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COMPUTER PROGRAM FOR CALCULATING PARTIALLY CAVITATING CASCADE F--ETC(U)
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Contract No. N00014-78-C-0146

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COMPUTER PROGRAM FOR CALCULATING PARTIALLY
CAVITATING CASCADE FLOWS IN NONLINEAR THEORY

By
OKITSUGU FURUYA

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JANUARY, 1979

Prepared for
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OFFICE OF NAVAL RESEARCH
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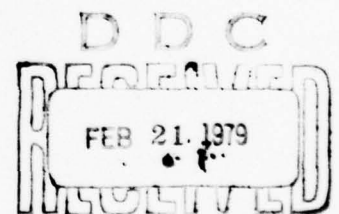
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20. ABSTRACT (Continue on reverse side if necessary and identify by block number) A nonlinear theory for solving partially cavitating cascade problems was formulated in two different types of input data set-ups, one specifying cavitation number and the other the cavity length. The second method was necessary to find a unique solution because the cavity length has two different values for a specified cavitation number in some blade geometry cases. The report describes the structure of program including various subroutines, input data set-up, typical output data and listing.		

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1.0 INTRODUCTION

As has been described in the text [1], two computer programs were developed under the present work, one specifying the cavitation number to determine the cavity length and the other specifying the cavity length to determine the corresponding cavitation number, both in partially cavitating flow conditions. The former is called "PCAS" and the latter is called "PCASL". The explanation in regard to which program is to be used for different cascade flows and geometric configurations is given in [1]. The general rule of thumb is that if the length of cavity is close to the chord length and the upper foil portion has relatively small negative camber, PCAS converges rapidly whereas if the cavity length is short in addition to the existence of the high negative chamber on the suction side of the cascade blade, PCASL must be used for convergence. Five solution parameters are to be determined for PCAS: those are three transform coordinates, scaling factor for mapping, and deflected flow angle at downstream infinity. For PCASL, one extra solution parameter, i.e., length of cavity, makes the total number of solution parameters six. Naturally, it will need more computer time for PCASL than PCAS.

In the following we will describe the structure of program including various subroutines, input data set-up, typical output data and listing for PCAS. For PCASL, there is no difference in terms of input data except for one extra solution parameter so that only listing is provided. It is believed that there will be no difficulty in running PCASL once one becomes familiar with PCAS.

2.0 STRUCTURE OF PCAS

PCAS consists of a main program and several subroutines, brief descriptions of which will be given as follows:

1) MAIN PROGRAM PCAS

- o Specify the dimensions for data.
- o Read input data.
- o Exercise Newton's iterative procedure.
- o Calculate lift and drag coefficients at the end of each iteration.
- o Calculate the cavity profile.

2) SUBROUTINE OXFNEW(X,STOL,M,I,DG,DF,FFF4)

- o Exercise Newton's iterative procedure in calculations for the five integral equations to find the five unknown solution parameters.

x: Input and output data in array SXSI(I)

- SXSI(1): ξ - coordinate for the point B of the foil.
- SXSI(2): ξ - coordinate for the point C.
- SXSI(3): ξ - coordinate for the point F.
- SXSI(4): \bar{A} , coefficient of the mapping function.
- SXSI(5): x_2 , downstream flow angle.

STOL: Control variables for the accuracy of Newton's iterations.

M: Number of desired iterations for Newton's procedure.

I: Counts the number of iterations of Newton's procedure. This is defined within OXFNEW.

DG: This is one of the assigned finite differences for the numerical derivations of $\frac{\partial f}{\partial x}$. However, it is no longer used in the calculations themselves as it has been replaced by the array DELI(I,J) which is read in at the beginning of the program.

DF: Same as DG.

FFF4: The residue of equation F(4); if FFF4 becomes larger than S4 of input data, the program is stopped.

3) SUBROUTINE OFSIM1 (ANS,NOF,XCA)

- o Calculates integral I(1) of integral equation F(1) for special ease of foil shape with rounded left end. Called from subroutines: FLINTL, RMINT, CAVITY (see Reference [1] for F(1)).

ANS: Final answer for the integral I(1) of equation F(1).

NOF: This is a controlling variable passed on from the calling subroutines:

NOF = 0 - OFSIM1 called from FLINTL
NOF = 1 - OFSIM1 called from RMINT for real part
NOF = 2 - OFSIM1 called from RMINT for imaginary part
NOF = 3 - OFSIM1 called from CAVITY OXFNEW at F(5)

XCA: Integration variable passed on to OFSIM1 only if NOF = 3.

4) SUBROUTINE OFSIM2 (ANS2)

o Controls iterative procedure for calculating integral equation F(4). Called from OXFNEW (see Reference [1] for F(4)).

ANS2: Final answer of OFSIM2

5) SUBROUTINE OFSIM3 (Y,XXII,IP,I)

o Calculates $g_1(\xi)$ in integral equation F(4). Called from OFSIM2. (see [1] for $g_1(\xi)$).

Y: Integration variable passed from OFSIM2, corresponding to ξ .

XXII: Returns value of $g_1(\xi)$ to OFSIM2. The parameter is passed from OFSIM2 to OFSIM3 in the form of one element of an array (XITC(I)) inside an iterative loop.

IP: Number referring to the control point; IP = 1 to LPM.

I: I = 2 for the subdivided middle point between the regular control points specified by IP; I = 3 for the control points.

6) SUBROUTINE OFSIM5 (ANS5)

o Calculates values of F(5) using Simpson's rule and Chebyshev-Gauss polynomials.

ANS5: Value returned to loop in OXFNEW for equation F(5).

7) SUBROUTINE FLINTL (YINT, KCTRL)

o Calculates integrals in integral equation F(1). Called from OXFNEW.

YINT: Value returned for integral each time FLINTL is called.

KCTRL: Control variable passed from OXFNEW directing which of the four integrals in F(1) is to be calculated. (see [1]).

- 8) SUBROUTINE G2(XS2,AG2,IS2)
- o Calculates $g_2(\xi)$ in F(5) given integral variable ξ , i.e., XS2. Called from iterative loop in OFSIM5.
- XS2: Abscissa subdivision points from which $g_2(\xi)$ are calculated, i.e., ξ .
- AG2: Value for $g_2(\xi)$ returned to OFSIM5 after each time it is called.
- IS2: Number of control points on the second arc S2.
- 9) SUBROUTINE RMINT(SR,SM,MIQ)
- o Calculates $r_1, r_2, r_3, r_4; m_1, m_2, m_3, m_4$ of equations F(2) and F(3) respectively. These values are used to calculate F(2) and F(3) in OXFNEW (see [1]).
- SR: Value for r returned to OXFNEW
- SM: Value for m returned to OXFNEW
- MIQ: Control variable passed from OXFNEW dictating which value (1, 2, 3 or 4) of r or m is to be calculated.
- 10) SUBROUTINE CAVITY (XCC, YCC)
- o Calculates coordinates of points along cavity cross-section to give cavity shape. Passes cavity endpoint coordinates back to OXFNEW.
- XCC: Value returned to OXFNEW for x coordinate of cavity endpoint.
- YCC: Value returned to OXFNEW for y coordinate of cavity endpoint.
- 11) SUBROUTINE IC2(SR,SM,XCA, ISIC)
- o When ISIC = 0 used to calculate r_4 and m_4 of equations F(2) and F(3) respectively. It is then called from OXFNEW. When ISIC = 1 it is used to calculate.
- SR,SM: When called from RMINT this is the returned value for r_4 and m_4 . When called from CAVITY, only SR is used and SM becomes dummy (see Reference [1]).
- XCA: Only used for ISIC = 1, integration variable.
- ISIC: This is a control variable which tells IC2 whether to do calculation for OXFNEW or for OFSIM5 or CAVITY.
- = 0 called from RMINT.
- = 1 called from CAVITY IN OFSIM5 for F(5).

- 12) SUBROUTINE MOSEC (A,B,ER1,X,J,XLPA,IS1I2)
- o Finds a root of $f(x) = 0$ where x must lie between A and B and $f(A) > 0$, $f(B) < 0$.
- A,B: A root of $f(x) = 0$ exists between A and B .
- ER1,ER2: Accuracy controlling variables where
 $|x_{\text{real}} - x| < ER1$ and $|f(x_{\text{real}}) - f(x)| < ER2$.
- x: A root of $f(x) = 0$, found in this subroutine and returned to the calling program.
- J: Number of iterations done in MOSEC.
- 13) FUNCTION AITKEN (XX,YY,X,N)
- o Interpolate the value corresponding to X with the data of $XX(N)$, $YY(N)$ specified by Aitken method.
- 14) SUBROUTINE DETERM (A,N,D)
- o Calculates determinant of a matrix A of rank N
- A: Matrix input, requiring dimension.
- N: Rank of the matrix.
- D: Calculated determinant of A .
- 15) SUBROUTINE ARCS2 (S2,XC,YC)
- o Calculates the arc length of the upper wetted portions $S2$. Called from OXFNEW in calculations for $F(5)$ after the CAVITY subroutine.
- S2: returned arc length of arc $S2$.
- XC: X-coordinate of cavity endpoint.
- YC: y-coordinate of cavity endpoint.
- 16) SUBROUTINE ARCLLEN (XSS,XL,XH,IS1I2)
- o Calculates arc length of small intervals between XL and XH along foil profile.
- XSS: Returned arc segment length.
- XL: Lower x coordinate of segment endpoint.
- XH: Upper x coordinate of segment endpoint.
- IS1I2: Control variable telling the routine whether the upper or lower edge of the foil is to be looked at; $IS1I2 = 0$ for the lower edge, $IS1I2 = 1$ for the upper edge.
- 17) SUBROUTINE XCYC (XCB,YCB,CX,CY)
- o Calculates the point on the upper face of the foil corresponding to the endpoint of the cavity.

- XCB: X-coordinate of returned point on foil.
YCB: Y-coordinate of returned point on foil.
CX: X-coordinate of cavity endpoint.
CY: Y-coordinate of cavity endpoint.
- 18) SUBROUTINE BBBETA (XX, RBETA, IS1I2)
o Calculates BETA(X(XSI))
XX: X-coordinate of the body for which the local body slope RBETA to be calculated.
RBETA: Local body slope in radians calculated in this subroutine.
IS1I2: Control variable; = 0 for the lower portion
- 19) SUBROUTINE FARC (FAR, XLPA, X1B, IS1I2)
o Calculates the difference between the arc length DSS and that corresponding the ξ -coordinates of XLPA and X1B.
IS1I2: The same as that in BBBETA.
- 20) SUBROUTINE SHAPE (X, Y, BETA, IS1I2)
o Calculates points along cross-section of foil to give shape of foil. Also gives the angle of the tangent to the foil at each point.
X: X-coordinate for which Y and BETA to be calculated.
Y: Y-coordinate of calculated point.
BETA: Angle of tangent to the foil at calculated point.
IS1I2: Control variable to tell the subroutine whether to look at the upper or lower face of the foil.

