES=0
      NLAST=0
C
      IF (NBODY1.EQ.0) GO TO 99
      IS=ISA+1
      NXP=NX(IS)+1
      NYP=NY(IS)+1
      DO 80 IY=1,NYP
      DO 80 IX=1,NXP
      IXY=IX+(IY-1)*NXP
C
      IF (IX.EQ.1.AND.IY.GT.1) GO TO 85
      NODES=NODES+1
85      CONTINUE
      INODE=NODES
      IF (IX.EQ.1) INODE=1
      NOECT (IXY,IS)=INODE
80      CONTINUE
99      CONTINUE
C
      NLAST=NODES
      IF (NBODY2.EQ.0) GO TO 199
      IS=ISA+1
      NXP=NX(IS)+1
      NYP=NY(IS)+1
      DO 180 IY=1,NYP
      DO 180 IX=1,NXP
      IXY=IX+(IY-1)*NXP
C
      IF (IX.EQ.1) GO TO 185
      NODES=NODES+1
185      CONTINUE
      INODE=NODES
      IF (IX.EQ.1) INODE=(NX(1)+1)+(IY-1)*NX(1)
      NOECT (IXY,IS)=INODE
180      CONTINUE
199      CONTINUE
C

```



```

      NLAST=NODE0
      IF(MR00Y1.EQ.8)GO TO 299
      IS=IS+1
      NXP=NY(IS)+1
      NYP=NY(IS)+1
      DO 288 IX=1,NXP
      DO 288 IX=1,NXP
      IXY=IX+(IX-1)*NXP
C
      IF(IY.EQ.1)GO TO 285
      IF(IX.EQ.NXP.AND.IY.GT.1)GO TO 295
      NODE8=NODE8+1
285  CONTINUE
      INODE=NODE8
      IF(IX.EQ.1)INODE=
1  NX(1)*(NY(1)+1)+1+
2  NX(2)*(IX-1)*NX(2)
      IF(IY.EQ.NYP)INODE=
1  NX(1)*(NY(1)+1)+1+
2  NX(2)*(NY(2)+1)+
3  NX(3)
      NOECT(IXY,IS)=INODE
288  CONTINUE
299  CONTINUE
C
      NLAST=NODE8
C
      IF(MR00Y1.EQ.8)GO TO 399
      IS=IS+1
      NXP=NY(IS)+1
      NYP=NY(IS)+1
      DO 388 IX=1,NXP
      DO 388 IX=1,NXP
      IXY=IX+(IX-1)*NXP
C
      IF(IY.EQ.1.AND.IY.GT.1)GO TO 385
      IF(IX.EQ.NXP)GO TO 385
      NODE8=NODE8+1
385  CONTINUE
      INODE=NODE8
      IF(IX.EQ.1)INODE=
1  NLAST+1
      IF(IX.EQ.NXP)INODE= NX(1)*(NY(1)+1)+1+NYP-(IX-1)
      NOECT(IXY,IS)=INODE
388  CONTINUE
399  CONTINUE
      NLAST=NODE8
C
      IF(KSYMHZ.NE.8)GO TO 499
      IF(MR00Y1.EQ.8)GO TO 499
      IS=IS+1
      NXP=NY(IS)+1
      NYP=NY(IS)+1
      DO 488 IX=1,NXP
      DO 488 IX=1,NXP
      IXY=IX+(IX-1)*NXP
C

```

```

      IF (IX.EQ.1) GO TO 485
      IF (IY.EQ.NYP) GO TO 4A5
      NODE0=NODE0+1
4A5  CONTINUE
      INODE=NODE0
      IF (IX.EQ.1) INODE=1
      IF (IX.NE.1.AND.IY.EQ.NYP) INODE=
1  NX(1)*NY(1)+IY
      NOFCT (IXY,IS)=INODE
4A8  CONTINUE
499  CONTINUE
C
      NLAST=NODE0
C
      IF (KSYMHZ.NE.0) GO TO 503
      IF (NBODY2.EQ.0) GO TO 509
      IS=ISA+1
      NXP=NX(IS)+1
      NYP=NY(IS)+1
      DO 588 IY=1,NYP
      DO 588 IX=1,NXP
      IXY=IX+(IY-1)*NXP
C
      IF (IX.EQ.1) GO TO 585
      IF (IY.EQ.NYP) GO TO 5A5
      NODE0=NODE0+1
5A5  CONTINUE
      INODE=NODE0
      IF (IX.EQ.1.AND.IY.NE.NY) INODE=
1  NLAST-NX(1)*(NY(1)-2)-(NX(1)-1)-1+(IY-1)*NX(1)
      IF (IX.EQ.1.AND.IY.EQ.NY) INODE=
1  NX(1)*(NY(1)+1)+1
      IF (IY.EQ.NYP.AND.IY.NE.1) INODE=
1  NX(1)*(NY(1)+1)+1+
2  NY(2)*NY(2)-1+IY
      NOFCT (IXY,IS)=INODE
5A8  CONTINUE
599  CONTINUE
C
      NLAST=NODE0
      IF (KSYMHZ.NE.0) GO TO 603
      IF (NBODY3.EQ.0) GO TO 609
      IS=ISA+1
      NXP=NX(IS)+1
      NYP=NY(IS)+1
      DO 688 IY=1,NYP
      DO 688 IX=1,NXP
      IXY=IX+(IY-1)*NXP
C
      IF (IX.EQ.1) GO TO 685
      IF (IY.EQ.NYP) GO TO 6A5
      IF (IX.EQ.NXP) GO TO 685
      NODE0=NODE0+1
685  CONTINUE
      INODE=NODE0
      IF (IX.EQ.1.AND.IY.NE.NY) INODE=

```

```

1 NLAST=NX(2)*(NY(2)-2)-(IX(2)-1)-1+(IX-1)*NX(2)
IF(IY.EQ.NYP.AND.(IX.NE.1.OR.IX.NE.NXP))INODE=
1 NX(1)*(NY(1)+1)+1+
2 NX(2)*(NY(2)+1)+
3 (NX(3)-1)*NY(3)+1+(IX-1)
IF(IY.EQ.NXP)INODE=
1 NX(1)*(NY(1)+1)+1+
2 NX(2)*(NY(2)+1)+
3 NX(3)
IF(IX.EQ.1.AND.IY.EQ.NYP)INODE=
1 NX(1)*(NY(1)+1)+1+NX(2)*(NY(2)+1)
NOFCT(IXY,IS)=INODE
688 CONTINUE
699 CONTINUE
C
NLAET=NODE8
NODET=NLAET
IF(NVTALE.EQ.8)GO TO 79
IS=IS+1
NXP=NX(IS)+1
NYP=NY(IS)+1
DO 788 IX=1,NXP
DO 788 IY=1,NYP
IXY=IX+(IY-1)*NXP
C
NODE8=NODE8+1
INODE=NODE8+NLAET
NOFCT(IXY,IS)=INODE
788 CONTINUE
799 CONTINUE
C
NLAET=NODE8
IF(KSYMMY.NE.0) GO TO 833
IF(NB0DY1.EQ.8)GO TO 89
IS=IS+1
NXP=NX(IS)+1
NYP=NY(IS)+1
DO 888 IX=1,NXP
DO 888 IY=1,NYP
IXY=IX+(IY-1)*NXP
C
IF(IY.EQ.1)GO TO 885
IF(IY.EQ.1)GO TO 885
NODE8=NODE8+1
885 CONTINUE
INODE=NODE8
IF(IX.EQ.1)INODE=1
IF(IY.EQ.1)INODE=IX
NOFCT(IXY,IS)=INODE
888 CONTINUE
899 CONTINUE
C
NLAET=NODE8
IF(KSYMMY.NE.8) GO TO 833
IF(NB0DY2.EQ.8)GO TO 999
IS=IS+1
NXP=NX(IS)+1

```

```

      NYP=NY(15)+1
      KPYL1=1
      KPYL2=2
      K1=KPYL1+2
      K2=K1+NX(4)-2
      DO 988 IY=1,NYP
      DO 986 IX=1,NXP
      IXY=IX+(IY-1)*NXP
C
      IF(MPYLON.NE.0) GO TO 951
      IF(IX.EQ.1) GO TO 985
      IF(IY.EQ.1) GO TO 985
      NODE0=NODE0+1
985  CONTINUE
      INODE=NODE0
      IF(IY.EQ.1) INODE=
1  NLAST-NX(1)*(NY(1)-1)-(VX(1)-1)-1+(IY-1)*NX(1)
      IF(IY.EQ.1) INODE=
2  NX(1)*(NY(1)+1)+1+(IX-1)
      IF(IY.EQ.1.AND.IY.EQ.1) INODE=
1  NX(1)+1
      GO TO 949
950  CONTINUE
      IF(IY.EQ.1) GO TO 951
      IF(IY.EQ.1.AND.(IX.LT.K1.OR.IX.GT.K2)) GO TO 951
      NODE0=NODE0+1
951  CONTINUE
      INODE=NODE0
      IF(IX.EQ.1) INODE=NLAST-NX(1)*(NY(1)-1)-(NX(1)-1)-1+(IY-1)*NX(1)
      IF(IY.EQ.1.AND.(IX.LT.K1.OR.IX.GT.K2)) INODE=
1  NX(1)*(NY(1)+1)+1+(IX-1)
      IF(IY.EQ.1.AND.IY.EQ.1) INODE=NX(1)+1
949  CONTINUE
      NOECT(IY,IS)=INODE
980  CONTINUE
989  CONTINUE
C
      NLAST=NODE0
      IF(KSYMMY.NE.0) GO TO 1039
      IF(MPOCY3.EQ.0) GO TO 1021
      IS=IS+1
      NYP=NY(15)+1
      NXP=NX(15)+1
      DO 1000 IY=1,NYP
      DO 1000 IX=1,NXP
      IXY=IX+(IY-1)*NXP
C
      IF(IY.EQ.1) GO TO 1005
      IF(IY.EQ.1) GO TO 1005
      IF(IY.EQ.1) GO TO 1005
      NODE0=NODE0+1
1005  CONTINUE
      INODE=NODE0
      IF(IY.EQ.1) INODE=
1  NLAST-NX(2)*(NY(2)-1)+(IY-2)*NX(2)
      IF(IY.EQ.1) INODE=
1  NX(1)*(NY(1)+1)+1+NX(2)*(NY(2)+1)+(IX-1)

```



```

      IF(IX.EQ.1.AND.IV.EQ.1)INODE=
      1 NX(1)*(NY(1)+1)+1+NX(2)
      IF(IX.EQ.NXP)INODE=
      1 NX(1)*(NY(1)+1)+1+1
      2 NX(2)*(NY(2)+1)+NX(3)
      MOECT(IX,IS)=INODE
1888 CONTINUE
1899 CONTINUE
C
      NLAST=NODE8
      IF(KSYMHY.NE.0) GO TO 1139
      IF(NBYLON.EQ.0)GO TO 1192
      IS=IS+1
      NXP=NX(IS)+1
      NYP=NY(IS)+1
      DO 1188 IX=1,NXP
      DO 1180 IX=1,NXP
      IXY=IX+(IX-1)*NXP
C
      IF(IV.EQ.1)GO TO 1185
      IF(IX.EQ.1.OR.(IX.EQ.NXP))GO TO 1185
      IF(IV.EQ.NYP)GO TO 1185
      NODE8=NODE8+1
1185 CONTINUE
      INODE=NODE8
      IF(IV.EQ.1)INODE=NODE8+1
      IF(IX.EQ.1)INODE=NODE8+1
      IF(IX.EQ.NXP.AND.IX.NE.1)INODE=NODE8+1+(NXP-2)*(NYP-1)+1+(IX-2)
      IF(IX.EQ.NXP)INODE=NLAST-(NX(3)-1)*NY(3)-NX(2)*NY(2)+1-(IX-1)
      IF(IV.EQ.1.AND.IX.EQ.NXP)INODE=NX(1)*(NY(1)+1)+1+NX(4)+1
      IF(IV.EQ.NYP.AND.IX.EQ.NXP)INODE=NX(1)*(NY(1)+1)+1+1
      MOECT(IX,IS)=INODE
1188 CONTINUE
1199 CONTINUE
C
      NLAST=NODE8
      IF(KSYMHZ.NE.0) GO TO 1239
      IF(NBYLON.EQ.0)GO TO 1232
      IS=IS+1
      NXP=NX(IS)+1
      NYP=NY(IS)+1
      DO 1288 IX=1,NXP
      DO 1280 IX=1,NXP
      IXY=IX+(IX-1)*NXP
C
      IF(IV.EQ.1)GO TO 1285
      IF(IX.EQ.1)GO TO 1285
      IF(IV.EQ.NYP)GO TO 1285
      NODE8=NODE8+1
1285 CONTINUE
      INODE=NODE8
      PSS=8
      IF(NPYLON.EQ.0)PSS=1.
      IF(PSS.EQ.1)GO TO 1288
      IF(IX.EQ.1)INODE=1
      IF(IV.NE.1.AND.IV.EQ.1)INODE=
      1 NODE8+

```