3.0

INPUT DATA

The following data are for the program PCAS (Partially Cavitating Cascade Cases). Formatting examples are shown in section 3.2. For running most cases, only a few data cards must be changed such as: cavitation number (SIGMA) and thickness (TH). In trying to obtain a convergent solution, updated data for the five parameters, SXSI(I), can be stored on tape and recalled by changing IREAD = 1 and IFLAG = 0. In this way new data need not be punched in and consecutive runs may be made very quickly.

It is important to note that the program, as it stands, is for plano-convex foils only. The thickness of the foil can be changed simply by changing TH. TH = 0 is the case of a flat plate. However, the input data set-up includes the capability of calculating the partially cavitating propeller local flows. The input parameters relating the propeller blade configurations include R, AAAA, to CCCC, A8 to D8, XROUD and AZAA to CZCC. In order to calculate the plano-convex blade cascade flow, these parameters are disregarded although dummy cards should be provided.

Different profiles may be analyzed through suitable changes in the program. Subroutines which must be changed are: ARCS2, ARCLEN, XCYC, and SHAPE. Coefficients for equations describing the profiles must be read in at the beginning of the program. Other data which can be changed are R, radial location on propeller blade; XROUND, the leading edge radius in the case of a rounded end; SBETA, the angle of incidence; SBETA2, the body angle of flat plate; ISHARP, specifies sharp or rounded leading edge; ALFALS, flow angle; GAMMAS, cascade stagger angle; SOLIS, solidity of the cascade.

3.1 INPUT DATA FOR PCAS (PARTIALLY CAVITATING CASCADE CASES)

DATA CARD NO.	SYMBOL	DESCRIPTION
1	NGAUS	Number of subdivisions used in Gaussian integration.
2-4	TGAUS(I)	Abscissas of Gaussian integration.
5-7	WGAUS(I)	Weight factors of Gaussian integration.
8	XXM	Weighting factor for solution parameters in iterative procedure (0 to 1).
9-13	DELTA(X,Y)	Increment for numerical calculations of partial derivatives.
14	TH	The thickness in percent of the plano-convex foil.
15	R	Specifies the radial location on the propeller blade. (normalized to be unity at the tip)
	AAAA,BBBB,CCCC	Coefficients for terms in the equation of the cross-sectional shape of the lower face of the propeller blade. These coefficients are used in the second equation for x values along the cross-section where $.2 \leq x \leq .8$ (see Reference 2 for the form of equation)
16	A8,B8,C8,D8	Coefficients for third equation of cross-sectional shape where $x \leq .8$ (see [2] for the form of equation)
17	XROUND	Leading edge radius. This is actually used only when ISHARP = 1 (rounded leading edge). Otherwise it is a dummy variable.
	A2AA,B2BB,C2CC	Coefficients for first equation of cross-sectional shape where $x \leq .2$ (see [2] for the form of equation)

18	IFLAG1	= 0 - for regular runs ≠ 0 - for runs reading data from CASCLIM. Needs extra data for SXSI(2), SXSI(3).
	NCHBY	The number of Chebyshev-Gauss control points.
19	SBETA	Initial angle of incidence for a starting flat plate solution in degrees.
	SBETA2	Body angle of a flat plate in degrees. Used as an initial solution.
	SF4	Always set = 10. Used to stop computation if the calculated arc length S1 becomes larger than SF4.
	BETAB	Body angle at point B.
	BETAC	Body angle at point C. (initially assumed value)
20	LPMS	Number of control points over the ξ coordinates between $\xi = -1$ and b. Used for first arc length S1. (see Reference [1])
	LPKS	Number of subdivisions between $\xi = b$ and the last point of the coarse division made by LPMS.
	LPM2	Same as LPMS only used for calculations on second arc length S2. Note that there is only 1 segment spacing here.
	IFLAG	= 1 - for first run which requires data to be fed in, i.e., but only SXSI(1) to SXSI(5). = 0 - for use of previous data in which case data will be read either from a data card (if IREAD = 5) or from tape (if IREAD = 1). For IREAD = 5, not only SXSI(1) to SXSI(5) but also SARC(I), BETAN(I); SARC2(I), BETA2(I) must be read from the data card.

	IREAD	Used for controlling where data is read from. Either tape or card as above.
	ISHARP	= 0 - for sharp leading edge. = 1 - for rounded leading edge.
21	NITER	Number of flow configurations to be calculated in 1 run.
	MSTOP	Number of iterations to stop the larger nest.
	MAXIT	Number of iterations for Newton's loop.
	NHK	Control index for varying either the set values of the angle of incidence, solidity, or cavitation number, depending on 1, 2, or 3, respectively for the NITER loop.
22	ALFALS	Flow incidence angle in degrees. (see Figure 1)
	GAMMAS	Cascade geometric stagger angle in degrees. (see Figure 1)
	SOLIS	Solidity of the cascade (= c/s in Figure 1)
	SIGMS	Cavitation number = $(p_1 - p_c) / \frac{1}{2} \rho V_1^2$
23	DE,DG,DF	Finite differences for numerical derivations of $\frac{\partial f}{\partial x}$ in subroutine OXFNEW. These are replaced by DELT(I,J), no longer used.
24	SXSI(I), I = 1,5	This card is necessary only if IFLAG = 1; SXSI(I), I = 1,5 correspond to b, c, a, \bar{A} and x_2 . Values for SXSI(I) must be arbitrarily assumed and tried to see if a convergent solution is obtained.

25 ~ (25 + LPM)

SARC(1), BETAN(1)

Arc length vs. local
incidence angle in
radians for the
lower portion of
the body; these
data are needed
only if IFLAG = 0
and IREAD = 5.

SARC(LPM), (LPM)

25 + LPM + 1~

SARC2(1) BETAN2(1)

Arc length vs. local
incidence angle in
radians for the
upper portion of
the body; these
data are needed
only if IFLAG = 0
and IREAD = 5.

SARC (LPM2 + 1), BETAN2 (LPM2 + 1)

3.3

TYPICAL DATA SET-UP

20				
.0765265211		.2277959511	.3737060997	.5108670020
.6360536807		.7453319065	.8391169718	.9122344283
.9639713273		.9931235992		
.1527533871		.1491729865	.1420951093	.1316886364
.1181945320		.1019301198	.0832767415	.0626720483
.0406014298		.0175140071		
0.7				
.0000001	.0000001	.0000001	.0000001	.0000001
.0000001	.0000001	.0000001	.0000001	.0000001
.0000001	.0000001	.0000001	.0000001	.0000001
.0000001	.0000001	.0000001	.0000001	.0000001
.0000001	.0000001	.0000001	.0000001	.0000001
.0000001	.0000001	.0000001	.0000001	.0000001
.00				
0.5		0.01193	-1.0602553	-0.0041395
0.1034867		-0.4542559	0.5308437	-0.2476181
0.0000965		-0.0653112	0.1579089	-0.3673004
0	40			
71	0.	-130.	10.	-130.
1	30	40	5	0
	1	3		
	8.	37.	.625	1.2
	1.E-7	1.E-5	1.E-5	
.0020874		.0555454	.1552192	.0493760
				.0184135

4.0 OUTPUT DATA

Typical output data are also listed at the end of the program listing. Most of them are self-explanatory, however, those not explained in output data are described as follows:

- T(I): This is just a repetition of the input data TGAUS(I).
- W(I): Repetition of input data WGAUS(I).
- X(I): Solution parameters corresponding to SXSI(I). Each time these appear they are an updated version of those preceding them.
- CAV(X): This gives the x-coordinate of the cavity endpoint.
- CAV(Y): This gives the y-coordinate of the cavity endpoint.
- P(I,J): Partial derivatives of Function F(I) used for Newton's method.
- YINT4: Solution to 4th integral of equation F(1).
- SOLNR & SOLNM: Intermediate calculated values of integrals, only used for checking the numerical accuracy.
- F(X): Residue of each function F(1)...F(5)
- CLINF: Lift coefficient at infinity.
- CDINF: Drag coefficient at infinity.
- CCDD: Drag coefficient.
- CCLL: Lift coefficient.
- L/D : Cavity length to chord ratio.
- BIGS2: Arc length of the face of the foil. Either upper or lower face.
- XCCC: x-coordinate of cavity endpoint.
- YCCC: y-coordinate of cavity endpoint.

- XS2D: Intermediate values used as a check for progress of program. Can be ignored.
- XKSI: Intermediate values used as a check for progress of program. Can be ignored.
- BBTAN2: Slope of foil profile at Chebychev-Gauss subdivision points.

4.1 TYPICAL OUTPUT DATA

T(1)= .07650652 .22778505 .37370609 .51086700 .63605308 .74033191 .83011697 .91223443 .96397193
 X(1)= .10270353 .14917299 .14209511 .13188664 .11819453 .10193012 .08327674 .06267205 .04060143
 DELTA(I,J)= .00000010 .00000010 .00000010 .00000010 .00000010 .00000010 .00000010 .00000010 .00000010
 DELTA(I,J)= .00000010 .00000010 .00000010 .00000010 .00000010 .00000010 .00000010 .00000010 .00000010
 DELTA(I,J)= .00000010 .00000010 .00000010 .00000010 .00000010 .00000010 .00000010 .00000010 .00000010
 DELTA(I,J)= .00000010 .00000010 .00000010 .00000010 .00000010 .00000010 .00000010 .00000010 .00000010
 DELTA(I,J)= .00000010 .00000010 .00000010 .00000010 .00000010 .00000010 .00000010 .00000010 .00000010
 THICKNESS OF FLAME CONVEY FOIL = 0.00000 XFM= .70000
 PETA 40 PETA 45 FIRST GUESS=-190.00000 -1FC.00000
 K= .50 AAAA= .011930 BBB= -.000255 CCCC= -.004140
 AB= .103487 BH= -.49425E GH= .530844 GR= -.24761H
 XROUND= .000097 A2A1= -.000011 B2B= .157909 C2CC= -.367300
 LPM= 71 LPK= 30 SBETA= 0. IREAD=1 NCHRY= 40
 DE= .1000000E-06 DG= .1000000E-02DF= .1000000E-04 SF4= .1000000E+02
 SBETA2= -.1000000E+03
 LFM2= 40 LSHARP= 0.
 INCIDENCE ANGLE= .9000000E+01 GAMMA= .3600000E+02 SOLIDITY= .6250000E+00
 FLAP ANGLE= 0.
 CAVIT. NO = .3750000E+02
 CHORD= .1000000E+01 UPPER SEP. POINT= 0. CORR. POINT(XC,YC)=(0. , 0.)
 SIGS= .1000000E+01
 ITERATION NO.= 2

X(1)= .0933550E-05
 X(2)= .1673660E+00
 X(3)= .1724534E+00
 X(4)= .4834349E-01
 X(5)= -.1858505E-01

I= 1	BETAN2=	-.3141593E+01	XKSI=	.1679877E+00
I= 2	BETAN2=	-.3141593E+01	XKSI=	.1690014E+00
I= 3	BETAN2=	-.3141593E+01	XKSI=	.1690267E+00
I= 4	BETAN2=	-.3141593E+01	XKSI=	.1690520E+00
I= 5	BETAN2=	-.3141593E+01	XKSI=	.1690773E+00
I= 6	BETAN2=	-.3141593E+01	XKSI=	.1691026E+00
I= 7	BETAN2=	-.3141593E+01	XKSI=	.1691279E+00
I= 8	BETAN2=	-.3141593E+01	XKSI=	.1691532E+00
I= 9	BETAN2=	-.3141593E+01	XKSI=	.1691785E+00
I= 10	BETAN2=	-.3141593E+01	XKSI=	.1692038E+00
I= 11	BETAN2=	-.3141593E+01	XKSI=	.1692291E+00
I= 12	BETAN2=	-.3141593E+01	XKSI=	.1692544E+00
I= 13	BETAN2=	-.3141593E+01	XKSI=	.1692797E+00
I= 14	BETAN2=	-.3141593E+01	XKSI=	.1693050E+00
I= 15	BETAN2=	-.3141593E+01	XKSI=	.1693303E+00
I= 16	BETAN2=	-.3141593E+01	XKSI=	.1693556E+00
I= 17	BETAN2=	-.3141593E+01	XKSI=	.1693809E+00
I= 18	BETAN2=	-.3141593E+01	XKSI=	.1694062E+00
I= 19	BETAN2=	-.3141593E+01	XKSI=	.1694315E+00
I= 20	BETAN2=	-.3141593E+01	XKSI=	.1694568E+00
I= 21	BETAN2=	-.3141593E+01	XKSI=	.1694821E+00
I= 22	BETAN2=	-.3141593E+01	XKSI=	.1695074E+00
I= 23	BETAN2=	-.3141593E+01	XKSI=	.1695327E+00
I= 24	BETAN2=	-.3141593E+01	XKSI=	.1695580E+00
I= 25	BETAN2=	-.3141593E+01	XKSI=	.1695833E+00
I= 26	BETAN2=	-.3141593E+01	XKSI=	.1696086E+00
I= 27	BETAN2=	-.3141593E+01	XKSI=	.1696339E+00
I= 28	BETAN2=	-.3141593E+01	XKSI=	.1696592E+00
I= 29	BETAN2=	-.3141593E+01	XKSI=	.1696845E+00
I= 30	BETAN2=	-.3141593E+01	XKSI=	.1697098E+00
I= 31	BETAN2=	-.3141593E+01	XKSI=	.1697351E+00
I= 32	BETAN2=	-.3141593E+01	XKSI=	.1697604E+00
I= 33	BETAN2=	-.3141593E+01	XKSI=	.1697857E+00
I= 34	BETAN2=	-.3141593E+01	XKSI=	.1698110E+00
I= 35	BETAN2=	-.3141593E+01	XKSI=	.1698363E+00
I= 36	BETAN2=	-.3141593E+01	XKSI=	.1698616E+00
I= 37	BETAN2=	-.3141593E+01	XKSI=	.1698869E+00
I= 38	BETAN2=	-.3141593E+01	XKSI=	.1699122E+00
I= 39	BETAN2=	-.3141593E+01	XKSI=	.1699375E+00

CAVX=	.55965	CAVY=	.10471
CAVX=	.59161	CAVY=	.10615
CAVX=	.62152	CAVY=	.10712
CAVX=	.64952	CAVY=	.10767
CAVX=	.67579	CAVY=	.10786
CAVX=	.70048	CAVY=	.10773
CAVX=	.72372	CAVY=	.10732
CAVX=	.74565	CAVY=	.10566
CAVX=	.76537	CAVY=	.10577
CAVX=	.78299	CAVY=	.10467
CAVX=	.80460	CAVY=	.10357
CAVX=	.82226	CAVY=	.10188
CAVX=	.83911	CAVY=	.10021
CAVX=	.85514	CAVY=	.09836
CAVX=	.87043	CAVY=	.09632
CAVX=	.88504	CAVY=	.09409
CAVX=	.89908	CAVY=	.09165
CAVX=	.91234	CAVY=	.08896
CAVX=	.92508	CAVY=	.08599
CAVX=	.93723	CAVY=	.08264
CAVX=	.94873	CAVY=	.07874
CAVX=	.95935	CAVY=	.07386
CAVX=	.96862	CAVY=	.06797

F(1)= .9533564E-05
 F(2)= -.1223830E-04
 F(3)= -.1072791E-04
 F(4)= .2250620E-06
 F(5)= .2391792E-02
 X(1)= .8933617E-03
 X(2)= .1673433E+00
 X(3)= .1713299E+00
 X(4)= .4634485E-01
 X(5)= -.1852233E-01

ITERATION NO.= 1

X(1)= .8933617E-03
 X(2)= .1673433E+00
 X(3)= .1713299E+00
 X(4)= .4634485E-01
 X(5)= -.1852233E-01

I= 1	BETA2=	-.3141593E+01	YKSI=	.1673448E+00
I= 2	BETA2=	-.3141593E+01	YKSI=	.1673571E+00
I= 3	BETA2=	-.3141593E+01	YKSI=	.1673616E+00
I= 4	BETA2=	-.3141593E+01	YKSI=	.1674181E+00
I= 5	BETA2=	-.3141593E+01	YKSI=	.1674665E+00
I= 6	BETA2=	-.3141593E+01	YKSI=	.1675264E+00
I= 7	BETA2=	-.3141593E+01	YKSI=	.1675974E+00
I= 8	BETA2=	-.3141593E+01	YKSI=	.1676792E+00
I= 9	BETA2=	-.3141593E+01	YKSI=	.1677712E+00
I= 10	BETA2=	-.3141593E+01	YKSI=	.1678724E+00
I= 11	BETA2=	-.3141593E+01	YKSI=	.1679835E+00
I= 12	BETA2=	-.3141593E+01	YKSI=	.1681025E+00
I= 13	BETA2=	-.3141593E+01	YKSI=	.1682292E+00
I= 14	BETA2=	-.3141593E+01	YKSI=	.1683626E+00
I= 15	BETA2=	-.3141593E+01	YKSI=	.1685021E+00
I= 16	BETA2=	-.3141593E+01	YKSI=	.1686467E+00
I= 17	BETA2=	-.3141593E+01	YKSI=	.1687955E+00
I= 18	BETA2=	-.3141593E+01	YKSI=	.1689477E+00
I= 19	BETA2=	-.3141593E+01	YKSI=	.1691023E+00
I= 20	BETA2=	-.3141593E+01	YKSI=	.1692583E+00
I= 21	BETA2=	-.3141593E+01	YKSI=	.1694149E+00
I= 22	BETA2=	-.3141593E+01	YKSI=	.1695709E+00
I= 23	BETA2=	-.3141593E+01	YKSI=	.1697255E+00
I= 24	BETA2=	-.3141593E+01	YKSI=	.1698777E+00
I= 25	BETA2=	-.3141593E+01	YKSI=	.1700265E+00
I= 26	BETA2=	-.3141593E+01	YKSI=	.1701711E+00
I= 27	BETA2=	-.3141593E+01	YKSI=	.1703106E+00

I= 28 BBTA2= -.3141593E+01 XCSI= .1704440E+00
 I= 29 BBTA2= -.3141593E+01 XCSI= .1705707E+00
 I= 30 BBTA2= -.3141593E+01 XCSI= .1706897E+00
 I= 31 BBTA2= -.3141593E+01 XCSI= .1708004E+00
 I= 32 BBTA2= -.3141593E+01 XCSI= .1709020E+00
 I= 33 BBTA2= -.3141593E+01 XCSI= .1710040E+00
 I= 34 BBTA2= -.3141593E+01 XCSI= .1711075E+00
 I= 35 BBTA2= -.3141593E+01 XCSI= .1712124E+00
 I= 36 BBTA2= -.3141593E+01 XCSI= .1713186E+00
 I= 37 BBTA2= -.3141593E+01 XCSI= .1714251E+00
 I= 38 BBTA2= -.3141593E+01 XCSI= .1715316E+00
 I= 39 BBTA2= -.3141593E+01 XCSI= .1716381E+00
 I= 40 BBTA2= -.3141593E+01 XCSI= .1717444E+00

YINT4= -.0000000000
 SOLN= -.0000000000
 X20= .0000007756
 X20= .0000007752
 X20= .0000007749
 X20= .0000007757
 X20= .0000007764
 X20= .0000007751
 X20= .0000007775
 X20= .0000007776
 X20= .0000007773
 X20= .0000007770
 X20= .0000007768
 X20= .0000007765
 X20= .0000007762
 X20= .0000007767
 X20= .0000007764
 X20= .0000007762
 X20= .0000007749
 X20= .0000007746
 X20= .0000007744
 X20= .0000007741
 X20= .0000007737
 X20= .0000007734
 X20= .0000007733
 X20= .0000007730
 X20= .0000007727
 X20= .0000007725
 X20= .0000007722
 X20= .0000007719
 X20= .0000007716
 X20= .0000007713
 X20= .0000007710
 X20= .0000007707
 X20= .0000007705
 X20= .0000007699
 X20= .0000007694
 X20= .0000007688
 X20= .0000007671
 X20= .0000007661