```

      2 (NX(4)-1)*(NY(4)+1)*IX
      IF (TX.NE.1.AND.IY.EQ.NY2) INODE=NLAST-
      1 NX(4)*(NY(4)-1)-(NX(3)-1)*NY(3)-
      2 NX(2)*NY(2)+NX(1)*(TX-1)
      GO TO 1250
1200 CONTINUE
      IF (TX.EQ.1) INODE=1
      IF (TX.NE.1.AND.IY.EQ.1) INODE=
      1 NODEU+(IX-1)
      IF (TX.NE.1.AND.IY.EQ.NY2) INODE=
      1 NODEU+NX(1)*NY(1)+NX(2)*Y(2)+(NX(3)-1)*NY(3)+
      2 NY(1)*NY(1)+1*(TX-1)
1250 CONTINUE
      NOECT(IY,IS)=INODE
1280 CONTINUE
1290 CONTINUE
C
      NLAST=NODE8
      IF (KSYMHZ.NE.0) GO TO 1393
      IF (MBOY2.EQ.0) GO TO 1333
      IS=IS+1
      NXP=NX(IS)+1
      NYP=NY(IS)+1
      DO 1380 IY=1,NYP
      DO 1380 IX=1,NXP
      IYV=IY+(IY-1)*NXP
      C
      IF (IY.EQ.1) GO TO 1385
      IF (IX.EQ.1) GO TO 1385
      IF (IY.EQ.NYP) GO TO 1385
      NODE8=NODE8+1
1385 CONTINUE
      INODE=NODE8
      PSS=0.
      IF (NPYLON.EQ.0) PSS=1.
      IF (PSS.EQ.1) GO TO 1390
      IF (IX.EQ.1.AND.(IY.NE.1.OR.IY.NE.NYP)) INODE=
      1 NLAST-NX(1)*(NY(1)-2)+IX-2)*NX(1)
      IF (IX.EQ.1.AND.IY.EQ.1) INODE=
      1 NODEU+NX(1)-1*(NY(1)-1)+NX(1)
      IF (IX.GT.1.AND.IY.EQ.1) INODE=
      1 NODEU+NX(1)-1*(NY(1)-1)+1
      2 NX(1)*NY(1)+(IX-1)
      IF (IX.EQ.1.AND.IY.EQ.NY2) INODE=
      1 NLAST-NX(1)*(NY(1)-1)-NX(4)*(NY(4)-1)-
      2 (NX(3)-1)*NY(3)-NX(2)*NY(2)
      IF (IX.GT.1.AND.IY.EQ.NY2) INODE=
      1 NLAST-NX(1)+1*(NY(1)-1)-
      2 (NX(4)-1)*(NY(4)-1)-(NX(3)-1)*NY(3)-
      3 NX(2)*NY(2)
      GO TO 1350
1390 CONTINUE
      IF (IX.EQ.1.AND.(IY.NE.1.OR.IY.NE.NYP)) INODE=
      1 NLAST-NX(1)-(NY(1)-1)+1*(IY-2)*NX(1)
      2 +NX(1)
      IF (IY.EQ.1.AND.IY.EQ.1) INODE=
      1 NODEU+NX(1)

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```

      IF (IV.EQ.1.AND.IX.NE.1) INODE=
1  NODEU+NX(1)*NY(1)+IX-1
      IF (IX.EQ.1.AND.IV.EQ.NY) INODE=
1  NLAST-NX(1)*NY(1)-IX(1)-1+NY(1)-NX(1)*NY(1)
      IF (IX.NE.1.AND.IV.EQ.NY) INODE=
1  NLAST-NX(1)*NY(1)-IX(1)-1+NY(1)-NX(1)+IX-1
1350 CONTINUE
      NOECT(IX,IS)=INODE
1360 CONTINUE
1380 CONTINUE
      NLAST=NODE8
      IF (NMODE3.EQ.8) GO TO 1423
      IS=IS+1
      NXP=NX(IS)+1
      NYP=NY(IS)+1
      DO 1488 IV=1,NYP
      DO 1488 IX=1,NXP
      IXY=IX+(IV-1)*NXP
C
      IF (IX.EQ.1) GO TO 1485
      IF (IV.EQ.1) GO TO 1485
      IF (IV.EQ.NYP) GO TO 1485
      IF (IX.EQ.NXP) GO TO 1485
      NODE8=NODE8+1
1485 CONTINUE
      INODE=NODE8
      PSS=0.
      IF (NBYLON.EQ.8) PSS=1.
      IF (PSS.EQ.1) GO TO 1498
      IF (IX.EQ.1) INODE=NLAST
1  NX(2)+(IV-2)*NX(2)
      IF (IX.EQ.1.AND.IV.EQ.1) INODE=
1  NODEU+(NX(4)-1)*(NY(4)+1)+1+
2  NX(1)*NY(1)+NX(2)
      IF (IX.NE.1.AND.IV.EQ.1) INODE=
1  NODEU+(NX(4)-1)*(NY(4)+1)+1+NX(1)*NY(1)+
2  NX(2)*NY(2)+(IX-1)
      IF (IV.EQ.NYP.AND.IX.EQ.1) INODE=
1  NLAST-NX(2)*(NY(2)-1)-IX(1)*(NY(1)-1)-
2  (NX(4)-1)*(NY(4)-1)-NX(1)*NY(1)
3  +NX(3)
      IF (IV.EQ.NYP.AND.IX.NE.1) INODE=
1  NLAST-NX(2)*(NY(2)-1)-IX(1)*(NY(1)-1)-
2  (NX(4)-1)*(NY(4)-1)-NX(3)+IX-1
      IF (IX.EQ.NXP) INODE=
1  NX(1)*(NY(1)+1)+NX(2)*NY(2)+1+NX(3)+1
      GO TO 1458
1488 CONTINUE
      IF (IV.EQ.1) INODE=
1  NODEU+NX(1)*NY(1)+NX(2)*NY(2)+IX-1
      IF (IV.EQ.NYP) INODE=
1  NLAST-NX(2)*(NY(2)-1)-IX(1)*(NY(1)-1)-NX(3)+IX-1
      IF (IX.EQ.NXP) INODE=
1  NODEU+(NX(3)+1)*NY(1)
      IF (IX.EQ.1) INODE=
1  NLAST-NX(2)-(NX(2)-1)-1+(IV-2)*NX(2)
2  +NX(2)

```

```

      IF(IX.EQ.1.AND.IY.EQ.1)INODE=
      1 NODE8+NX(1)*NY(1)+NX(2)
      IF(IX.EQ.1.AND.IY.EQ.NYP)INODE=
      1 NLAST-NX(2)*NY(2)+1+NX(1)*NY(1)+1+NX(3)+1+NY(3)
1458 CONTINUE
      NOFCT(IXY,IS)=INODE
1468 CONTINUE
1499 CONTINUE
      NLAST=NODE8
      IF(NSHFT.EQ.8)GO TO 1503
      IS=IS+1
      NXP=NX(IS)+1
      NYP=NY(IS)+1
      DO 1508 IY=1,NYP
      DO 1508 IX=1,NXP
      IXY=IX+(IY-1)*NXP
      C
      IF(IY.EQ.1.OR.IY.EQ.NYP)GO TO 1505
      IF(IY.EQ.NYP)GO TO 1505
      NODE8=NODE8+1
1505 CONTINUE
      INODE=NODE8
      IF(IX.EQ.1)INODE=
      1 NODE8+IX-1+NX(1)+1
      IF(IX.EQ.NXP)INODE=
      1 NODE8+1+NX(1)+(IY-1)*(NX(1)+1)
      IF(IY.EQ.NYP)INODE=
      1 NODE8+NX(1)+1+NY(1)+1
      NOFCT(IXY,IS)=INODE
1588 CONTINUE
1599 CONTINUE
      C
      NLAST=NODE8
      NSOBY=NODE8
      IF(NSHFT.EQ.8)GO TO 1603
      IS=IS+1
      NXP=NX(IS)+1
      NYP=NY(IS)+1
      DO 1608 IY=1,NYP
      DO 1608 IX=1,NXP
      IXY=IX+(IY-1)*NXP
      C
      NODE8=NODE8+1
      INODE=NODE8
      NOFCT(IXY,IS)=INODE
1688 CONTINUE
1699 CONTINUE
      C
      NLAST=NODE8
      IF(KSYHHV.NE.8)GO TO 1709
      IF(NSHFT.EQ.8)GO TO 1709
      IS=IS+1
      NXP=NX(IS)+1
      NYP=NY(IS)+1
      DO 1708 IY=1,NYP
      DO 1708 IX=1,NXP
      IXY=IX+(IY-1)*NXP

```



```

C
IF (IV.EQ.1.OR.IV.EQ.NYP) GO TO 1735
NODE8=NODE8+1
1735 CONTINUE
INODE=NODE8
IF (IV.EQ.1) INODE=
1 NBODY+IX
IF (IV.EQ.NYP) INODE=
1 NBODY+(NX(15)+1)*NY(15)+IX
NOFCT (IXY, IS) = INODE
1780 CONTINUE
1790 CONTINUE
C
NLAST=NODE8
IF (NMHUB.EQ.8) GO TO 1899
IS=IS+1
NXP=NX(15)+1
NYP=NY(15)+1
DO 1880 IV=1, NYP
DO 1880 IX=1, NXP
IXY=IX+(IV-1)*NXP
C
IF (IX.EQ.1.AND.IV.GT.1) GO TO 1885
NODE8=NODE8+1
1885 CONTINUE
INODE=NODE8
IF (IX.EQ.1) INODE=NLAST+1
NOFCT (IXY, IS) = INODE
1888 CONTINUE
1899 CONTINUE
C
NLAST=NODE8
IF (KSYMZ.NE.8) GO TO 1939
IF (NMHUB.EQ.8) GO TO 1939
IS=IS+1
NXP=NX(15)+1
NYP=NY(15)+1
DO 1988 IX=1, NXP
DO 1988 IV=1, NYP
IXY=IX+(IV-1)*NXP
C
IF (IV.EQ.1.AND.IV.GT.1) GO TO 1985
IF (IX.EQ.NXP) GO TO 1985
NODE8=NODE8+1
1985 CONTINUE
INODE=NODE8
IF (IX.EQ.1) INODE=NBODY+
1 (NX(15)+1)*(NY(15)+1)+
2 (NX(16)+1)*(NY(16)-1)+
3 NX(17)*(NY(17)+1)+1
IF (IX.EQ.NXP) INODE=NBODY+
1 (NX(15)+1)*(NY(15)+1)+
2 (NX(16)+1)*(NY(16)-1)+
3 (NX(17)+1)*(NY(17)+1)
NOFCT (IXY, IS) = INODE
1988 CONTINUE
1999 CONTINUE

```

```

C
  NLAST=NODE8
  IF(KSYMHV.NE.0) GO TO 2199
  IF(NHUB.EQ.8) GO TO 2899
  IS=IS+1
  NXP=NX(IS)+1
  NYP=NY(IS)+1
  DO 2888 IY=1,NYP
  DO 2888 IX=1,NXP
    IXY=IX+(IY-1)*NXP
  C
    IF(IY.EQ.1) GO TO 2885
    IF(IY.EQ.1.OR.IY.EQ.NYP) GO TO 2885
    NODE8=NODE8+1
  2885 CONTINUE
    INODE=NODE8
    IF(IX.EQ.1) INODE=NBODY+
    1 (NX(15)+1)*(NY(15)+1)+
    2 (NX(16)+1)*(NY(16)-1)+
    3 1
    IF(IY.EQ.1.AND.IX.NE.1) INODE=
    1 NBODY+(NX(15)+1)*(NY(15)+1)+
    2 (NX(16)+1)*(NY(16)-1)+
    3 IY
    IF(IY.EQ.NYP.AND.IX.NE.1) INODE=
    1 NBODY+(NX(15)+1)*(NY(15)+1)+
    2 (NX(16)+1)*(NY(16)-1)+
    3 NY(17)+NY(17)+1
    NOFCT(IXY,IS)=INODE
  2888 CONTINUE
  2899 CONTINUE
C
  NLAST=NODE8
  IF(KSYMHV.NE.0) GO TO 2199
  IF(NHUB.EQ.6) GO TO 2199
  IS=IS+1
  NXP=NX(IS)+1
  NYP=NY(IS)+1
  DO 2180 IY=1,NYP
  DO 2180 IX=1,NXP
    IXY=IX+(IY-1)*NXP
  C
    IF(IX.EQ.1) GO TO 2185
    IF(IY.EQ.1.OR.IY.EQ.NYP) GO TO 2185
    IF(IX.EQ.NXP) GO TO 2185
    NODE8=NODE8+1
  2185 CONTINUE
    INODE=NODE8
    IF(IX.EQ.1) INODE=NBODY+
    1 (NX(15)+1)*(NY(15)+1)+
    2 (NX(16)+1)*(NY(16)-1)+
    3 NY(17)+NY(17)+1
    4 1
    IF(IY.EQ.1.AND.IX.NE.1) INODE=NBODY+
    1 (NX(15)+1)*(NY(15)+1)+
    2 (NX(16)+1)*(NY(16)-1)+
    3 NX(17)+NY(17)+1+1

```