P(I,J)= .3330956E+02 -.5525706E+00 .3310912E+00 0. -.8278648E+00
 P(1,0)= .1498917E+03 .6957599E+00 -.4076245E+00 -.3904930E+01 .2452498E+00
 P(I,0)= -.5985130E+02 .5373941E+00 -.3105371E+00 .3470362E+00 .1276932E+00
 P(I,0)= -.7883514E+02 .4780747E+00 -.2831855E+00 .9135496E+01 .7016636E+00
 P(A,J)= .7801370E+01 .5735937E+01 -.5590977E+01 -.1118936E+00 .1327013E-01

BIGS2= .03292 YCCC= .96703 YCCC= .06861
 CAVX= 1.00000 CAVY= 0.00000
 CAVX= .00162 CAVY= .00161
 CAVX= .00513 CAVY= .00493
 CAVX= .01334 CAVY= .00360
 CAVX= .02647 CAVY= .01551
 CAVX= .04531 CAVY= .02259

CAVX=	.07037	CAVY=	.03065
CAVX=	.10160	CAVY=	.03742
CAVX=	.13871	CAVY=	.04355
CAVX=	.18034	CAVY=	.05702
CAVX=	.22504	CAVY=	.06626
CAVX=	.27120	CAVY=	.07418
CAVX=	.31757	CAVY=	.08120
CAVX=	.36205	CAVY=	.08725
CAVX=	.40630	CAVY=	.09234
CAVX=	.44767	CAVY=	.09653
CAVX=	.48601	CAVY=	.09990
CAVX=	.52314	CAVY=	.10256
CAVX=	.55734	CAVY=	.10458
CAVX=	.58933	CAVY=	.10605
CAVX=	.61927	CAVY=	.10704
CAVX=	.64731	CAVY=	.10762
CAVX=	.67362	CAVY=	.10784
CAVX=	.69834	CAVY=	.10774
CAVX=	.72162	CAVY=	.10735
CAVX=	.74351	CAVY=	.10671
CAVX=	.76433	CAVY=	.10585
CAVX=	.78399	CAVY=	.10477
CAVX=	.80263	CAVY=	.10349
CAVX=	.82034	CAVY=	.10202
CAVX=	.83719	CAVY=	.10038
CAVX=	.85325	CAVY=	.09855
CAVX=	.86857	CAVY=	.09654
CAVX=	.88321	CAVY=	.09433
CAVX=	.89719	CAVY=	.09192
CAVX=	.91055	CAVY=	.08926
CAVX=	.92333	CAVY=	.08633
CAVX=	.93551	CAVY=	.08302
CAVX=	.94705	CAVY=	.07915
CAVX=	.95774	CAVY=	.07441
CAVX=	.96765	CAVY=	.06861

F(1) = .2050388E-05
 F(2) = -.3558289E-05
 F(3) = -.2871526E-05
 F(4) = -.6844000E-05
 F(5) = -.1556759E-02
 X(1) = .8933603E-03
 X(2) = .1677211E+00
 X(3) = .1719972E+00
 X(4) = .634410E-01
 X(5) = -.1557080E-01

ITERATION NO. = 2

X(1) = .8933603E-03
 X(2) = .1677211E+00
 X(3) = .1719972E+00
 X(4) = .634410E-01
 X(5) = -.1557080E-01

I= 1	BETA2=	-.3141593E+01	XKSI=	.1677228E+00
I= 2	BETA2=	-.3141593E+01	XKSI=	.1677359E+00
I= 3	BETA2=	-.3141593E+01	XKSI=	.1677622E+00
I= 4	BETA2=	-.3141593E+01	XKSI=	.1679014E+00
I= 5	BETA2=	-.3141593E+01	XKSI=	.1678533E+00
I= 6	BETA2=	-.3141593E+01	XKSI=	.1679175E+00
I= 7	BETA2=	-.3141593E+01	XKSI=	.1679937E+00
I= 8	BETA2=	-.3141593E+01	XKSI=	.1680614E+00
I= 9	BETA2=	-.3141593E+01	XKSI=	.1681301E+00
I= 10	BETA2=	-.3141593E+01	XKSI=	.1682892E+00
I= 11	BETA2=	-.3141593E+01	XKSI=	.1684079E+00
I= 12	BETA2=	-.3141593E+01	XKSI=	.1685355E+00
I= 13	BETA2=	-.3141593E+01	XKSI=	.1686713E+00
I= 14	BETA2=	-.3141593E+01	XKSI=	.1688145E+00
I= 15	BETA2=	-.3141593E+01	XKSI=	.1689641E+00

I= 15	BBTAN2=	-.3141593E+01	XKSI=	.1691192E+00
I= 16	BBTAN2=	-.3141593E+01	XKSI=	.1692788E+00
I= 17	BBTAN2=	-.3141593E+01	XKSI=	.1694421E+00
I= 18	BBTAN2=	-.3141593E+01	XKSI=	.1696079E+00
I= 19	BBTAN2=	-.3141593E+01	XKSI=	.1697792E+00
I= 20	BBTAN2=	-.3141593E+01	XKSI=	.1699431E+00
I= 21	BBTAN2=	-.3141593E+01	XKSI=	.1701105E+00
I= 22	BBTAN2=	-.3141593E+01	XKSI=	.1702763E+00
I= 23	BBTAN2=	-.3141593E+01	XKSI=	.1704395E+00
I= 24	BBTAN2=	-.3141593E+01	XKSI=	.1705992E+00
I= 25	BBTAN2=	-.3141593E+01	XKSI=	.1707543E+00
I= 26	BBTAN2=	-.3141593E+01	XKSI=	.1709039E+00
I= 27	BBTAN2=	-.3141593E+01	XKSI=	.1710470E+00
I= 28	BBTAN2=	-.3141593E+01	XKSI=	.1711828E+00
I= 29	BBTAN2=	-.3141593E+01	XKSI=	.1713105E+00
I= 30	BBTAN2=	-.3141593E+01	XKSI=	.1714292E+00
I= 31	BBTAN2=	-.3141593E+01	XKSI=	.1715382E+00
I= 32	BBTAN2=	-.3141593E+01	XKSI=	.1716369E+00
I= 33	BBTAN2=	-.3141593E+01	XKSI=	.1717246E+00
I= 34	BBTAN2=	-.3141593E+01	XKSI=	.1718009E+00
I= 35	BBTAN2=	-.3141593E+01	XKSI=	.1718651E+00
I= 36	BBTAN2=	-.3141593E+01	XKSI=	.1719170E+00
I= 37	BBTAN2=	-.3141593E+01	XKSI=	.1719562E+00
I= 38	BBTAN2=	-.3141593E+01	XKSI=	.1719824E+00
I= 39	BBTAN2=	-.3141593E+01	XKSI=	.1719956E+00
I= 40	BBTAN2=	-.3141593E+01	XKSI=	.1719956E+00

YINT4=	-.0000000000		
SCLN4=	-.0000000000	SCLN4=	-.0000000000
XS20=	.0000007752		
XS20=	.0000007773		
XS20=	.0000007775		
XS20=	.0000007772		
XS20=	.0000007769		
XS20=	.0000007765		
XS20=	.0000007763		
XS20=	.0000007761		
XS20=	.0000007759		
XS20=	.0000007755		
XS20=	.0000007750		
XS20=	.0000007749		
XS20=	.0000007746		
XS20=	.0000007743		
XS20=	.0000007740		
XS20=	.0000007737		
XS20=	.0000007735		
XS20=	.0000007732		
XS20=	.0000007729		
XS20=	.0000007725		
XS20=	.0000007723		
XS20=	.0000007721		
XS20=	.0000007718		
XS20=	.0000007715		
XS20=	.0000007712		
XS20=	.0000007709		
XS20=	.0000007706		
XS20=	.0000007703		
XS20=	.0000007700		
XS20=	.0000007697		
XS20=	.0000007694		
XS20=	.0000007691		
XS20=	.0000007687		
XS20=	.0000007683		
XS20=	.0000007679		
XS20=	.0000007673		
XS20=	.0000007668		
XS20=	.0000007650		

XS20= .0000007578
 P(I,J)= .3472230E+02 -0.5445413E+00 .3233681E+00 0. -0.8780176E+00
 P(I,J)= .1471255E+03 .6847454E+00 -.3967422E+00 -.3905092E+01 .2460039E+00
 P(I,J)= -.5942770E+02 .5783554E+00 -.3018577E+00 .3470013E+00 .1272004E+00
 P(I,J)= -.711355E+02 .4708073E+00 -.2761684E+00 .9135696E+01 .7016071E+00
 P(I,J)= .007515E+01 .5645936E+01 -.5482672E+01 -.1191422E+00 .1412314E-01

BISS2= .03204 YCCC= .96795 YCCC= .06820

CAVX=	0.00000	CAVY=	0.00000
CAVX=	.00103	CAVY=	.00161
CAVX=	.00518	CAVY=	.00495
CAVX=	.01341	CAVY=	.00763
CAVX=	.02882	CAVY=	.01557
CAVX=	.04857	CAVY=	.02268
CAVX=	.07076	CAVY=	.03077
CAVX=	.10222	CAVY=	.03957
CAVX=	.13943	CAVY=	.04871
CAVX=	.18123	CAVY=	.05780
CAVX=	.22011	CAVY=	.06645
CAVX=	.27245	CAVY=	.07436
CAVX=	.31803	CAVY=	.08138
CAVX=	.36417	CAVY=	.08741
CAVX=	.40771	CAVY=	.09249
CAVX=	.44905	CAVY=	.09666
CAVX=	.48793	CAVY=	.10001
CAVX=	.52492	CAVY=	.10265
CAVX=	.55972	CAVY=	.10465
CAVX=	.59200	CAVY=	.10610
CAVX=	.62057	CAVY=	.10706
CAVX=	.64601	CAVY=	.10764
CAVX=	.67490	CAVY=	.10794
CAVX=	.69900	CAVY=	.10773
CAVX=	.72000	CAVY=	.10733
CAVX=	.74400	CAVY=	.10667
CAVX=	.76057	CAVY=	.10579
CAVX=	.78510	CAVY=	.10470
CAVX=	.80379	CAVY=	.10341
CAVX=	.82177	CAVY=	.10193
CAVX=	.83832	CAVY=	.10026
CAVX=	.85439	CAVY=	.09842
CAVX=	.86997	CAVY=	.09639
CAVX=	.88429	CAVY=	.09417
CAVX=	.89829	CAVY=	.09174
CAVX=	.91101	CAVY=	.08907
CAVX=	.92439	CAVY=	.08610
CAVX=	.93752	CAVY=	.08277
CAVX=	.94904	CAVY=	.07890
CAVX=	.95971	CAVY=	.07407
CAVX=	.96730	CAVY=	.06820

F(1)= .1174474E-05
 F(2)= -.1490407E-05
 F(3)= -.1210143E-05
 F(4)= .1180259E-05
 F(5)= .1000015E-03
 X(1)= -.023022E-03
 X(2)= .1474993E+00
 X(3)= .1718105E+00
 X(4)= .4634458E-01
 X(5)= -.1557721E-01

ITERATION NO.= 3

DXFNE. DID NOT CONVERGE WITHIN #M#
 SXSI(1)= .8933522E-03
 SXSI(2)= .1674993E+00
 SXSI(3)= .1718105E+00
 SXSI(4)= .4634458E-01
 SXSI(5)= -.1557721E-01

I= 71 SAMP= 0. XXX= 0. CP= -.3750000E+00 BETAN= 0.