```

4 IX
IF (IV.EQ.NYP.AND.IX.NE.1) INODE=NBODY+
1 (NX(15)+1)*(NY(15)+1)+
2 (NX(16)+1)*(NY(16)+1)+
3 NX(17)*(NY(17)+1)+1+
4 (NX(18)+1)*NY(18)+IX
IF (IX.EQ.NXP) INODE=NBODY+
1 (NX(15)+1)*(NY(15)+1)+
2 (NX(16)+1)*(NY(16)+1)+
3 NX(17)*(NY(17)+1)+1+
4 (NX(18)+1)*(NY(18)+1)+1+
5 NX(19)*(IV-3)*NX(19)
IF (IX.EQ.NXP.AND.IV.EQ.NYP) INODE=
1 NBODY+
2 (NX(15)+1)*(NY(15)+1)+
3 (NX(16)+1)*(NY(16)+1)+
4 NX(17)*(NY(17)+1)+1
IF (IV.EQ.NYP.AND.IV.EQ.1) INODE=
1 NBODY+
2 (NX(15)+1)*(NY(15)+1)+
3 (NX(16)+1)*(NY(16)+1)+NX(17)
4 1
NOFCT (IXY, IS) = INODE
2198 CONTINUE
2199 CONTINUE
C
NLAST=NODE0
IF (NMARK.EQ.0) GO TO 2232
IS=IS+1
NXR=NX (IS)+1
NYP=NY (IS)+1
DO 2288 IV=1, NYP
DO 2288 IX=1, NXP
IXY=IX+(IV-1)*NXP
C
IF (IV.EQ.NYP) GO TO 2285
NODE0=NODE0+1
2285 CONTINUE
INODE=NODE0
IF (IV.EQ.NYP) INODE=NLAST+IXY
NOFCT (IXY, IS) = INODE
2288 CONTINUE
2299 CONTINUE
C
NLAST=NODE0
IF (NBLADE.EQ.0) GO TO 2332
IS=IS+1
NXR=NX (IS)+1
NYP=NY (IS)+1
DO 2388 IV=1, NYP
DO 2388 IX=1, NXP
IXY=IX+(IV-1)*NXP
C
NODE0=NODE0+1
INODE=NODE0
NOFCT (IXY, IS) = INODE
2388 CONTINUE

```

```

2399 CONTINUE
C
NLAST=NODE0
IF(KSYNCHZ.EQ.0) GO TO 2439
IF(NBLADE.EQ.0) GO TO 2439
IS=IS+1
NXP=NX(IS)+1
NYP=NY(IS)+1
DO 2480 IY=1,NYP
DO 2480 IX=1,NXP
IXY=IX+(IY-1)*NXP
C
IF(IX.EQ.1.OR.IX.EQ.NXP) GO TO 2485
IF(IY.EQ.NYP) GO TO 2445
NODE0=NODE0+1
2445 CONTINUE
INODE=NODE0
IF(IY.EQ.1) INODE=
1 NLAST-NXP*NYP+(IY-1)*NXP
1 +1
IF(IX.EQ.NXP) INODE=NLAST-NXP*NYP+1+(IY-1)*NXP*NX(IS)
IF(IY.EQ.NYP) INODE=NLAST-NXP+IX
NOFCT(IXY,IS)=INODE
2480 CONTINUE
2499 CONTINUE
C
NLAST=NODE0
NTEMP=NODE0
IF(NSHANK.EQ.0) GO TO 2533
IS=IS+1
NXP=NX(IS)+1
NYP=NY(IS)+1
DO 2580 IY=1,NYP
DO 2580 IX=1,NXP
IXY=IX+(IY-1)*NXP
C
IF(IY.EQ.NYP) GO TO 2585
NODE0=NODE0+1
CC
2585 CONTINUE
INODE=NODE0
IF(IY.EQ.NYP) INODE=NLAST+IX
NOFCT(IXY,IS)=INODE
2580 CONTINUE
2599 CONTINUE
C
NLAST=NODE0
IF(NBLADE.EQ.0) GO TO 2633
IS=IS+1
NXP=NX(IS)+1
NYP=NY(IS)+1
DO 2680 IY=1,NYP
DO 2680 IX=1,NXP
IXY=IX+(IY-1)*NXP
C
NODE0=NODE0+1
INODE=NODE0

```



```

      NOFCT (IXY, IS) = INODE
2688 CONTINUE
2699 CONTINUE
C
      NLAST=NODE0
      IF (INBLADE.EQ.0) GO TO 2723
      IS=IS+1
      NXP=NX (IS)+1
      NYP=NY (IS)+1
      DO 2788 IX=1, NXP
      DO 2788 IX=1, NXP
      IXY=IX+(IX-1)*NXP
C
      IF (IX.EQ.1.OR. IX.EQ.NXP) GO TO 2785
      IF (IY.EQ.NYP) GO TO 2785
      NODE0=NODE0+1
2785 CONTINUE
      INODE=NODE0
      IF (IX.EQ.1) INODE=NLAST-NXP*NYP+(IY-1)*NXP
      1 1
      IF (IX.EQ.NXP) INODE=NLAST-NXP*NYP+1+(IY-1)*NXP+NX (IS)
      IF (IY.EQ.NYP) INODE=NLAST-NXP+IX
      NOFCT (IXY, IS) = INODE
2788 CONTINUE
2799 CONTINUE
      NLAST=NODE0
      NODE=NLAST
CC
CC
C
      IF (KSYMHY.EQ.0) NSYMHY=1
      IF (KSYMHY.NE.0) NSYMHY=2
      IF (KSYMHZ.EQ.0) NSYMHZ=1
      IF (KSYMHZ.NE.0) NSYMHZ=2
C
      NNODE=NODE0
      WRITE (6,4000)
4000 FORMAT (18X,6HREP20)
      WRITE (6,4001) NNODE
4001 FORMAT (5X,6HNNODE=,I5)
      DO 100 IS=1, NS
      NXP=NX (IS)+1
      NYP=NY (IS)+1
      DO 100 IY=1, NYP
      DO 100 IX=1, NXP
      IXY=IX+(IX-1)*NXP
      WRITE (6,200) IS, IX, IY, IXY, NOFCT (IXY, IS)
100 CONTINUE
200 FORMAT (2X, 'IS=', I5, 2X, 'IX=', I5, 2X, 'IY=', I5, 2X, 'IXY=', I5, 2X,
1 NOFCT=', I5)
      RETURN
      END

```

```

SUBROUTINE GEOMET (NELEM, NXYMP, NOFCT, NODE, XK, NTNODE, KWAKE, KROTOR)
C
C
COMMON/ZZZ1/XY(34), NY(34), NXY(34), KSYMMX, KSYMMZ, NSYMMX, NSYMMZ
COMMON/ZZZ2/NSFX, NSBODY, NS, NT(34), ISFACE(34), KNORHL(34), KWAKES(34)
COMMON/ZZZ3/NBYLON, NBOOY1, NBOOY2, NBOOY3, NYTAIL, NSHAFT, NMUB, NSMANK,
1 NBLADE
COMMON/ZZZ4/CIMACH, OMEGA, ALFA, ABETA
COMMON/ZZZ5/KPYCTR, YPYCTR, ZPYCTR, RXPYL, RYPYL, RZPYL
COMMON/ZZZ6/XNOSE, XBO1, XBO2, XTATL
COMMON/ZZZ7/YNOSE, YBO1, YBO2, YTATL
COMMON/ZZZ8/ZNOSE, ZBO1, ZBO2, ZTATL
COMMON/ZZZ9/RXBO1, RZBO1, RYBO2, RZBO2
COMMON/ZZZ10/LSHAFT, LSHANK, LSHANK
COMMON/ZZZ11/XHUBCR, YHUBCR, ZHUBCR, RXHUB, RYHUB, RZHUB
COMMON/ZZZ12/KROTOR, BCMD10, TAUB1, ALFA0
COMMON/ZZZ13/THET1S, THET1C, THET1S, CONING, AZIMUTH
COMMON/ZZZ14/KBLADE, TAM18, TANT18, XBLE, YBLE, KROTOR(34)
COMMON/ZZZ15/VSPAN, XLEZV, XTEZV, TANLEV, TANTEV, TAU, ZVTAIL
COMMON/ZZZ16/WMAPY, WAK18, WAKLSK, WAKBL
COMMON/ZZZ17/WAKLPY, WAK18, WAKLSK, WAKBL
COMMON/ZZZ18/WANGPY, WANG18, WANGSK, WANGBL
COMMON/ZZZ19/KPRINT(10), NREAD, NWRITE, KREAD
COMMON/ZZZ20/RT
COMMON/ZZZ21/KPY1, KPY2
COMMON/ZZZ22/KNSELE, KNSS10, KNSTYP
COMMON/ZZZ23/KBOELE, KBOS1P, KBOTYP
COMMON/ZZZ24/KINELE, KINS10, KINTYP
COMMON/ZZZ25/KPYELE, KPY1P, KPYTYP
COMMON/ZZZ26/KKTELE, KKT10, KKTYP
COMMON/ZZZ27/KSHELE, KSHS1P, KSHTYP
COMMON/ZZZ28/KMBELE, KMBS1P, KMBTYP
COMMON/ZZZ29/KSKELE, KSKS1P, KSKTYP
COMMON/ZZZ30/KBLELE, KBL10, KBLTYP
COMMON/ZZZ31/NSLAG, NVORT, NSPIRAL, SPIRAL
DIMENSION KROTOR(NELEM)
DIMENSION XK(3, NTNODE), NOFCT(NXYMP, 34), KWAKE(NELEM), NODE(4, NELEM)
REAL LSHAFT, LSHANK
C
C
NSH=NS
NMALE=NELEM
DO 1999 IS=1, NSH
ISFIX=ISFACE(IS)
NXX=NX(IS)
NXP=NXX+1
NYY=NY(IS)
DO 999 IX=1, NXX
DO 999 IY=1, NYY
C
C
IELEM=IX+NXY(IS)*IY+1+NT(IS)
IF(KNORHL(IS).EQ.-1) GO TO 986
C
C
-- --
++ ++
C

```

```

      IXMH=IX
      IYPM=IX+1
      IXMP=IX
      IYPM=IX+1
      IYMH=IY
      IYPM=IY
      IYPP=IY+1
      IYMD=IY+1
C
      GO TO 987
986 CONTINUE
C
      --
      **
C
      IXMH=IX
      IXMP=IX
      IYPM=IX+1
      IXPM=IX+1
      IYMH=IY+1
      IYMP=IY
      IYPP=IY
      IYPM=IY+1
987 CONTINUE
C
      IYPP=IYPP+(IYPP-1)*NXP
      IXPM=IXPM+(IYPM-1)*NXP
      IYMD=IYMD+(IYMD-1)*NXP
      IXMH=IXMH+(IYMH-1)*NXP
C
      NODE(1,IELEM)=NOFCT(IXY=1,IS)
      NODE(2,IELEM)=NOFCT(IXY=2,IS)
      NODE(3,IELEM)=NOFCT(IXY=3,IS)
      NODE(4,IELEM)=NOFCT(IXY=4,IS)
      KWAKE(IELEM)=0
      KROTOR(IELEM)=0
      IF(KWAKES(IS).GT.0.AND..X.EQ.NXX) KWAKE(IELEM)=1
      IF(KROTORS(IS).NE.0) KROTOR(IELEM)=1
      WRITE(6,50) IS, IELEM, NODE(1,IELEM), NODE(2,IELEM), NODE(3,IELEM),
      1 NODE(4,IELEM), KWAKE(IELEM), KROTOR(IELEM)
50 FORMAT(5X, 'IS=', I5, 2X, 'IELEM=', I5, 2X, 'NODE1=', I5, 2X, 'NODE2=', I5,
      1 2X, 'NODE3=', I5, 2X, 'NODE4=', I5, 2X, 'KWAKE=', I5, 2X, 'KROTOR=', I5)
C
999 CONTINUE
1999 CONTINUE
C
      WRITE(6,60)
60 FORMAT(10X, '==== END OF SECT ====')
      RETURN
      END

```



```

C
SUBROUTINE WEC123(NELEM,NODE,PC,P1,P2,P3,XK,NNODE)
COMMON/ZZZ1/NX(34),NY(34),NXV(34),KSYM1,KSYM2,NSYMM1,NSYMM2
COMMON/ZZZ2/NSFX,NSBODY,NS,NT(34),ISFACE(34),KNORM(34),KNAXES(34)
COMMON/ZZZ3/NPYLON,NBODY1,NBODY2,NBODY3,NVTAIL,NSHAFT,NHUB,NSHANK,
1 NBLADE
COMMON/ZZZ4/UNACH,OMEGA,ALFA,ABETA
COMMON/ZZZ5/VPYCTR,VBYCT,ZBYCTR,RPYI,RYBI,RZBI
COMMON/ZZZ6/XNOSE,XB01,X302,XTAIL
COMMON/ZZZ7/YNOSE,YB01,Y302,YTAIL
COMMON/ZZZ8/ZNOSE,ZB01,Z302,ZTAIL
COMMON/ZZZ9/ZYB01,ZYB02,ZYB03
COMMON/ZZZ10/RSHAFT,LSHFT,RSNANK,LSHANK
COMMON/ZZZ11/YHUBCR,YHUBCR,ZHUBCR,RXHUB,RXHUB,RZHUB
COMMON/ZZZ12/RROTOR,ROTOR,TAU8L,ALFA9
COMMON/ZZZ13/TMETZ,TMETZ,TMETZ,CONING,AZIMUTH
COMMON/ZZZ14/KBLADE,TANLEB,TANTEB,XBLE,XBTE,KROTORS(34)
COMMON/ZZZ15/NSHAN,XLEZ,XLEZ,TANLEB,TANTEB,TAU,ZVTAT
COMMON/ZZZ16/NWAKPY,NWAKPY,NWAKSK,NWAKBL
COMMON/ZZZ17/NWAKPY,NWAKPY,NWAKSK,NWAKBL
COMMON/ZZZ18/WANGPY,WANGPY,WANGSK,WANGBL
COMMON/ZZZ19/KPRINT(10),KREAD,NWRITE,KREAD
COMMON/ZZZ20/PI
COMMON/ZZZ21/KPY1,KPY2
COMMON/ZZZ22/KNSELE,KNS4P,KNSTYP
COMMON/ZZZ23/KBDELE,KBS4P,KBDTYP
COMMON/ZZZ24/KTNELE,KTS4P,KTNTYP
COMMON/ZZZ25/KPYELE,KPS4P,KPYTYP
COMMON/ZZZ26/KVTELE,KVS4P,KVTYP
COMMON/ZZZ27/KSMELE,KSS4P,KSMTYP
COMMON/ZZZ28/KHBELE,KHS4P,KHSTYP
COMMON/ZZZ29/KSKELE,KKS4P,KSKTYP
COMMON/ZZZ30/KBLELE,KBS4P,KBLTYP
COMMON/ZZZ31/NSIAG,NVORT,NSPIRAL,SPTRAL
DIMENSION XK(3,NNODE),NODE(4,NELEM)
DIMENSION PC(3,NELEM),P1(3,NELEM),P2(3,NELEM),P3(3,NELEM)
REAL LSHAFT,LSHANK
C
ALFA=ALFA*3.14159/180.
SINALF=SIN(ALFA)
COSALF=COS(ALFA)
BETA=SQRT(ABS(1.-UNACH*UNACH))
C
BET=ABETA*3.14159/180.
SINBET=SIN(BET)
COSBET=COS(BET)
C
DO 100 INODE=1,NNODE
XK1=XK(1,INODE)
XK3=XK(3,INODE)
XK(1,INODE)=(XK1*COSALF+XK3*SINALF)/BETA
XK(3,INODE)=(XK1*SINALF+XK3*COSALF)
WRITE(6,1)INODE,XK1,XK3
61 FORMAT(10Y,2INODE=2,15,2Y,2XK1=2,F16.6,2XK3=2,F16.6)
100 CONTINUE
DO 101 INODE=1,NNODE
XK1=XK(1,INODE)

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      XK2=XK(2,INODE)
      XK(1,INODE)=XK1*COSBET+XK2*SINBET
      XK(2,INODE)=-XK1*SINBET+XK2*COSBET
101 CONTINUE
      DO 200 IELEM=1,NELEM
      DO 199 K=1,3
        YPP=XK(K,NODE(1,IELEM))
        YPH=XK(K,NODE(2,IELEM))
        YMP=XK(K,NODE(3,IELEM))
        YMH=XK(K,NODE(4,IELEM))
        PC(K,IELEM)=(YPP+YPH+YMP+YMH)/4.
        P1(K,IELEM)=(YPP+YPH-YMP-YMH)/4.
        P2(K,IELEM)=(YPP-YPH+YMP-YMH)/4.
        P3(K,IELEM)=(YPP-YPH-YMP+YMH)/4.
      C
199 CONTINUE
      C
200 CONTINUE
      C
      WRITE(6,60)
      60 FORMAT(10X,'==== END OF VEC 123 ===')
      RETURN
      END

```

```

C      SUBROUTINE PRINTA
C      SUBROUTINE PRINTA(NELEM,NXYMP,XK,NODE,PC,NOFCT,NODE,NPRINT)
COMMON/ZZZ1/XX(34),NY(34),NXY(34),KSYMMY,KSYMMZ,NSYMMY,NSYMMZ
COMMON/ZZZ2/NSFX,NSBODY,YS,NT(34),ISFACE(34),KNORHL(34),KNAKES(34)
COMMON/ZZZ3/NRYLON,NBODY1,NBODY2,NBODY3,NVTAIL,NSHAFT,NHUB,NSHANK,
1 NBLADE
COMMON/ZZZ4/OMACH,OMEGA,ALFA,ABETA
COMMON/ZZZ5/KPYCTR,YPYCTR,ZPYCTR,RXPYL,RYPYL,RZPYL
COMMON/ZZZ6/XNOSE,YB01,X302,YTAIL
COMMON/ZZZ7/YNOSE,YB01,Y302,YTAIL
COMMON/ZZZ8/ZNOSE,ZB01,Z302,ZTAIL
COMMON/ZZZ9/RB01,RZB01,RB02,RZ02
COMMON/ZZZ10/LSHAFT,LSHAFT,LSHANK,LSHANK
COMMON/ZZZ11/XHUBCR,YHUBCR,ZHUBCR,RXHUB,RXHUB,RZHUB
COMMON/ZZZ12/PROTOR,BCHRD,TAUBL,ALFA
COMMON/ZZZ13/THET75,THET1C,THET1S,CONING,AZIMUTH
COMMON/ZZZ14/KBLADE,TAN1B,TAN1S,XBLE,XBTE,KROTOR(34)
COMMON/ZZZ15/VSPAN,XLEZV,XTEZV,TANLEY,TANTEV,TAU,ZVTAIL
COMMON/ZZZ16/MAKPY,MAK1B,MAK1S,MAK1B,MAK1S
COMMON/ZZZ17/MAKPY,MAK1B,MAK1S,MAK1B,MAK1S
COMMON/ZZZ18/MANGPY,MANG1B,MANG1S,MANG1B,MANG1S
COMMON/ZZZ19/KPRINT(10),VREAD,NWRITE,KREAD
COMMON/ZZZ20/PT
COMMON/ZZZ21/KPY1,KPY2
COMMON/ZZZ22/KNSELE,KNSE4P,KNSTYP
COMMON/ZZZ23/KBDELE,KB04P,KB0TYP
COMMON/ZZZ24/KTNELE,KTNS4P,KTNTYP
COMMON/ZZZ25/KPYELE,KPY54P,KPYTYP
COMMON/ZZZ26/KVTELE,KVT4P,KVTTYP
COMMON/ZZZ27/KSHELE,KSH54P,KSHTYP
COMMON/ZZZ28/KHBELE,KHB54P,KHBTP
COMMON/ZZZ29/KSKELE,KS54P,KSCTYP
COMMON/ZZZ30/KBLELE,KBL54P,KBLTYP
COMMON/ZZZ31/NSTAG,NVORT,NSPIRAL,SPIRAL
DIMENSION PC(3,NELEM),X(3,NODE),NOFCT(NXYMP,34),NODE(4,NELEM)
REAL LSHAFT,LSHANK
C
GO TO (1,2,3,4),NPRINT
CONTINUE
WRITE(NWRITE,110)
110 FORMAT(11X,'SPECIFICATIONS OF THE PROBLEM :')
DO 112 II=1,NS
TE(NXY(II),E3,DIGO TO 112
WRITE(NWRITE,113)ISFACE(II)
WRITE(NWRITE,114)NXY(II),NY(II)
112 CONTINUE
113 FORMAT(12X,'FOR PART :')
WRITE(NWRITE,115)NELEM,CSYMMY,KSYMMZ,REFLEN,SPAN,TAU,
1ALFA,ALFABC,OMACH,ZZZ7
115 FORMAT(2X,'NK=',I2,2X,'NY=',I2,2X,'KSYMMY=',I2,2X,'KSYMMZ=',I2,2X,
1 2X,'REFERENCE LENGTH =',F6.2/2X,'SPAN =',F6.2/
1 2X,'BLADE THICKNESS =',F3.5/2X,'ALFA =',F7.3/2X,'ALFABC =',F7.3/
1 2X,'OMACH NUMBER =',F7.3/2X,'ZZZ7=',I5//)
WRITE(NWRITE,116)TANGLE,TANGTE,CHORD,B
116 FORMAT(2X,'TANGLE=',F6.2/2X,'TANGTE=',F6.2/2X,'CHORD =',F6.2

```



```

C
C ***** SUBROUTINE 7=BUG *****
C
SUBROUTINE 7=BUG(K)
COMMON/ZZZ19/KPRINT(10),NREAD,NWRITE,KREAD
WRITE(NWRITE,1)
1 FORMAT(/2X," ERROR CODE = ",I5/)
RETURN
END

```



```

C
C
C
SUBROUTINE PRINTB(NELEN, NESQ, AA, SOURCE, NPRINT)
COMMON/ZZZ1/XY(34), NY(34), NXY(34), KXY(34), KSYM1, NSYMM1, NSYMM2
COMMON/ZZZ2/NSFX, NSBODY, YS, NT(34), ISFACE(34), KNORML(34), KNAKES(34)
COMMON/ZZZ3/NRYLOM, NBOOY1, NBOOY2, NBOOY3, NYTAIL, NSHAFT, NMUB, NSHANK,
1 NBLADE
COMMON/ZZZ4/UMACH, JMEGA, ALFA, ABETA
COMMON/ZZZ5/XPYCTR, YPYCTR, ZPYCTR, RXPYL, RYPYL, RZPYL
COMMON/ZZZ6/XNOSE, YB01, X3D2, YTAIL
COMMON/ZZZ7/YNOSE, YB01, X3D2, YTAIL
COMMON/ZZZ8/ZNOSE, ZB01, Z3D2, ZTAIL
COMMON/ZZZ9/RXB01, RZB01, RYB02, RZB02
COMMON/ZZZ10/RSMAFT, LSHAF, RSHANK, LSHANK
COMMON/ZZZ11/XHUBCR, YHUBCR, ZHUBCR, RXHUB, RYHUB, RZHUB
COMMON/ZZZ12/PROTOR, RCHORD, TAUBL, ALFA3
COMMON/ZZZ13/THET75, THETLC, THETLS, CONLNS, AZIMUTH
COMMON/ZZZ14/KBLADE, YAM = B, YANTEB, XBLE = X3TE, KROTORS(34)
COMMON/ZZZ15/VSPAN, XLEZV, XTEZV, TANLEV, TANTEV, TAU, ZYTAIL
COMMON/ZZZ16/NMAKRY, NMAK4B, NMAKSK, NMAKBL
COMMON/ZZZ17/WAKLPY, WAK4B, WAKLSK, WAKLBL
COMMON/ZZZ18/WANGRY, WANG4B, WANGSK, WANGBL
COMMON/ZZZ19/KPRINT(10), KREAD, KWRITE, KREAD
COMMON/ZZZ20/BI
COMMON/ZZZ21/KPY1, KPY2
COMMON/ZZZ22/KMSLE, KMS4B, KMSLYP
COMMON/ZZZ23/KBDELE, KB04B, KBOTYP
COMMON/ZZZ24/KINELE, KIN4B, KINTYP
COMMON/ZZZ25/KPYELE, KPY4B, KPYTYP
COMMON/ZZZ26/KVTELE, KVT4B, KVTTYP
COMMON/ZZZ27/KSHELE, KSH4B, KSHTYP
COMMON/ZZZ28/KMBELE, KMB4B, KMBTYP
COMMON/ZZZ29/KSKELE, KSK4B, KSKTYP
COMMON/ZZZ30/KBLELE, KBL4B, KBLTYP
COMMON/ZZZ31/NSTAG, NVORT, NSPIRAL, SPIRAL
C
DIMENSION SOURCE(NELEN), IA(NESQ)
DIMENSION ABSVAL(100), FISEAN(100)
REAL LSHAF, LSHANK
NXY(34) = NY(34)
GO TO(1,2,3,4,5), NPRINT
1 CONTINUE
WRITE(NWRITE, 110)
110 FORMAT(///2X, 'DISTRIBUTION OF AA(I, J)')
DO 11 I=1, NELEN
WRITE(NWRITE, 111)
111 FORMAT(2X, 'INDEX =', I2)
WRITE(NWRITE, 112) (AA(K), K=N1, N2, NELEN)
112 FORMAT(1X, 8E15.6)
11 CONTINUE
RETURN
2 CONTINUE
WRITE(NWRITE, 221)

```