I= 70	SARC=	.2827763E-03	XXX=	.2827763E-03	CP=	.9992645E+00	BETAN= 0.
I= 69	SARC=	.7733153E-03	XXX=	.7733153E-03	CP=	.9707013E+00	BETAN= 0.
I= 68	SARC=	.1418540E-02	XXX=	.1418540E-02	CP=	.9266227E+00	BETAN= 0.
I= 67	SARC=	.2198029E-02	XXX=	.2198029E-02	CP=	.8731072E+00	BETAN= 0.
I= 66	SARC=	.3097978E-02	XXX=	.3097978E-02	CP=	.8309002E+00	BETAN= 0.
I= 65	SARC=	.4187602E-02	XXX=	.4187602E-02	CP=	.7937816E+00	BETAN= 0.
I= 64	SARC=	.5218159E-02	XXX=	.5218159E-02	CP=	.7610091E+00	BETAN= 0.
I= 63	SARC=	.6421755E-02	XXX=	.6421755E-02	CP=	.7318964E+00	BETAN= 0.
I= 62	SARC=	.7711830E-02	XXX=	.7711830E-02	CP=	.7058538E+00	BETAN= 0.
I= 61	SARC=	.9091822E-02	XXX=	.9091822E-02	CP=	.6824023E+00	BETAN= 0.
I= 60	SARC=	.1052613E-01	XXX=	.1052613E-01	CP=	.6611552E+00	BETAN= 0.
I= 59	SARC=	.1204003E-01	XXX=	.1204003E-01	CP=	.6417990E+00	BETAN= 0.
I= 58	SARC=	.1361898E-01	XXX=	.1361898E-01	CP=	.6240741E+00	BETAN= 0.
I= 57	SARC=	.1525733E-01	XXX=	.1525733E-01	CP=	.6077819E+00	BETAN= 0.
I= 56	SARC=	.1695226E-01	XXX=	.1695226E-01	CP=	.5927355E+00	BETAN= 0.
I= 55	SARC=	.1870952E-01	XXX=	.1870952E-01	CP=	.5787927E+00	BETAN= 0.
I= 54	SARC=	.2053555E-01	XXX=	.2053555E-01	CP=	.5658299E+00	BETAN= 0.
I= 53	SARC=	.2233701E-01	XXX=	.2233701E-01	CP=	.5537421E+00	BETAN= 0.
I= 52	SARC=	.2422077E-01	XXX=	.2422077E-01	CP=	.5424392E+00	BETAN= 0.
I= 51	SARC=	.2614389E-01	XXX=	.2614389E-01	CP=	.5318438E+00	BETAN= 0.
I= 50	SARC=	.2810362E-01	XXX=	.2810362E-01	CP=	.5218854E+00	BETAN= 0.
I= 49	SARC=	.3009734E-01	XXX=	.3009734E-01	CP=	.5125144E+00	BETAN= 0.
I= 48	SARC=	.3212263E-01	XXX=	.3212263E-01	CP=	.5036705E+00	BETAN= 0.
I= 47	SARC=	.3417719E-01	XXX=	.3417719E-01	CP=	.4953111E+00	BETAN= 0.
I= 46	SARC=	.3625880E-01	XXX=	.3625880E-01	CP=	.4873964E+00	BETAN= 0.
I= 45	SARC=	.3836559E-01	XXX=	.3836559E-01	CP=	.4798906E+00	BETAN= 0.
I= 44	SARC=	.4049545E-01	XXX=	.4049545E-01	CP=	.4727620E+00	BETAN= 0.
I= 43	SARC=	.4264665E-01	XXX=	.4264665E-01	CP=	.4659820E+00	BETAN= 0.
I= 42	SARC=	.4481748E-01	XXX=	.4481748E-01	CP=	.4595253E+00	BETAN= 0.
I= 41	SARC=	.4700632E-01	XXX=	.4700632E-01	CP=	.4533666E+00	BETAN= 0.
I= 40	SARC=	.4921166E-01	XXX=	.4921166E-01	CP=	.4474917E+00	BETAN= 0.
I= 39	SARC=	.5143207E-01	XXX=	.5143207E-01	CP=	.4418743E+00	BETAN= 0.
I= 38	SARC=	.5366619E-01	XXX=	.5366619E-01	CP=	.4365006E+00	BETAN= 0.
I= 37	SARC=	.5591278E-01	XXX=	.5591278E-01	CP=	.4313545E+00	BETAN= 0.
I= 36	SARC=	.5817055E-01	XXX=	.5817055E-01	CP=	.4264217E+00	BETAN= 0.
I= 35	SARC=	.6043845E-01	XXX=	.6043845E-01	CP=	.4216907E+00	BETAN= 0.
I= 34	SARC=	.6271537E-01	XXX=	.6271537E-01	CP=	.4171480E+00	BETAN= 0.
I= 33	SARC=	.6500032E-01	XXX=	.6500032E-01	CP=	.4127740E+00	BETAN= 0.
I= 32	SARC=	.6729232E-01	XXX=	.6729232E-01	CP=	.4085578E+00	BETAN= 0.
I= 31	SARC=	.6959049E-01	XXX=	.6959049E-01	CP=	.4044535E+00	BETAN= 0.
I= 30	SARC=	.7189384E-01	XXX=	.7189384E-01	CP=	.4003422E+00	BETAN= 0.
I= 29	SARC=	.7420338E-01	XXX=	.7420338E-01	CP=	.3962147E+00	BETAN= 0.
I= 28	SARC=	.7651812E-01	XXX=	.7651812E-01	CP=	.3920704E+00	BETAN= 0.
I= 27	SARC=	.7883805E-01	XXX=	.7883805E-01	CP=	.3879094E+00	BETAN= 0.
I= 26	SARC=	.8116318E-01	XXX=	.8116318E-01	CP=	.3837318E+00	BETAN= 0.
I= 25	SARC=	.8349350E-01	XXX=	.8349350E-01	CP=	.3795375E+00	BETAN= 0.
I= 24	SARC=	.8582902E-01	XXX=	.8582902E-01	CP=	.3753265E+00	BETAN= 0.
I= 23	SARC=	.8816974E-01	XXX=	.8816974E-01	CP=	.3711088E+00	BETAN= 0.
I= 22	SARC=	.9051566E-01	XXX=	.9051566E-01	CP=	.3668844E+00	BETAN= 0.
I= 21	SARC=	.9286678E-01	XXX=	.9286678E-01	CP=	.3626556E+00	BETAN= 0.
I= 20	SARC=	.9522310E-01	XXX=	.9522310E-01	CP=	.3584222E+00	BETAN= 0.
I= 19	SARC=	.9758472E-01	XXX=	.9758472E-01	CP=	.3541843E+00	BETAN= 0.
I= 18	SARC=	.9995164E-01	XXX=	.9995164E-01	CP=	.3499419E+00	BETAN= 0.
I= 17	SARC=	.1.0232386E+00	XXX=	.1.0232386E+00	CP=	.3456950E+00	BETAN= 0.
I= 16	SARC=	.1.0470148E+00	XXX=	.1.0470148E+00	CP=	.3414436E+00	BETAN= 0.
I= 15	SARC=	.1.0708450E+00	XXX=	.1.0708450E+00	CP=	.3371877E+00	BETAN= 0.
I= 14	SARC=	.1.0947292E+00	XXX=	.1.0947292E+00	CP=	.3329273E+00	BETAN= 0.
I= 13	SARC=	.1.1186674E+00	XXX=	.1.1186674E+00	CP=	.3286624E+00	BETAN= 0.
I= 12	SARC=	.1.1426596E+00	XXX=	.1.1426596E+00	CP=	.3243930E+00	BETAN= 0.
I= 11	SARC=	.1.1667058E+00	XXX=	.1.1667058E+00	CP=	.3201191E+00	BETAN= 0.
I= 10	SARC=	.1.1908060E+00	XXX=	.1.1908060E+00	CP=	.3158407E+00	BETAN= 0.
I= 9	SARC=	.1.2149602E+00	XXX=	.1.2149602E+00	CP=	.3115578E+00	BETAN= 0.
I= 8	SARC=	.1.2391684E+00	XXX=	.1.2391684E+00	CP=	.3072704E+00	BETAN= 0.
I= 7	SARC=	.1.2634306E+00	XXX=	.1.2634306E+00	CP=	.3029785E+00	BETAN= 0.
I= 6	SARC=	.1.2877468E+00	XXX=	.1.2877468E+00	CP=	.2986821E+00	BETAN= 0.
I= 5	SARC=	.1.3121170E+00	XXX=	.1.3121170E+00	CP=	.2943812E+00	BETAN= 0.

I= 0	SARC=	.9999999E+00	XXX=	.9999999E+00	CP=	.2470711E+00	BETAN=	0.
I= 4	SARC=	.9593951E+00	XXX=	.9593951E+00	CP=	.2470711E+00	BETAN=	0.
I= 8	SARC=	.9734664E+00	XXX=	.9734664E+00	CP=	.2431766E+00	BETAN=	0.
I= 2	SARC=	.9870866E+00	XXX=	.9870866E+00	CP=	.2495849E+00	BETAN=	0.
I= 1	SARC=	.1000000E+01	XXX=	.1000000E+01	CP=	.2528905E+00	BETAN=	0.