```

221 FORMAT(///2X,*THE DISTRIBUTION OF SOURCE*)
225 CONTINUE
NSBTOT=0
DO 229 IS=1,NS
WRITE(NWRITE,223)ISFACE(IS)
223 FORMAT(//5X,*FOR SUBSURFACE*13)
IND=NSBTOT
NSBTOT=NSBTOT+NX(IS)*NY IS)
IFIN=NSBTOT
NXX=NX(IS)
DO 226 IX=1,NXX
WRITE(NWRITE,228)
IF(NPRINT.GE.5.AND.(IX.EQ.NXX))GO TO 226
IND=IND+1
WRITE(NWRITE,227)(SOURC(KK),KK=IND,IFIN,NXX)
226 CONTINUE
227 FORMAT(1X,8E15.5)
228 FORMAT(//)
229 CONTINUE
RETURN
3 CONTINUE
WRITE(NWRITE,330)
330 FORMAT(///2X,*THE DISTRIBUTION OF THE VELOCITY POTENTIAL*)
GO TO 225
4 CONTINUE
WRITE(NWRITE,440)
440 FORMAT(///2X,*THE DISTRIBUTION OF CP*)
GO TO 225
5 CONTINUE
RETURN
END

```

```

C
C
C
SUBROUTINE S3LUTN(NELEM,NESQ,AA,SOURCE)
C
COMMON/ZZZ1/XY(34),NY(34),NX(34),KSYMM1,KSYMM2,NSYMM1,NSYMM2
COMMON/ZZZ2/NSFX,NSBODY,VS,NT(34),ISPACE(34),KNORM(34),KNAKES(34)
COMMON/ZZZ3/XPYLOM,NBODY1,NBODY2,NBODY3,NVTAIL,NSHAFT,NHUB,NSHANK,
1 NBLADE
COMMON/ZZZ4/OMEGA,ALFA,ABETA
COMMON/ZZZ5/XPYCTR,YPYCTR,ZPYCTR,RXPYL,RYPYL,RZPYL
COMMON/ZZZ6/XNOSE,YB01,ZB02,YTAIL
COMMON/ZZZ7/YNOSE,YB01,YB02,YTAIL
COMMON/ZZZ8/ZNOSE,ZB01,ZB02,ZTAIL
COMMON/ZZZ9/RXB01,RXB02,RXB03,RXB04
COMMON/ZZZ10/RSHAFT,LSHAFT,RSHANK,LSHANK
COMMON/ZZZ11/XHUBCR,YHUBCR,ZHUBCR,RXHUB,RYHUB,RZHUB
COMMON/ZZZ12/ROTOR,SCW,SD,TAUHL,ALFA2
COMMON/ZZZ13/THET75,THET1C,THET1S,CONING,AZIMUTH
COMMON/ZZZ14/KBLADE,TAN1B,TAN1S,XBLE,XSTE,KROTORS(34)
COMMON/ZZZ15/VSPAN,XLEZV,XTEZV,TANLEV,TAN1EV,TAU,ZVTAIL
COMMON/ZZZ16/WMKPY,WMK1B,WMK1S,WMK1C
COMMON/ZZZ17/WAKPY,WAK1B,WAK1S,WAK1C
COMMON/ZZZ18/WANGPY,WANG1B,WANG1S,WANG1C
COMMON/ZZZ19/KPRINT(10),VREAD,NWRITE,KREAD
COMMON/ZZZ20/PT
COMMON/ZZZ21/KPY1,KPY2
COMMON/ZZZ22/KNSELE,KNS14P,KNSTY2
COMMON/ZZZ23/KBDELE,KBD14P,KBDTY2
COMMON/ZZZ24/KTNELE,KTN14P,KNTY2
COMMON/ZZZ25/KPYELE,KPY14P,KPYTY2
COMMON/ZZZ26/KVTELE,KVT14P,KVTY2
COMMON/ZZZ27/KSELE,KSE14P,KSHTY2
COMMON/ZZZ28/KHBELE,KHB14P,KHBTY2
COMMON/ZZZ29/KSKELE,KSK14P,KSKTY2
COMMON/ZZZ30/KBLELE,KBL14P,KBLTY2
COMMON/ZZZ31/NSTAG,NVOR,NSPIRAL,SPIRAL
DIMENSION AA(NESQ),SOURCE(NELEM)
REAL LSHAFT,LSHANK
C
IF(KPRINT(5).EQ.1)CALL PRINTB(NELEM,NESQ,AA,SOURCE,1)
IF(KPRINT(6).EQ.1)CALL PRINTB(NELEM,NESQ,AA,SOURCE,2)
TOL=0.001
CALL CGELG(SOURCE,AA,NELEM,1,TOL,IER)
C
IF(IER.NE.0)WRITE(NWRITE,101)IER
C
101 IF(IER.NE.0)CALL DEBUG(1001)
IF(KPRINT(7).EQ.1)CALL PRINTB(NELEM,NESQ,AA,SOURCE,3)
RETURN
END

```

```

C
C      SUBROUTINE CGGELG(R,A,M,N,EPS,IF2)
C
C
C
C      DIMENSION A(1),R(1)
C      IF(1)23,23,1
C
C      SEARCH FOR GREATEST ELEMENT IN MATRIX A
C      1 IER=0
C      PIV=0.
C      NM=N*M
C      NM=N*M
C      DO 3 L=1,NM
C      T88=ABS(A(1))
C      IF(T88-PIV)3,3,2
C      2 PIV=T88
C      I=L
C      3 CONTINUE
C      TOL=EPS*PIV
C      A(I) IS PIVOT ELEMENT. PIV CONTAINS THE ABSOLUTE VALUE OF A(I).
C
C
C      START ELIMINATION LOOP
C      LST=1
C      DO 17 K=1,M
C
C      TEST ON SINGULARITY
C      IF(PIV)23,23,4
C      4 IF(1ER)7,5,7
C      5 IF(PIV-TOL)6,6,7
C      6 IER=K-1
C      7 PIVT=1./A(I)
C      J=(I-1)/M
C      T=I-J*M=K
C      J=J+1-K
C      J+K IS ROW-INDEX, J+K COLUMN-INDEX OF PIVOT ELEMENT
C
C      PIVOT ROW REDUCTION AND ROW INTERCHANGE IN RIGHT HAND SIDE R
C      DO 8 L=K,NM,M
C      LL=L+T
C      TB=PIV*R(LL)
C      R(LL)=R(I)
C      8 R(L)=TB
C
C      IS ELIMINATION TERMINATED?
C      IF(K=M)9,18,18
C
C      COLUMN INTERCHANGE IN MATRIX A
C      9 LEND=LST+M-K
C      IF(1)12,12,10
C      10 II=J*M
C      DO 11 L=LST,LEND
C      TB=A(L)
C      LL=L+T
C      A(L)=A(LL)

```



```

11 A(LL)=TB
C
C ROW INTERCHANGE AND PIVOT ROW REDUCTION IN MATRIX A
12 DO 13 L=LST,NM,M
LL=L+1
TB=PIVIAA(LL)
A(LL)=A(L)
13 A(L)=TB
C
C SAVE COLUMN INTERCHANGE INFORMATION
A(LST)=J
C
C ELEMENT REDUCTION AND NEXT PIVOT SEARCH
PIV=0
LST=LST+1
J=0
DO 14 II=LST,LEND
PIV=A(II)
IST=II+M
14 J=1
DO 15 L=IST,NM,M
LL=L+1
A(L)=A(L)+PIV*A(LL)
TB=A(L)
IF (TB-PIV) 15,15,1+
15 PIV=TB
I=L
15 CONTINUE
DO 16 L=K,NM,M
LL=L+1
16 R(LL)=R(LL)+PIV*R(L)
17 LST=LST+M
C
C END OF ELIMINATION LOOP
C
C
C BACK SUBSTITUTION AND BACK INTERCHANGE
18 IF (M-1) 23,22,19
19 IST=NM+M
LST=M+1
DO 20 I=2,M
II=LST-I
IST=IST-LST
L=IST-M
19 A(LL)=A(L)
DO 21 J=II,NM,M
TB=A(J)
LL=J
DO 22 K=IST,NM,M
LL=LL+1
22 TB=A(K)+A(LL)*R(LL)
K=J+L
R(J)=R(K)
21 R(K)=TB
22 RETURN
C
C
C ERROR RETURN
23 IER=-1
RETURN
END

```



```

      DIMENSION PCJ(3)
      REAL L,SHAFT,L,SHANK
C
      DO 100 I=1,N1,X1,Y1,Z1,X2,Y2,Z2=X1+X2*V1+Y2*V2+Z1*Z2
C
      1  PRONTY(VX1,VY1,Z1,XK3,Z2,XK3,VY2,Z2)=VY2*Z2-VY1*Z1+XK3*
      - (XK2*Z23-XK3*Z22)*VY1+(XK2*VY3-XK3*VY2)*Z21
      XPROX(OX,OY,OZ,EX,EY,ED=OY*EZ-EX*OZ
      XPROY(OX,OY,OZ,EX,EY,ED=OZ*EX-EZ*OX
      XPROZ(OX,OY,OZ,EX,EY,ED=OX*EY-EX*OY
C
      IF(UMACH.GT.1)CALL DEBIC(400)
      BETA=SQRT(1.-UMACH**2)
C
C
C
C
      SIGNBT(1)=1.0
C
      CONST=48.5/3.14159
C
      KOUNT=0
      DO 100 J=1,NELEM
C
      KSPIRAL=1
      LSPIRAL=1
      IF(ICHECK.EQ.4) KSPIRAL=SPIRAL
      IF(ICHECK.EQ.4) LSPIRAL=LSPIRAL
      DO 100 ISD=1,KSPIRAL
      DO 100 NSP=1,LSPIRAL
C
      GO TO (100,200,300,400),ICHECK
C
      100 CONTINUE
C
      DO 94 K=1,3
      YPP(K)=YK(K,NODE(1,J))
      YPM(K)=YK(K,NODE(2,J))
      YNP(K)=YK(K,NODE(3,J))
      YNM(K)=YK(K,NODE(4,J))
      PCJ(K)=PC(K,J)
C
      94  CONTINUE
      GO TO 500
C
      200 CONTINUE
      NSTAG=1
      IF(KOUNT.EQ.1) RETURN
      READ(NREAD,201) (YPP(K),K=1,3)
      WRITE(NWRITE,202) (YPP(K),K=1,3)
      READ(NREAD,201) (YPM(K),K=1,3)
      WRITE(NWRITE,202) (YPM(K),K=1,3)
      READ(NREAD,201) (YNP(K),K=1,3)
      WRITE(NWRITE,202) (YNP(K),K=1,3)
      READ(NREAD,201) (YNM(K),K=1,3)
      WRITE(NWRITE,202) (YNM(K),K=1,3)
      DO 205 K=1,3
      205 PCJ(K)=(YPP(K)+YPM(K)+YNP(K)+YNM(K))/4.

```

```

COUNT=1
GO TO 500
300 CONTINUE
C
NWRITE=1
IF (COUNT.EQ.1) RETURN
READ(NREAD,201) (YPP(I),K=1,3)
WRITE(NWRITE,202) (YPP(I),K=1,3)
READ(NREAD,201) (YPM(I),K=1,3)
WRITE(NWRITE,202) (YPM(I),K=1,3)
READ(NREAD,201) (YMP(I),K=1,3)
WRITE(NWRITE,202) (YMP(I),K=1,3)
READ(NREAD,201) (YMN(K),K=1,3)
WRITE(NWRITE,202) (YMN(K),K=1,3)
DO 305 K=1,3
305 PCJ(K)=(YPP(K)+YPM(K)+YMP(K)+YMN(K))/4.
COUNT=1
201 FORMAT(1X,10F8.3)
202 FORMAT(1X,10F8.3)
GO TO 500
400 CONTINUE
C
NSPIRAL=1
IF (KMAKE(J).EQ.0) GO TO 100
IF (KROTOR(J).EQ.0) GO TO 100
DO 405 K=1,3
YPP(K)=XK(K,NODE(1,J))
YPM(K)=XK(K,NODE(2,J))
YMP(K)=XK(K,NODE(3,J))
YMN(K)=XK(K,NODE(4,J))
405 CONTINUE
C
RATIO=UMAKE/JMEGA
RATIO=RATIO*50./(2.*PI)
RATIO=-1.*RATIO
FACTOR=2.*PI/NSPIRAL
C
DO 100 ISP=1,ISPIRAL
C
DO 100 NSP=1,NSPIRAL
IMAKE=NSP+(ISP-1)*NSPIRAL
C
THETA1=(IMAKE-1)*FACTOR
THETA2=IMAKE*FACTOR
C
SIN1=SIN(THETA1)
COS1=COS(THETA1)
C
SIN2=SIN(THETA2)
COS2=COS(THETA2)
C
YPP2=YPP(1)*COS2+YPP(2)*SIN2
YPP2=-YPP(1)*SIN2+YPP(2)*COS2
C
XMP1=YPP(1)*COS1+YPP(2)*SIN1
YMP1=YPP(1)*SIN1+YPP(2)*COS1
C
YMN1=YPM(1)*COS1+YPM(2)*SIN1
YMN1=-YPM(1)*SIN1+YPM(2)*COS1
C
XPM2=YPM(1)*COS2+YPM(2)*SIN2

```