I= 1	SARC2=	0.	XXX2=	.9679643E+00	CP2=	-.3750000E+00	BETAN2=	-.3141593E+01
I= 2	SARC2=	.4442623E-02	XXX2=	.9724645E+00	CP2=	.9968768E+00	BETAN2=	-.3141593E+01
I= 3	SARC2=	.4435246E-02	XXX2=	.9768496E+00	CP2=	.9910322E+00	BETAN2=	-.3141593E+01
I= 4	SARC2=	.1058183E-01	XXX2=	.9735332E+00	CP2=	.9579241E+00	BETAN2=	-.3141593E+01
I= 5	SARC2=	.1226241E-01	XXX2=	.9802567E+00	CP2=	.9370314E+00	BETAN2=	-.3141593E+01
I= 6	SARC2=	.1339302E-01	XXX2=	.9813573E+00	CP2=	.9063011E+00	BETAN2=	-.3141593E+01
I= 7	SARC2=	.1449343E-01	XXX2=	.9824580E+00	CP2=	.8807853E+00	BETAN2=	-.3141593E+01
I= 8	SARC2=	.1557462E-01	XXX2=	.9833391E+00	CP2=	.8561452E+00	BETAN2=	-.3141593E+01
I= 9	SARC2=	.1665600E-01	XXX2=	.9842203E+00	CP2=	.8325175E+00	BETAN2=	-.3141593E+01
I= 10	SARC2=	.1773744E-01	XXX2=	.9849940E+00	CP2=	.8099248E+00	BETAN2=	-.3141593E+01
I= 11	SARC2=	.1881888E-01	XXX2=	.9857478E+00	CP2=	.7883352E+00	BETAN2=	-.3141593E+01
I= 12	SARC2=	.1990032E-01	XXX2=	.9864564E+00	CP2=	.7676506E+00	BETAN2=	-.3141593E+01
I= 13	SARC2=	.2098176E-01	XXX2=	.9871259E+00	CP2=	.7479281E+00	BETAN2=	-.3141593E+01
I= 14	SARC2=	.2197320E-01	XXX2=	.9877624E+00	CP2=	.7289741E+00	BETAN2=	-.3141593E+01
I= 15	SARC2=	.2296464E-01	XXX2=	.9883785E+00	CP2=	.7107617E+00	BETAN2=	-.3141593E+01
I= 16	SARC2=	.2395608E-01	XXX2=	.9889660E+00	CP2=	.6932257E+00	BETAN2=	-.3141593E+01
I= 17	SARC2=	.2494752E-01	XXX2=	.9895322E+00	CP2=	.6763044E+00	BETAN2=	-.3141593E+01
I= 18	SARC2=	.2593896E-01	XXX2=	.9900834E+00	CP2=	.6599401E+00	BETAN2=	-.3141593E+01
I= 19	SARC2=	.2693040E-01	XXX2=	.9906254E+00	CP2=	.6440765E+00	BETAN2=	-.3141593E+01
I= 20	SARC2=	.2792184E-01	XXX2=	.9911642E+00	CP2=	.6286684E+00	BETAN2=	-.3141593E+01
I= 21	SARC2=	.2891328E-01	XXX2=	.9917069E+00	CP2=	.6136617E+00	BETAN2=	-.3141593E+01
I= 22	SARC2=	.2990472E-01	XXX2=	.9922544E+00	CP2=	.5990120E+00	BETAN2=	-.3141593E+01
I= 23	SARC2=	.3089616E-01	XXX2=	.9928059E+00	CP2=	.5846750E+00	BETAN2=	-.3141593E+01
I= 24	SARC2=	.3188760E-01	XXX2=	.9933470E+00	CP2=	.5706070E+00	BETAN2=	-.3141593E+01
I= 25	SARC2=	.3287904E-01	XXX2=	.9938881E+00	CP2=	.5567448E+00	BETAN2=	-.3141593E+01
I= 26	SARC2=	.3387048E-01	XXX2=	.9944292E+00	CP2=	.5431047E+00	BETAN2=	-.3141593E+01
I= 27	SARC2=	.3486192E-01	XXX2=	.9949703E+00	CP2=	.5297166E+00	BETAN2=	-.3141593E+01
I= 28	SARC2=	.3585336E-01	XXX2=	.9955114E+00	CP2=	.5164440E+00	BETAN2=	-.3141593E+01
I= 29	SARC2=	.3684480E-01	XXX2=	.9960525E+00	CP2=	.5027523E+00	BETAN2=	-.3141593E+01
I= 30	SARC2=	.3783624E-01	XXX2=	.9965936E+00	CP2=	.4897372E+00	BETAN2=	-.3141593E+01
I= 31	SARC2=	.3882768E-01	XXX2=	.9971347E+00	CP2=	.4773041E+00	BETAN2=	-.3141593E+01
I= 32	SARC2=	.3981912E-01	XXX2=	.9976758E+00	CP2=	.4654174E+00	BETAN2=	-.3141593E+01
I= 33	SARC2=	.4081056E-01	XXX2=	.9982169E+00	CP2=	.4540221E+00	BETAN2=	-.3141593E+01
I= 34	SARC2=	.4180200E-01	XXX2=	.9987580E+00	CP2=	.4430697E+00	BETAN2=	-.3141593E+01
I= 35	SARC2=	.4279344E-01	XXX2=	.9993000E+00	CP2=	.4324948E+00	BETAN2=	-.3141593E+01
I= 36	SARC2=	.4378488E-01	XXX2=	.9998411E+00	CP2=	.4222300E+00	BETAN2=	-.3141593E+01
I= 37	SARC2=	.4477632E-01	XXX2=	.9999999E+00	CP2=	.4122200E+00	BETAN2=	-.3141593E+01
I= 38	SARC2=	.4576776E-01	XXX2=	.9999999E+00	CP2=	.4024100E+00	BETAN2=	-.3141593E+01
I= 39	SARC2=	.4675920E-01	XXX2=	.9999999E+00	CP2=	.3928000E+00	BETAN2=	-.3141593E+01
I= 40	SARC2=	.4775064E-01	XXX2=	.9999999E+00	CP2=	.3833000E+00	BETAN2=	-.3141593E+01
I= 41	SARC2=	.4874208E-01	XXX2=	.9999999E+00	CP2=	.3739000E+00	BETAN2=	-.3141593E+01

CLINF= .7597406E+00 COINF= .5862158E-01

FINV IS OBTAINED FROM Y-MAXIMUM EQUATION= .7235926E+00

----- COORDS ARE BASED ON OI IN ALPHA DIRECTION-----

COORD= .1024922E+00 COIL= .5468147E+00 L/D= .6313752E+01

---CAVITY SHAPE-----

X= 0.	Y= 0.
X= .102627E-02	Y= .1514021E-02
X= .515236E-02	Y= .4350535E-02
Y= .1340631E-01	Y= .9532170E-02
X= .2681912E-01	Y= .1557418E-01
X= .4555544E-01	Y= .2257773E-01
X= .7076512E-01	Y= .3176794E-01
Y= .102223E+00	Y= .3356877E-01
X= .139433E+00	Y= .4471467E-01
X= .1612317E+00	Y= .5779972E-01
X= .225106E+00	Y= .6644632E-01
X= .272448E+00	Y= .7434398E-01
X= .3138345E+00	Y= .8137602E-01
X= .3541671E+00	Y= .8741290E-01
X= .4077110E+00	Y= .9248590E-01
X= .4490465E+00	Y= .9565685E-01

X=	.9679897E+00	Y=	.1000120E+00
X=	.9245167E+00	Y=	.1026451E+00
X=	.8837022E+00	Y=	.1046471E+00
X=	.8467555E+00	Y=	.1061006E+00
X=	.8135102E+00	Y=	.1070779E+00
X=	.7840133E+00	Y=	.1076411E+00
X=	.7583394E+00	Y=	.1078424E+00
X=	.7355105E+00	Y=	.1077254E+00
X=	.7155005E+00	Y=	.1073255E+00
X=	.6982711E+00	Y=	.1066730E+00
X=	.6836175E+00	Y=	.1057405E+00
X=	.6714471E+00	Y=	.1046000E+00
X=	.6617755E+00	Y=	.1034093E+00
X=	.6544140E+00	Y=	.1021924E+00
X=	.6491170E+00	Y=	.1010204E+00
X=	.6457037E+00	Y=	.9942186E-01
X=	.6439552E+00	Y=	.9839441E-01
X=	.6436725E+00	Y=	.9717272E-01
X=	.6447050E+00	Y=	.9573543E-01
X=	.6471170E+00	Y=	.9406673E-01
X=	.6514361E+00	Y=	.9210344E-01
X=	.6571495E+00	Y=	.8927647E-01
X=	.6640307E+00	Y=	.8549603E-01
X=	.6720711E+00	Y=	.7906642E-01
X=	.6812543E+00	Y=	.6919692E-01

----- DRIFT BY SHAPE -----

X=	0.00000	Y=	0.00000
X=	.02000	Y=	0.00000
X=	.04000	Y=	0.00000
X=	.06000	Y=	0.00000
X=	.08000	Y=	0.00000
X=	.10000	Y=	0.00000
X=	.12000	Y=	0.00000
X=	.14000	Y=	0.00000
X=	.16000	Y=	0.00000
X=	.18000	Y=	0.00000
X=	.20000	Y=	0.00000
X=	.22000	Y=	0.00000
X=	.24000	Y=	0.00000
X=	.26000	Y=	0.00000
X=	.28000	Y=	0.00000
X=	.30000	Y=	0.00000
X=	.32000	Y=	0.00000
X=	.34000	Y=	0.00000
X=	.36000	Y=	0.00000
X=	.38000	Y=	0.00000
X=	.40000	Y=	0.00000
X=	.42000	Y=	0.00000
X=	.44000	Y=	0.00000
X=	.46000	Y=	0.00000
X=	.48000	Y=	0.00000
X=	.50000	Y=	0.00000
X=	.52000	Y=	0.00000
X=	.54000	Y=	0.00000
X=	.56000	Y=	0.00000
X=	.58000	Y=	0.00000
X=	.60000	Y=	0.00000
X=	.62000	Y=	0.00000
X=	.64000	Y=	0.00000
X=	.66000	Y=	0.00000
X=	.68000	Y=	0.00000
X=	.70000	Y=	0.00000
X=	.72000	Y=	0.00000
X=	.74000	Y=	0.00000

X=	.76000	Y=	0.00000
X=	.78000	Y=	0.00000
X=	.80000	Y=	0.00000
X=	.82000	Y=	0.00000
X=	.84000	Y=	0.00000
X=	.86000	Y=	0.00000
X=	.88000	Y=	0.00000
X=	.90000	Y=	0.00000
X=	.92000	Y=	0.00000
X=	.94000	Y=	0.00000
X=	.96000	Y=	0.00000
X=	.98000	Y=	0.00000
X=	1.00000	Y=	0.00000