```

      YPM2=-YPM(1)*SIN2+YPM(2)*COS2
C
      RPP2=SQRT(XPP2*XPP2+YPP2*YPP2)
      RMP1=SQRT(XMP1*XMP1+YMP1*YMP1)
      RHM1=SQRT(XHM1*XHM1+YHM1*YHM1)
      RRM2=SQRT(XPM2*XPM2+YPM2*YPM2)
C
      IF(MSP-CT.1) GO TO 503
C
      ZP=0.0
      ZPP2=ZP+RATIO*THETA2*RP2/RRTOR
      ZMP1=ZP+RATIO*THETA1*RM1/RRTOR
      ZHM1=ZP+RATIO*THETA1*RM1/RRTOR
      ZPM2=ZP+RATIO*THETA2*RP2/RRTOR
      GO TO 504
503 CONTINUE
      ZPP2=ZP+RATIO*(THETA2-FACTOR)+RATIO*FACTOR*RPP2/RRTOR
      ZMP1=ZP+RATIO*(THETA1-FACTOR)+RATIO*FACTOR*RMP1/RRTOR
      ZHM1=ZP+RATIO*(THETA1-FACTOR)+RATIO*FACTOR*RHM1/RRTOR
      ZPM2=ZP+RATIO*(THETA2-FACTOR)+RATIO*FACTOR*RRM2/RRTOR
504 CONTINUE
C
      YPP(1)=XPP2
      YPP(2)=YPP2
      YPP(3)=ZPP2
C
      YPM(1)=XPM2
      YPM(2)=YPM2
      YPM(3)=ZPM2
C
      YMP(1)=XMP1
      YMP(2)=YMP1
      YMP(3)=ZMP1
C
      YHM(1)=XHM1
      YHM(2)=YHM1
      YHM(3)=ZHM1
C
      IF(ZPP2.LT.(ZBD1+RZBD1+ZPYL))GO TO 100
      IF(ZPM2.LT.(ZBD1+RZBD1+ZPYL)) GO TO 100
C
      DO 505 K=1,3
505 PCJ(K)=(YPP(K)+YPM(K)+YMP(K)+YHM(K))/4.
C
500 CONTINUE
C
      DO 1002 K=1,3
      AA1(K,1)=0.5*(YPP(K)-YMP(K))
      AA1(K,2)=0.5*(YPM(K)-YHM(K))
      AA2(K,1)=0.5*(YPP(K)-YPM(K))
      AA2(K,2)=0.5*(YMP(K)-YHM(K))
      A1(K,1)=AA1(K,1)
      A1(K,2)=AA1(K,2)
      A2(K,1)=AA2(K,1)
      A2(K,2)=AA2(K,2)
1002 CONTINUE

```

```

DO 1003 L=1,2
A1A1(L)=DOTPRD(A1(1,L),A1(2,L),A1(3,L),A1(1,L),A1(2,L),A1(3,L))
1003 A2A2(L)=DOTPRD(A2(1,L),A2(2,L),A2(3,L),A2(1,L),A2(2,L),A2(3,L))
C
DO 1004 K=1,3
IF(A1A1(1).EQ.0.)A1(K,0)=A1(K,2)
IF(A1A1(2).EQ.0.)A1(K,0)=A1(K,1)
IF(A2A2(1).EQ.0.)A2(K,0)=A2(K,2)
IF(A2A2(2).EQ.0.)A2(K,0)=A2(K,1)
1004 CONTINUE
C
DO 1005 L=1,2
A1A1(L)=DOTPRD(A1(1,L),A1(2,L),A1(3,L),A1(1,L),A1(2,L),A1(3,L))
1005 A2A2(L)=DOTPRD(A2(1,L),A2(2,L),A2(3,L),A2(1,L),A2(2,L),A2(3,L))
C
DO 1007 L=1,2
DO 1007 M=1,2
1007 A1A2(L,M)=DOTPRD(A1(1,L),A1(2,L),A1(3,L),A2(1,M),A2(2,M),A2(3,M))
C
A1CRA2(1)=SQRT(A1A1(2)*A2A2(1)-A1A2(2,1)**2)
A1CRA2(2)=SQRT(A1A1(1)*A2A2(1)-A1A2(1,1)**2)
A1CRA2(3)=SQRT(A1A1(1)*A2A2(2)-A1A2(1,2)**2)
A1CRA2(4)=SQRT(A1A1(2)*A2A2(2)-A1A2(2,2)**2)
C
DO 1008 K=1,3
AVA1(K)=0.5*(A1(K,1)+A1(K,2))
1008 AVA2(K)=0.5*(A2(K,1)+A2(K,2))
C
YNORM(1)=AVA1(2)*AVA2(3)-AVA1(3)*AVA2(2)
YNORM(2)=AVA1(3)*AVA2(1)-AVA1(1)*AVA2(3)
YNORM(3)=AVA1(1)*AVA2(2)-AVA1(2)*AVA2(1)
C
SN(1)=YNORM(1)/BETA
SN(2)=YNORM(2)
SN(3)=YNORM(3)
ASN=SQRT(SN(1)**2+SN(2)**2+SN(3)**2)
AYN=SQRT(YNORM(1)**2+YNORM(2)**2+YNORM(3)**2)
DO 1010 K=1,3
UN(K)=YNORM(K)/AYN
SNUN(K)=SN(K)/ASN
1010 CONTINUE
C
DO 178 I=1,MELEM
C
DO 160 ISYMM=1,NSYMM
DO 160 ISYMHZ=1,NSYMHZ
SIGNPT(2)=3.-2*ISYMHZ
SIGNPT(3)=3.-2*ISYMHZ
C
DO 1102 K=1,3
1102 PZ(K)=PC(K)-PC(K,I)*SIGNPT(K)
QDOTUN=DOTPRD(UN(1),UN(2),UN(3),PZ(1),PZ(2),PZ(3))
C
DO 1110 K=1,3
Q(K,1)=YFN(K)-PC(K,I)*SIGNPT(K)
Q(K,2)=YPP(K)-PC(K,I)*SIGNPT(K)

```

```

      Q(K,3)=YMP(K)-PC(K,1)*STGNPT(K)
      Q(K,4)=YHM(K)-PC(K,1)*STGNPT(K)
1110  CONTINUE
      DO 1111 K=1,3
      QH(K,1)=0.5*(Q(K,1)+Q(K,2))
      QH(K,2)=0.5*(Q(K,2)+Q(K,3))
      QH(K,3)=0.5*(Q(K,3)+Q(K,4))
      QH(K,4)=0.5*(Q(K,4)+Q(K,1))
1111  CONTINUE
      C
      DO 1112 K=1,3
      KP1=K+1
      KP2=K+2
      IF(KP1.GT.3)KP1=KP1-3
      IF(KP2.GT.3)KP2=KP2-3
      QMCRA1(K,1)=QH(KP1,2)*A1(KP2,1)-QH(KP2,2)*A1(KP1,1)
      QMCRA1(K,2)=QH(KP1,4)*A1(KP2,2)-QH(KP2,4)*A1(KP1,2)
      QMCRA2(K,1)=QH(KP1,1)*A2(KP2,1)-QH(KP2,1)*A2(KP1,1)
      QMCRA2(K,2)=QH(KP1,3)*A2(KP2,2)-QH(KP2,3)*A2(KP1,2)
1112  CONTINUE
      C
      RC=SQRT(DOTPR0(PZ(1),PZ(2),PZ(3),PZ(1),PZ(2),PZ(3)))
      C
      DO 155 ICORN2=1,4
      GO TO (5502,5504,5506,5508),ICORN2
5502  CONTINUE
      SIGN12=-1.
      ICST=1
      IETA=2
      GO TO 5510
5504  CONTINUE
      SIGN12=+1.
      ICST=1
      IETA=1
      GO TO 5510
5506  CONTINUE
      SIGN12=-1.
      ICST=2
      IETA=1
      GO TO 5510
5508  CONTINUE
      SIGN12=+1.
      ICST=2
      IETA=2
5510  CONTINUE
      C
      DO 5520 K=1,3
      QV(K)=Q(K,ICORN2)
      A1V(K)=A1(K,IETA)
      A2V(K)=A2(K,ICST)
      QCRA1(K)=QMCRA1(K,IETA)
      QCRA2(K)=QMCRA2(K,ICST)
5520  CONTINUE
      C
      QQ=SQRT(DOTPR0(QV(1),QV(2),QV(3),QV(1),QV(2),QV(3)))
      C
      CALL LOG(ICORN2,QQ,QV,A1V,QCRA1,ALOG1,1)

```

```

3      CALL LOGTCORN2,QQ,QV,A2V,QCRA2,ALOG2,2)
C
      TAMP=8.
      IF(QDOTUN.EQ.0.)GO TO 550
      HNUMER=DOTPRJ(QCRA1(1),QCRA1(2),QCRA1(3),QCRA2(1),QCRA2(2),
1      QCRA2(3))
      DENOM=QQ*QDOTUN*A1CRA2(IT*QVNR)
      IF(DENOM.NE.0.)TAMP=ATAN(HNUMER,DENOM)
550    CONTINUE
C
      COEFF1=DOTPRJ(UN(1),UN(2),UN(3),QCRA1(1),QCRA1(2),QCRA1(3))
      COEFF2=DOTPRJ(UN(1),UN(2),UN(3),QCRA2(1),QCRA2(2),QCRA2(3))
C
      SRCINT=-CONST*SIGN12*
1      (-COEFF1*ALOG1+COEFF2*ALOG2-QDOTUN*TAMP)
C
      GO TO (801,802,803,804),ICHECK
801    CONC=1.0
      GO TO 850
802    CONC=CSTAG
      GO TO 850
803    CONC=CVORT
      GO TO 850
804    CONC=1.0
850    CONTINUE
      DBTINT=-CONST*SIGN12*TA,P*CONC
C
      SGNINT=1.
C
      NNN=I+(J-1)*NELEM
C
      AA(NNN)=AA(NNN)-SGNINT*DBTINT
C
C
      IF(ICHECK.NE.1)GO TO 600
      UFREE=UNACH*1117.
      OMEGAX=8.
      OMEGAY=0.
      OMEGAZ=OMEGA*2.*PI/68.
      RX=PC(1,J)
      RY=PC(2,J)
      RZ=PC(3,J)
      BCX=XPROJ(OMEGAX,OMEGAY,OMEGAZ,RX,RY,RZ)
      BCY=XPROJ(OMEGAX,OMEGAY,OMEGAZ,RX,RY,RZ)
      BCZ=XPROJ(OMEGAX,OMEGAY,OMEGAZ,RX,RY,RZ)
      BCR=DOTPRO(BCX,BCY,BCZ,JY(1),UN(2),UN(3))
      IF(KROTOR(J).EQ.0) BCR=
      BCB=-1.*UFREE*UN(1)
      BC(J)=BCB+BCR
      SOURCE(I)=SOURCE(I)+SGNINT*SRCINT*      BC(J)
600    CONTINUE
C
C
150    CONTINUE
155    CONTINUE
160    CONTINUE

```


170 CONTINUE
180 CONTINUE
C
C
RETURN
END

```

C
C
SUBROUTINE LJG(ICORNR,QI,QV,AV,QCRAV,ALOG,ICORR)
  DIMENSION QV(3)
  DIMENSION AV(3),QCRAV(3)
C
  DOTPRO(X1,V1,Z1,X2,V2,Z2)=X1*X2+Y1*Y2+Z1*Z2
C
  AVAV=DOTPRO(AV(1),AV(2),AV(3),AV(1),AV(2),AV(3))
  QQAV=DOTPRO(QV(1),QV(2),QV(3),AV(1),AV(2),AV(3))
  QXA=SQRT(DOTPRO(QCRAV(1),QCRAV(2),QCRAV(3),
    QCRAV(1),QCRAV(2),QCRAV(3)))
  ALOG=ASINH(QQAV/QXA)/SQRT(AVAV)
  RETURN
END

```

PC

```
FUNCTION ATANP(HNUMER,DENOM)  
ADENOM=ABS(DENOM)  
ATANP=ATAN2(HNUMER,ADENOM)  
IF(DENOM.LT.0.)ATANP=ATANP  
RETURN  
END
```

C
C

```

SUBROUTINE AVERAG(SOURCE, SOR, PC, NELEN, NNODE, NOFCT, NKYMF, NNODE,
1 AVG)
DIMENSION SOURCE(NELEN), SOR(NNODE), AVG(NNODE), PC(3, NELEN)
DIMENSION NOFCT(NKYM, 3)
COMMON/ZZZ1/NX(34), NY(34), NXY(34), KSYMMY, KSYMMZ, NSYMMY, NSYMMZ
COMMON/ZZZ2/NSFX, NSBODY, NS, NT(34), TFACE(34), KNORM(34), KNKES(34)
COMMON/ZZZ3/VPYLOW, NBOOY1, NBOOY2, NBOOY3, NVTAIL, NSHAFT, NHUB, NSHANK,
1 NBLADE
COMMON/ZZZ4/OMEGA, ALFA, ABETA
COMMON/ZZZ5/RYCTR, RYCYZ, ZRYCTR, RYRVL, RYRVL, RZRYL
COMMON/ZZZ6/XNOSE, XSD1, XSD2, XTAIL
COMMON/ZZZ7/YNOSE, YSD1, YSD2, YTAIL
COMMON/ZZZ8/ZNOSE, ZSD1, ZSD2, ZTAIL
COMMON/ZZZ9/RYSO1, RZSO1, RYSD2, RZSD2
COMMON/ZZZ10/RSHAFT, LSHAFT, RSHANK, LSHANK
COMMON/ZZZ11/XHUBC1, XHUBC2, ZHUBC1, XHUB, RYHUB, RZHUB
COMMON/ZZZ12/RROTOR, BCHORD, TAUSL, ALFA9
COMMON/ZZZ13/TMETZ, TMETIC, TMETIS, CONING, AZIMUTH
COMMON/ZZZ14/KBLADE, TANEB, TANTEB, XBLE, XOTE, KROTORS(34)
COMMON/ZZZ15/NSRAN, XLEZ, XTEZ, TANLEV, TANTEV, TAU, ZVTAIL
COMMON/ZZZ16/HNAKPY, HNAK4B, HNAKSK, HNAKBL
COMMON/ZZZ17/HAKLBY, HAK4B, HAKLEK, HAKLBL
COMMON/ZZZ18/HANGPY, HAN4B, HANGSK, HANGBL
COMMON/ZZZ19/KPRINT(10), VREAD, NWRITE, KREAD
COMMON/ZZZ20/PI
COMMON/ZZZ21/KPY1, KPY2
COMMON/ZZZ22/KNSELE, KNS1P, KNSTYP
COMMON/ZZZ23/KQBLE, KQBS4B, KQBTYP
COMMON/ZZZ24/KTNELE, KTN1P, KNTYP
COMMON/ZZZ25/KPYELE, KPYSHB, KPYTYP
COMMON/ZZZ26/KVTELE, KVT1P, KVTYP
COMMON/ZZZ27/KSMELE, KSM1P, KSMTYP
COMMON/ZZZ28/KHBELE, KHB1P, KHB TYP
COMMON/ZZZ29/KSKELE, KSK1P, KSKTYP
COMMON/ZZZ30/KBLELE, KBL1P, KBLTYP
COMMON/ZZZ31/MSLAG, MSOR, MSPTRAL, SPTRAL
INTEGER PH, PP
REAL LSHAFT, LSHANK

```

C

```

DO 98 I=1, NNODE
AVG(I, NNODE)=0.
98 SOR(I, NNODE)=0.
DO 100 IELEN=1, NELEN
PP=NODE(1, IELEN)
PH=NODE(2, IELEN)
NP=NODE(3, IELEN)
HM=NODE(4, IELEN)
SOR(PP)=SOR(PP)+SOURCE(1, IELEN)
SOR(PH)=SOR(PH)+SOURCE(2, IELEN)
SOR(NP)=SOR(NP)+SOURCE(3, IELEN)
SOR(HM)=SOR(HM)+SOURCE(4, IELEN)
AVG(PP)=AVG(PP)+1.
AVG(PH)=AVG(PH)+1.
AVG(NP)=AVG(NP)+1.
AVG(HM)=AVG(HM)+1.

```



```
100 CONTINUE  
DO 110 INODE=1,NMODE  
110 SOR(INODE)=SOR(INODE)/AVG(INODE)  
100 CONTINUE  
SOR(1)=0.0  
SOR(2)=0.0  
RETURN  
END
```

C

```

SUBROUTINE PH1(SOR,NMODE,MODE,PHIC,PHI1,PHI2,PHI3,NELEM)
DIMENSION SOR(NMODE),PHIC(NELEM),PHI1(NELEM),PHI2(NELEM)
DIMENSION PHI3(NELEM)
DIMENSION NMODE(4,NELEM)
COMMON/ZZZ1/NX(34),NY(34),NZ(34),KSYMMV,KSYMMZ,NSYMMV,NSYMMZ
COMMON/ZZZ2/NSFX,NSBODY,VS,NT(34),ISFACE(34),KNORML(34),KNAKES(34)
COMMON/ZZZ3/MBYLON,MBODY1,MBODY2,MBODY3,MWTAIL,NSHAFT,MHUB,NSHANK
1 NBLADE
COMMON/ZZZ4/OMEGA,OMEGA,ALFA,ABETA
COMMON/ZZZ5/XPYCTR,YPYCTR,ZPYCTR,XPYVL,RPYVL,RZPYVL
COMMON/ZZZ6/XNOSE,XBD1,ZD2,YTAIL
COMMON/ZZZ7/YNOSE,YBD1,ZD2,YTAIL
COMMON/ZZZ8/ZNOSE,ZBD1,ZD2,ZTAIL
COMMON/ZZZ9/RYBD1,RZBD1,RZBD2,RZBD3
COMMON/ZZZ10/RSHAFT,LSHAFT,RSHANK,LSHANK
COMMON/ZZZ11/XHUBCR,YHUBCR,ZHUBCR,RXHUB,RXHUB3,RZHUB3
COMMON/ZZZ12/ROTOR2,RCM2D,TAU2,ALFA2
COMMON/ZZZ13/TMET/5,THE1C,THE1S,CONING,AZIMUTH
COMMON/ZZZ14/KBLADE,TAN2B,TAN2E,XBL,Y3TE,KROTORS(34)
COMMON/ZZZ15/VSPAN,XLEZV,XTEZV,TANLEV,TANTEV,TAU,ZVTAIL
COMMON/ZZZ16/NNAKRY,NNAC4B,NNAKSK,NNAKBL
COMMON/ZZZ17/WAKLPY,WAK4B,WAKLSK,WAKLBL
COMMON/ZZZ18/WANGRY,WAN4B,WANGSK,WANGBL
COMMON/ZZZ19/KPRINT(10),IREAD,NWRITE,KREAD
COMMON/ZZZ20/PT
COMMON/ZZZ21/KPY1,KPY2
COMMON/ZZZ22/KNSLE1,KNS4B,KNSTY2
COMMON/ZZZ23/KBOLE1,KBO4B,KBOTY2
COMMON/ZZZ24/KTNELE,KTN4B,KTNTY2
COMMON/ZZZ25/KPYELE,KPY4B,KPYTY2
COMMON/ZZZ26/KVTELE,KVT4B,KVTY2
COMMON/ZZZ27/KSHELE,KSH4B,KSHTY2
COMMON/ZZZ28/KSBELE,KSB4B,KSBTY2
COMMON/ZZZ29/KSKELE,KSK4B,KSKTY2
COMMON/ZZZ30/KBLELE,KBL4B,KBLTY2
COMMON/ZZZ31/NSTAG,NVORT,NSPIRAL,SPIRAL
INTEGER RM,R2
REAL LSHAFT,LSHANK
DO 701 IELEM=1,NELEM
PP=NMODE(1,IELEM)
RM=NMODE(2,IELEM)
NP=NMODE(3,IELEM)
NM=NMODE(4,IELEM)
PHIC(IELEM)=(SOR(PP)+SO*(PHI1+SOR(NP)+SOR(NM)))/4.
PHI1(IELEM)=(SOR(PP)+SOR(PM)+SOR(NP)+SOR(NM))/4.
PHI2(IELEM)=(SOR(PP)+SO*(PHI1+SOR(NP)+SOR(NM)))/4.
PHI3(IELEM)=(SOR(PP)+SOR(PM)+SOR(NP)+SOR(NM))/4.
701 CONTINUE
WRITE(6,719)
719 FORMAT(//6X,'ELEM',9X,'PHIC',11X,
10PHI1,9X,PHI2,9X,PHI3)
DO 720 IELEM=1,NELEM
720 WRITE(6,721)IELEM,PHIC(IELEM),PHI1(IELEM),PHI2(IELEM),PHI3(IELEM)
721 FORMAT(5X,I6,9X,6E15.5)
RETURN
END

```

```

C
SUBROUTINE VELXYZ(VELX,VELY,VELZ,PM11,PM12,PM13,PC,P1,P2,P3,
1 NELEM)
DIMENSION VELX(NELEM),PM11(NELEM),PM12(NELEM)
DIMENSION PM13(NELEM)
DIMENSION VC(NELEM),V1(NELEM)
DIMENSION PC(3,NELEM),P1(3,NELEM),P2(3,NELEM),P3(3,NELEM)
COMMON/ZZZ1/XX(36),YY(36),ZZ(36),KSYM1,KSYM2,KSYM3,KSYM4,KSYM5,KSYM6,KSYM7
COMMON/ZZZ2/NSFX,NSB0Y,YS,NT(34),ISFACE(34),KNORHL(34),KNAKES(34)
COMMON/ZZZ3/ABYLON,NBODY1,NBODY2,NBODY3,NBTATL,NSHAFT,NMUB,NSHANK,
1 NBLADE
COMMON/ZZZ4/OMEGA,ALFA,ABETA
COMMON/ZZZ5/XPYCTR,YPYCTR,ZPYCTR,RXPVL,RYPYL,RZPYL
COMMON/ZZZ6/XMOSE,YBD1,ZBD2,YTATL
COMMON/ZZZ7/YNOSE,YBD1,ZBD2,YTATL
COMMON/ZZZ8/ZNOSE,ZBD1,ZBD2,YTATL
COMMON/ZZZ9/RYBD1,RZBD1,RYBD2,RZBD2
COMMON/ZZZ10/RSHAFT,LSHAFT,RSHANK,LSHANK
COMMON/ZZZ11/XHUBCR,YHUBCR,ZHUBCR,RXHUB,RYHUB,RZHUB
COMMON/ZZZ12/PROTOR,BCMED,TAUBL,ALFA3
COMMON/ZZZ13/THET75,THET1C,THET1S,CON,NG,AZIMUTH
COMMON/ZZZ14/KBLADE,TAN1B,TAN1E,KBL1,XRTE,KROTORS(34)
COMMON/ZZZ15/VSPAN,XLEZV,XTEZV,TANLEV,TANTEV,TAU,ZVTAIL
COMMON/ZZZ16/HMAKRY,HMAK4B,HMAKSK,HMAKBL
COMMON/ZZZ17/WAKLPY,WAK1B,WAKLSK,WAKLBL
COMMON/ZZZ18/HANGRY,HAN1B,HANGSK,HANGBL
COMMON/ZZZ19/KPRINT(10),NREAD,NWRITE,KREAD
COMMON/ZZZ20/PI
COMMON/ZZZ21/KPY1,KPY2
COMMON/ZZZ22/KNSLE,KNS4B,KNSTYB
COMMON/ZZZ23/KBOELE,KBS4P,KBDTYP
COMMON/ZZZ24/KTNELE,KTN4B,KTNTYP
COMMON/ZZZ25/KPYELE,KPY4P,KPYTYP
COMMON/ZZZ26/KVTELE,KVT4B,KVTYP
COMMON/ZZZ27/KSHELE,KSH4P,KSHTYP
COMMON/ZZZ28/KMBELE,KMB4B,KMBTYP
COMMON/ZZZ29/KSKELE,KSK4P,KSKTYP
COMMON/ZZZ30/KBLELE,KBL4P,KBLTYP
COMMON/ZZZ31/NSTAG,NVORT,NSPIRAL,SPIRAL

C
DOTPRO(X1,X2,X3,Y1,Y2,Y3)=X1*Y1+X2*Y2+X3*Y3
VECPRX(D1,D2,D3,E1,E2,E3)=D2*E3-D3*E2
VECPRY(D1,D2,D3,E1,E2,E3)=D3*E1-D1*E3
VECPRZ(D1,D2,D3,E1,E2,E3)=D1*E2-D2*E1