.1674993E+00 .1714105E+00 .463445PE-01 -.1557721E-01
 .1000000E+00
 .7774504E+00
 .7893901E+00
 .7441414E+00
 .7278010E+00
 .7141310E+00
 .6979005E+00
 .6810000E+00
 .6634287E+00
 .6450000E+00
 .6250000E+00
 .6037377E+00
 .5845900E+00
 .5623269E+00
 .5358061E+00
 .5130000E+00
 .5073790E+00
 .5000000E+00
 .6257282E+00
 .5960016E+00
 .5605000E+00
 .5217242E+00

.4790189E+00 0.
 .4315217E+00 0.
 .3790939E+00 0.
 .3172135E+00 0.
 .2464474E+00 0.
 .1648037E+00 0.
 .7189336E-01 0.
 .6959049E-01 0.
 .6729432E-01 0.
 .6500021E-01 0.
 .6271577E-01 0.
 .6043782E-01 0.
 .5817052E-01 0.
 .5591275E-01 0.
 .5366419E-01 0.
 .5143267E-01 0.
 .4921166E-01 0.
 .4700012E-01 0.
 .4481744E-01 0.
 .4264561E-01 0.
 .4049345E-01 0.
 .3836098E-01 0.
 .3625002E-01 0.
 .3417771E-01 0.
 .3212233E-01 0.
 .3009734E-01 0.
 .2810315E-01 0.
 .2614365E-01 0.
 .2422047E-01 0.
 .2233703E-01 0.
 .2048555E-01 0.
 .1866922E-01 0.
 .1689205E-01 0.
 .1525713E-01 0.
 .1361866E-01 0.
 .1204007E-01 0.
 .1052613E-01 0.
 .9071503E-01 0.
 .7711833E-01 0.
 .6401733E-01 0.
 .5218113E-01 0.
 .4117887E-01 0.
 .3097971E-01 0.
 .2198039E-01 0.
 .1415941E-01 0.
 .7755153E-01 0.
 .2117733E-01 0.
 0.
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 .4442661E-01 -0.3141593E+01
 .3883241E-01 -0.3141593E+01
 .3390003E-01 -0.3141593E+01
 .2929241E-01 -0.3141593E+01
 .2539362E-01 -0.3141593E+01
 .2144936E-01 -0.3141593E+01
 .1837421E-01 -0.3141593E+01
 .1625600E-01 -0.3141593E+01
 .1791972E-01 -0.3141593E+01
 .1778341E-01 -0.3141593E+01
 .1447247E-01 -0.3141593E+01
 .1916150E-01 -0.3141593E+01
 .1979004E-01 -0.3141593E+01
 .2043451E-01 -0.3141593E+01
 .2103172E-01 -0.3141593E+01
 .2182882E-01 -0.3141593E+01
 .2219497E-01 -0.3141593E+01

.22761075-01 -.31415975+01
.23361498-01 -.31415975+01
.23842822-01 -.31415938+01
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.24881572-01 -.31415938+01
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.25883018-01 -.31415938+01
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.26883375-01 -.31415938+01
.27324218-01 -.31415938+01
.27794007-01 -.31415938+01
.28281821-01 -.31415938+01
.28706773-01 -.31415938+01
.29183082-01 -.31415938+01
.29598381-01 -.31415938+01
.30031210-01 -.31415938+01
.30483848-01 -.31415938+01
.30884448-01 -.31415938+01
.31308438-01 -.31415938+01
.31713888-01 -.31415938+01
.32121088-01 -.31415938+01
.32512708-01 -.31415938+01
.32807778-01 -.31415938+01

5.0 LISTING OF PCAS

```

PROGRAM PCAS(INPUT,OUTPUT,TAPE5=INPUT,TAPE6=OUTPUT,TAPE7,TAPE1)
C NONLINEAR PARTIALLY CAVITATING CASCADE CALCULATIONS.
C 5/17/1978 PROGRAMMED BY J. FUKIYA.
  DIMENSION YBE(5),X2(5),BETANC(513),BETAMJ(513),BETAJ2(100)
  DIMENSION SXSI(5),XX(513),CP(513),INT(10),XCP(5),YCP(5)
  DIMENSION FL(200),FD(200),CPC(101),CX2(201),FL2(100),FD2(100)
  COMMON/DELTA0/DELTA(5,5)
  COMMON/THICK/TH
  COMMON/YCCC,SBETA2
  COMMON/XITM(200),XITN(200),ANSG2S(200),SARC2(200)
  COMMON/CAVX(100),CAVY(100),RETA3,BETAC,YCCC,NCAY,LFMM,NS2
  COMMON/AJ(100),ISHARP,NCHBY,BBTAN(100),BBTAN2(100),BETAN2(100)
  COMMON/FLAPAR,DELTA,OGAP,ALFA1,GAMMA
  COMMON/SIGMA,SBETA,XX4,ICPI,SARCO(513)
  COMMON/ICJL,XA,XB,XC,TANG,E?,YC,YR,JBIGS,XLBIGS,BIGS,SMALS,DSS
  COMMON/XSN(5),CCCC,CLE,ERC,YYY,XY,ITERA,CXSIG(5),SYSIG(5),YXS(5)
  COMMON/PSIZ,LP,SARC(513),SARCO(513),LPM,DE
  COMMON/BETAN(513),BETAM(513),IJ,LPK,XII(200),YJJ(200),XX
  COMMON/XROUND,A2AA,s23B,C2CC
  COMMON/AAAA,BBBB,CCCC,AG,BS,CS,DS,TGAJS(100),JGAJS(100),VGAUS
C BETAN-----FOR ARC 1 FOR REGULAR INTEGRAL.
C BBTAN IS FOR INTERPOLATED VERSION OF BETAN.
C BETAN2 FOR EQUALLY SPACED INCREMENT FOR ARC 2.
C BBTAN2 FOR CHEBYCHEV- GAUSS VERSION OF BETAN2.
  PAI=3.141592653
  READ(5,795) NGAJS
  NGAJS1=NGAJS+1
  NNN2=NGAJS/2
  VGAJS2=NNN2+1
  READ(5,560) (TGAUS(I),I=NGAJS2,NGAJS)
  READ(5,560) (JGAUS(I),I=NGAJS2,NGAJS)
  DO 26 IQ=1,NNN2
  TGAUS(IQ)=-TGAUS(NGAJS1-IQ)
  JGAUS(IQ)=JGAUS(NGAJS1-IQ)
  26 WRITE(6,561) (TGAUS(I),I=NGAJS2,NGAJS)
  WRITE(6,562) (JGAUS(I),I=NGAJS2,NGAJS)
560 FORMAT(4F20.10)
561 FORMAT(1X,*T(I)=*,10(F10.8,1X))
  READ(5,590) XX4

  DO 589 IDELTA=1,5
589 READ(5,590) (DELTA(IDELTA,I),I=1,5)
582 FORMAT(1X,**(I)=*,10(F10.8,1X))

  READ(5,560) TH
  READ(5,560) R,AAAA,BBBB,CCCC
  READ(5,560) AG,BB,CB,CS
  READ(5,560) XROUND,A2AA,B2BB,C2CC
  READ(5,795) IFLAG1,NCHBY
  READ(5,1321) SBETA,SBETA2,SF4,BETA3,BETAC
  READ(5,551) LPM,LPS,LPM2,IFLAG,IREAD,ISHARP
  READ(5,201) NITER,MSTCP,MAXIT,VHK
  READ(5,202) ALFAIS,GAMMAS,SJLIS,SIGMS
  READ(5,229) DE,OG,DF
  DO 592 IDELTA=1,5
592 WRITE(6,591) (DELTA(IDELTA,I),I=1,5)

```

```

WRITE (6,5690) TH,XX4
WRITE(6,5651) BETAB,BETAC
WRITE(6,565) A,AAAA,BBBB,CCCC
WRITE(6,566) A6,B6,C6,D6
WRITE(6,567) XROUND,A2AA,d2B,C2CC
WRITE(6,1229) LPMS,PKS,SBETA,IREAD,NCHBY
WRITE(6,1324) DE,DG,JF,SF4
WRITE(6,1521) SBETA2
590 FORMAT (8F10.6)
591 FORMAT (10X,DELTA(I,J)=,5(F10.8,2X))
5690 FORMAT (20X,THICKNESS OF PLANO CONVEX FOIL = ,F10.5,10X,XX"=,
1F10.5)
565 FORMAT(20X,*R=,F5.2,2X,*AAAA=,F10.6,2X,*BBBB=,F10.6,2X,*CCCC=,
XF10.5)
566 FORMAT(20X,*A6=,F10.6,2X,*B6=,F10.6,2X,*C6=,F10.6,2X,*D6=,F10.
X6)
567 FORMAT(20X,*XROUND=,F10.6,2X,*A2AA=,F10.6,2X,*B2BB=,F10.6,2X,*C
X2CC=,F10.6)
C IFLAG1+++++IFLAG=1 FOR THE FIRST RUN & IFLAG=0 FOR PREVIOUS DATA USE.
C IFLAG1=0 FOR REGULAR RUNS, IFLAG1=0 FOR RUNS OF READING DATA FROM CASCLIM.
C IF IFLAG1=0 NEED EXTRA DATA FOR SXSI(2) AND SXSI(3).
795 FORMAT(9I10)
C AAAA,BBBB,CCCC ARE CONSTANTS FOR 2-TERM CAMBER, Y AND SQRT(X)
C -----CALCULATED FROM ANOTHER PROGRAM CALLED *CAMBER-----
C A6,B6,C6 AND D6 ARE COEFFICIENTS FOR POLYNOMIALS FOR X GREATER THAN .9.
C C6D AND C6D6 ARE NO. DUMMY.
C SF4 IS USED FOR DETERMINING WHETHER TO CALCULATE BETA.
1521 FORMAT(5E14.7)
C IFLAG=1 NEEDS DATA CARDS FOR SXSI(I), I=1,5. IREAD MAY BE SET TO 5.
C IF IFLAG=0, DATA WILL BE READ EITHER FROM
C DATA CARD, IF IREAD=5
C TAPE1, IF IREAD=1.
551 FORMAT(10I8)
201 FORMAT(4I8)
202 FORMAT(4E14.7)
C DE,DG,DF ARE THE INCREMENTS FOR DERIVATIVES IN OXFNE.
C DE=1.E-5 & DF=1.E-5 ARE USED BEFORE.
229 FORMAT(3E14.7)
1229 FORMAT(5X,4HLPM=,I4,2X,4HLPK=,I4,2X,6HSBETA=,E14.7,5X,6HIREAD=,I1,
X2X,6HNCHBY=,I3)
5651 FORMAT(20X,*BETAB AND BETAC AS FIRST GUESS=,F10.5,2X,F10.5)
1324 FORMAT(10X,3HDE=,E14.7,2X,3HDG=,E14.7,3HDF=,E14.7,2X,4HSF4=,E14.7)
1521 FORMAT(10X,*SBETA2=,E14.7)
SBETA2=SBETA*PAI/180.
BETAB=BETA5*PAI/180.
BETAC=BETAC*PAI/180.
C LPM1=LPM2+NS2
LPM1=LPM2
NS2=LPM2
LPM1=LPM1+1
WRITE(6,1489) LPM2,ISHARP
1489 FORMAT(10X,*LPM2=,I3,2X,*ISHARP=,E14.7)
C ISHARP=0 FOR SHARP L.E.
C 1 FOR ROUNDED L.E.
SBETA=SBETA*PAI/180.
DO 999 IJKL=1,NITER
C FFF4 IS PROVIDED FROM OXFNEV, BUT IF THE LOOP DOES NOT GO THROUGH
C IT, FFF4 OF PRESET VALUE MUST BE USED.
FFF4=0.
ALFA10=ALFA15