C
DO 888 JELEN=1,NELEM
C
A1XC=P1(1,JELEN)
A1YC=P1(2,JELEN)
A1ZC=P1(3,JELEN)
A2XC=P2(1,JELEN)
A2YC=P2(2,JELEN)
A2ZC=P2(3,JELEN)

A1XA2X=VECPRX(A1XC,A1YC,A1ZC,A2XC,A2YC,A2ZC)
A1XA2Y=VECPRY(A1XC,A1YC,A1ZC,A2XC,A2YC,A2ZC)
A1XA2Z=VECPRZ(A1XC,A1YC,A1ZC,A2XC,A2YC,A2ZC)

```

```

C      A1XA2S=DOTPRQ(A1XA2Y,A1XA2Y,A1XA2Z,A1XA2Y,A1XA2Y,A1XA2Z)
      A1XA2A=SQRT(A1XA2S)
C
      A1A1=DOTPRQ(A1XC,A1YC,A1ZC,A1XC,A1YC,A1ZC)
      A1A2=DOTPRQ(A1XC,A1YC,A1ZC,A2XC,A2YC,A2ZC)
      A2A2=DOTPRQ(A2XC,A2YC,A2ZC,A2XC,A2YC,A2ZC)
C
      A11=A2A2/A1XA2S
      A12=A1A2/A1XA2S
      A21=A12
      A22=A1A1/A1XA1S
C
      UNORMX=A1XA2Y/A1XA2A
      UNORMY=A1XA2Y/A1XA2A
      UNORMZ=A1XA2Z/A1XA2A
C
      A1XU=A11*A1YC+A12*A2XC
      A1YU=A11*A1YC+A12*A2YC
      A1ZU=A11*A1ZC+A12*A2ZC
C
      A2XU=A21*A1YC+A22*A2XC
      A2YU=A21*A1YC+A22*A2YC
      A2ZU=A21*A1ZC+A22*A2ZC
C
      A3XU=UNORMX
      A3YU=UNORMY
      A3ZU=UNORMZ
C
      VELX(JELEM)=PHI1(JELEM)*A1XU+PHI2(JELEM)*A2XU
      VELY(JELEM)=PHI1(JELEM)*A1YU+PHI2(JELEM)*A2YU
      VELZ(JELEM)=PHI1(JELEM)*A1ZU+PHI2(JELEM)*A2ZU+PHI3(JELEM)*A3ZU
800  CONTINUE
      RETURN
      END

```



```

SUBROUTINE CPLINR(CP,VE,X,VELY,VELZ,PHIC,NELEN,PC,KROTOR)
DIMENSION CP(NELEN),VEL(NELEN),PHIC(NELEN)
DIMENSION VE,Y(NELEN),VE,Z(NELEN)
DIMENSION PC(3,NELEN),KROTOR(NELEN)
COMMON/ZZZ1/NX(34),NY(34),NXY(34),KSYM1MY,KSYM2Z,NSYMMY,NSYMMZ
COMMON/ZZZ2/NSFX,NSBODY1,NS,NT(34),TSEAF(34),KNORM(34),KNAKES(34)
COMMON/ZZZ3/NPYLON,NBODY1,NBODY2,NBODY3,NVTAIL,NSH4FT,NHUB,NSHANK,
1 NBLADE
COMMON/ZZZ4/JMACH,OMEGA,ALFA,ABETA
COMMON/ZZZ5/XPYCTR,YPYCTR,ZPYCTR,XPYV1,YPYV1,ZPYV1
COMMON/ZZZ6/KNOSE,XB01,ZB02,XTAIL
COMMON/ZZZ7/XMOSE,YB01,ZB02,YTAIL
COMMON/ZZZ8/ZNOSE,ZB01,ZB02,ZTAIL
COMMON/ZZZ9/RXBD1,RZBD1,ZYB02,RZB02
COMMON/ZZZ10/RSHAFT,LSM,T,RSMANK,LSHANK
COMMON/ZZZ11/XHUBC2,ZHUBC2,RXHUBC2,ZXHUBC2,ZXHUBC3
COMMON/ZZZ12/RROTOR,BCHD1D,TAU8L,ALFA9
COMMON/ZZZ13/THET1S,THET1C,THET1S,COMING,AZIMUTH
COMMON/ZZZ14/KBLADE,TAN.EB,TANTE3,XBLE,XBTE,KROTORS(34)
COMMON/ZZZ15/XSPAN,XLEZV,YTEZV,TAN.EV,TANTEV,TAU,ZVTAIL
COMMON/ZZZ16/NHAKPY,NHAK1B,NHAKSK,NHAKBL
COMMON/ZZZ17/HAKPY,HAK1B,HAKSK,HAKBL
COMMON/ZZZ18/HANGPY,HANG1B,HANGSK,HANGBL
COMMON/ZZZ19/KROT1T(10),KREAD,NHAKTE,KREAD
COMMON/ZZZ20/PI
COMMON/ZZZ21/KPY1,KPY2
COMMON/ZZZ22/KNSELE,KNSS4P,KNSTYP
COMMON/ZZZ23/KB0ELE,KBS4P,KB0TY2
COMMON/ZZZ24/KTNELE,KTNSHP,KTNTY2
COMMON/ZZZ25/KPYELE,KPS4P,KPYTY2
COMMON/ZZZ26/KVTELE,KVTS4P,KVTY2
COMMON/ZZZ27/KSMELE,KSM4P,KSMTY2
COMMON/ZZZ28/KHBELE,KHBS4P,KHBTY2
COMMON/ZZZ29/KSKELE,KSK4P,KSKTY2
COMMON/ZZZ30/KBLELE,KBLS4P,KBLTY2
COMMON/ZZZ31/NSIAC,NVORT,NSIRAI,SPIRAI
DOTPRO(X1,Y1,Z1,X2,Y2,Z2)=X1*X2+Y1*Y2+Z1*Z2
XPROY(DX,DY,DZ,EX,EY,EZ)=DY*EZ-EZ*DY
XPROZ(DX,DY,DZ,EX,EY,EZ)=DX*EZ-EZ*DX
BETA2A=ABS(1.-UMACH**2)
BETA=SQRT(BETA2A)
UFREE=UMACH*1117
OMEGAY=0.
OMEGAZ=OMEGA
OMEGAZ=OMEGAZ*2.*PI/60.
IF(UMACH.EQ.0) UFREE=OM :A=2 *DOTRROTOR/60.
DO 900 IELEN=1,NELEN
RX=PC(1,IELEN)
RY=PC(2,IELEN)
RZ=PC(3,IELEN)
VX=VELX(IELEN)
VY=VELY(IELEN)
VZ=VELZ(IELEN)
CPB=(-2.*UFREE*VX-(VX*VX+VY*VY+VZ*VZ))/(UFREE*UFREE)
CPB=(-2.*UFREE*VY)/(UFREE*UFREE)

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```

CRX=XPROX(OMEGAX,OMEGAY,JMEGAZ,RX,RY,RZ)
CRY=XPROY(OMEGAX,OMEGAY,JMEGAZ,RX,RY,RZ)
CRZ=XPROZ(OMEGAX,OMEGAY,JMEGAZ,RX,RY,RZ)
CPR=0.01PRO(CRY,CRY,CRZ,X,XY,XZ)
CPR=CPR*2./(JFREE*UFREE)
IF(KROTOR/IELEM).EQ.0)C2=0.
CP(IELEM)=CPS+CPR
300 CONTINUE
RETURN
END

```

```

SUBROUTINE FJRCE(NNODE,XX,NELEM,NODE,CP)
DIMENSION A1(3),A2(3),XC(3),NNODE1,NODE(3,NELEM),PC(3),CP(NELEM)
COMMON/ZZZ1/XX(34),NY(34),NXY(34),KSY:MY,KSYMMZ,NSYMMY,NSYMMZ
COMMON/ZZZ2/NSFY,NSBODY,YS,NT(34),ISEACE(34),KNORML(34),KNAKES(34)
COMMON/ZZZ3/VPYLON,NBODY1,NBODY2,NBODY3,NVTAIL,NSHAFT,NHUB,NSHANK,
+ NBLADE
COMMON/ZZZ4/UMACH,OMEGA,ALFA,ABETA
COMMON/ZZZ5/VPYCTR,VPYCTR,ZPYCTR,XPYL,YPYL,RZPYL
COMMON/ZZZ6/XNOSE,XB01,X3D2,XTAIL
COMMON/ZZZ7/XNOSE,YB01,Y3D2,YTAIL
COMMON/ZZZ8/ZNOSE,ZB01,Z3D2,ZTAIL
COMMON/ZZZ9/ZYB01,ZYB02,ZYB03
COMMON/ZZZ10/RSHAFT,LSHAFT,RSHANK,LSHANK
COMMON/ZZZ11/XHUBCR,YHUBCR,ZHUBCR,RXHUB,RXHUB,RZHUB
COMMON/ZZZ12/ROTOR,BCHORD,TAUBL,ALFA3
COMMON/ZZZ13/THET75,THET1C,THET1S,CORING,AZTMUTH
COMMON/ZZZ14/KBLADE,TAN:EB,TAN:ES,XBLE,X9TE,KROTOR(34)
COMMON/ZZZ15/NSRAM,XLEZY,XTEZY,TANLEY,TAN:EN,TAIL,ZNTAIL
COMMON/ZZZ16/NWAKPY,NWAK1B,NWAKSK,NWAKBL
COMMON/ZZZ17/NAKPY,NAK1B,NAKLSK,NAKLB
COMMON/ZZZ18/WANGPY,WAN:1B,WANGSK,WANGBL
COMMON/ZZZ19/KPRINT(10),VREAD,NWRITE,KREAD
COMMON/ZZZ20/PI
COMMON/ZZZ21/KPY1,KPY2
COMMON/ZZZ22/KNSELE,KNSS1P,KNSTYP
COMMON/ZZZ23/KBDELE,KBS1P,KBTYP
COMMON/ZZZ24/KTNELE,KTNS1P,KTNTYP
COMMON/ZZZ25/KPYELE,KPS1P,KPTYP
COMMON/ZZZ26/KVTELE,KVS1P,KVTTY
COMMON/ZZZ27/KSHELE,KS1P,KSHTYP
COMMON/ZZZ28/KHBELE,KHS1P,KHBTYP
COMMON/ZZZ29/KSKELE,KS1P,KSHTYP
COMMON/ZZZ30/K9LELE,K9L1P,K9LTYP
COMMON/ZZZ31/INSTAG,MVORT,MSPIRAL,SPIRAL
INTEGER PP,PH,HP,M4
C
DOTPRD(X1,Y1,Z1,X2,Y2,Z2)=X1*X2+Y1*Y2+Z1*Z2
XPROX(IX,DY,JZ,EX,EY,EZ)=DY*EZ-DZ*EY
XPROY(IX,DY,JZ,EX,EY,EZ)=DZ*EX-DX*EZ
XPROZ(IX,DY,JZ,EX,EY,EZ)=DX*EY-DY*EX
C
BETA=SQRT(1-UMACH*UMACH)
MULT=1
MULTZ=1
IF(KSYMMZ.NE.0) MULTZ=2
IF(KSYMMY.NE.0) MULT=2
CLIFT=0.0
CDRAG=0.0
CH=0.0
DO 100 J=1,NELEM
PP=NODE(1,J)
PH=NODE(2,J)
HP=NODE(3,J)
NM=NODE(4,J)
DO 200 K=1,3
YPP=XX(K,PP)
YPH=XX(K,PH)

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YMP=XK(K,MP)
YMM=XK(K,MM)
A1(K)=(YPP+YPM-YMP-YMM)/4.
A2(K)=(YPP-YPM+YMP-YMM)/4.
PC(K)=(YPP+YPM+YMP+YMM)/4.
200 CONTINUE
A1(1)=A1(1)*BETA
A2(1)=A2(1)*BETA
PC(1)=PC(1)*BETA
C
A1X2X=XPROX(A1(1),A1(2),A1(3),A2(1),A2(2),A2(3))
A1X2Y=XPROY(A1(1),A1(2),A1(3),A2(1),A2(2),A2(3))
A1X2Z=XPROZ(A1(1),A1(2),A1(3),A2(1),A2(2),A2(3))
C
DELL=A1X2Z
CLIFT=CLIFT+.5*CP(J)*DELL*MULT*MULTZ
C
DELD=A1X2Y
CDRAG=CDRAG+.5*CP(J)*DELD*MULT*MULTZ
C
100 CONTINUE
C
AREA=1.
C
CLIFT=CLIFT/AREA
CDRAG=CDRAG/AREA
C
WRITE(INWRITE,300)CLIFT
300 FORMAT(//10X,'LIFT COEFFICIENT =',E12.6)
WRITE(INWRITE,301)CDRAG
301 FORMAT(//10X,'DRAG (INDUCED) COEFFICIENT =',E12.6)
RETURN
END

```