```

```

GAMMAD=GAMMAS
SOLID=SOLIS
SIGMA=SIGMS
IF(NHK.EQ.1) GO TO 240
IF(NHK.EQ.2) GO TO 241
IF(NHK.EQ.3) GO TO 242
SIGMA=SIGMS-0.01*FLOAT(IJKL-1)
GO TO 243
242 SOLID=SOLIS+0.1*FLOAT(IJKL-1)
GO TO 243
241 GAMMAD=GAMMAS+2.*FLOAT(IJKL-1)
GO TO 243
240 ALFA1D=ALFA1S-2.*FLOAT(IJKL-1)
243 CONTINUE
X1=XX1
ALFA1=ALFA1D*PAI/180.
DGAP=1./SOLID
GAMMA=GAMMAD*PAI/180.
DELTA=ALFA1+GAMMA
FLAPAN=C.
WRITE(6,666) ALFA1D,GAMMAD,SOLID
666 FORMAT(1X,16HINCIDENCE ANGLE=,E14.7,1X,6HGAMMA=,E14.7,1X,9HSOLIDIT
XY=,E14.7)
WRITE(6,665) FLAPAN
665 FORMAT(5X,11HFLAP ANGLE=,E14.7)
STOLL=2.E-4
STGLS=5.E-4
ERC=1.E-2
CLE=1.E-4
C CAVIT. NO.=SIGMA, AND PSIZ.
WRITE(6,511) SIGMA
511 FORMAT(10X,11HCAVIT. NO =,E14.7)
CCC1=ALOG(1.+SIGMA)/(2.*PAI)
C SPECIFY HYDROFOILS CHARACTERISTICS AND SEP. POINTS.
XC=0.
YC=0.
XB=0.
XA=1.
WRITE(6,502) XA,XB,XC,YC
502 FORMAT(10X,5HCORD=,E14.7,2X,17HUPPER SEP. POINT=,E14.7,2X,20HCORNY
X. POINT(XC,YC)=(,E14.7,1H,,E14.7,1H))
C START ITERATIVE PROCEDURE.
C -----BASIC FLUX IS THAT OF FLAT PLATE-----
C ITERAT IS INDEX FOR NUMBER OF ITERATIONS.
ITERA=1
IF(IFLAG.EQ.0) ITERA=2
IF(IFLAG.EQ.0) IREAD=1
BIGS=0.
XHIG=0.
XLOW=0.
XINCRT=XA/50.
DO 248 IINC=1,50
XLJW=XHIG-I
XHIG=XLOW+XINCRT
CALL ARCLN(S,XLOW,XHIGH)
248 BIGS=BIGS+S
WRITE(6,504) BIGS
504 FORMAT(10X,5HBIGS=,E14.7)
STOL=1.E-5
LPM=LPM5

```

```

      LPK=LPKS
      LPM=LPM-1
      LPM=LPM-3
C ICPI IS USED FOR CONTROLLING PROGRAM; 0 FOR ITER. 1 FOR THE REST.
C FIND XSIB,XSIC,XSIF,A,ALFA2 BY USING NEWTON,S METHOD.
C SXSI(1)=XSIB
C SXSI(2)=XSIC
C SXSI(3)=XSIF
C SXSI(4)=A WHICH IS THE COEFFT. OF MAPPING FCN.
C SXSI(5)=ALF2
      IF(IJKL.GE.2) GO TO 630
      IF(IFLAG.EQ.0) GO TO 761
C INITIAL GUESS FOR SXSI(I) IS -----
      READ(5,764) SXSI(1),SXSI(2),SXSI(3),SXSI(4),SXSI(5)
      GO TO 160
C THIS IS THE CASE THAT OLD DATA ARE USED WITH PUNCHED CARDS.
761 CONTINUE
      IF(IFLAG1.EQ.0) GO TO 779
      READ(1,620) SXSI(1),SXSI(2),SXSI(3),SXSI(4)
      SXSI(5)=SXSI(3)
      READ(5,778) SXSI(2),SXSI(3)
778 FORMAT(2E14.7)
      GO TO 629
779 READ(IREAD,620) SXSI(1),SXSI(2),SXSI(3),SXSI(4),SXSI(5)
620 FORMAT(5E14.7)
629 DO 621 IC=1,LPM
621 READ(IREAD,622) SARC(IC),BETAN(IC)
622 FORMAT(2E14.7)
      DO 1621 IC=1,LPM1
1621 READ(IREAD,622) SARC2(IC),BETAN2(IC)
      IF(IFLAG.EQ.0) GO TO 490
      GO TO 461
460 DO 462 IBT=1,LPM1
462 BETAN(IBT)=.5*(BETAN(IBT)+BETAN(IBT+1))
461 CONTINUE
160 ICPI=0
      WRITE(6,102) ITERA
102 FORMAT(10X,14HITERATION NO.=',I2)
      DO 450 IRP=1,5
450 SXSI(IRP)=SXSI(IRP)
      IF(ITERA.GE.2) STOL=STOLS
      IF(ITERA.EQ.MSTOP) STOL=STOLL
C
C
C
C
      CALL OXFNEW(SXSI,STOL,MAXIT,ITV,OG,OF,FFF4)
C
C
C
630 CONTINUE
      DO 537 IO1=1,5
      XSR(IO1)=SXSI(IO1)
537 WRITE(6,536) IO1,SXSI(IO1)
536 FORMAT(10X,5HSXSI(',I1,2H)=',E14.7)
      CSPACE=(1.+SXSI(1))/FLOAT(LPK)
      HCSpace=0.5*CSPACE
      FSPACE=CSPACE/FLOAT(LPM-LPK)
      HFSpace=0.5*FSPACE

```



```

        IF (NCP.E..LPMM1) GO TO 682
        Q2 = EXP(AVSG2S(NCP))
        G2 = G2**2
        CP2(NCP) = 1.-G2*UU22
        GO TO 680
681 CP2(NCP) = -SIGMA
        GO TO 680
682 CP2(NCP) = 1.-UU22
680 CONTINUE
C
C
C*****MAIN INSERT 1*****
C
C
        AF4=ABS(FFF4)
        IF(AF4.GE.SF4) GO TO 1135
        GO TO 1134
1135 WRITE(6,1136)
1136 FORMAT(5X,*F(4) IS TOO LARGE TO CALCULATE BETA*)
        STOP
C FIND XXX(XSIP) FIRST.
1134 CONTINUE
        IS1S2=0
C-----FIRST BETA FOR ARC 1-----
        DO 100 LLP=1,LPM
        LP=LPM-LLP+1
        CALL BBBETA(XYA,BETA,IS1S2)
        XXX(LP)=XX
        BETAN(LP)=BETA
        IF(LP.EQ.LPM) BETAB=BETA
        IF(ITERA.LE.MSTJF1) GO TO 100
        WRITE(6,101) LP,SARC(LP),XXX(LP),CP(LP),BETAN(LP)
100 CONTINUE
101 FORMAT(1X,2H1=,I3,1X,5HSARC=,E14.7,1X,4HXXX=,E14.7,1X,3HCP=,E14.7,
        1X,6HBETAN=,E14.7)
C
C
C*****MAIN INSERT 2*****
C
C
C-----BETA FOR ARC S2-----
C          SARC HAS BEEN CALCULATED
C          IN SJBROUTINE DFSIMS AND
C          STORED IN COMMON AREA.
        IS1S2 = 1
        DO 429 LLP=1,LPM1
        LP=LLP
        CALL BBBETA(XXY,BETA,IS1S2)
        IF(LP.EQ.1) BETAC=BETA
        XXX2(LP) = XXY
        BETAN2(LP) = BETA
        IF(ITERA.LE.MSTOPL) GO TO 329
        WRITE(6,239) LP,SARC2(LP),XXX2(LP),CP2(LP),BETAN2(LP)
239 FORMAT(9X,*1=*,I3,1X,*SARC2=*,E14.7,1X,*XXX2=*,
        *E14.7,1X,*CP2=*,E14.7,1X,*BETAN2=*,E14.7)
        329 CONTINUE
        429 CONTINUE
C
C
C*****MAIN INSERT 2*****

```

```

C
C
C*****MAIN INSERT 3*****
C
C
C FIND LIFT AND DRAG.
C-----FIRST CL AND CD FOR S1 PART.
      USID = SIN(DELTA)
      UCOD = COS(DELTA)
      JXB = SXSI(4)*UCOD
      JXB2 = UXB**2
      DO 105 ITK = 1, LPM
      IF(ITK.GT.LPK) GO TO 106
      XPS = -1.*CSPACE*FLOAT(ITK-1)
      GO TO 108
106 XPS = XBET*FSPACE*FLOAT(ITK-LPK)
108 CONTINUE
      UXA = XPS-SXSI(4)*USID
      UXA2 = UXA**2
      PXXP = UCOD/(UXA2+UXB2)
      DJDX = DGAP*PXXP*XPS/PAI
      CCBET1 = COS(BETAN(ITK))
      SIBET1 = SIN(BETAN(ITK))
      DS1DX = -EXP(-XITN(ITK))*DJDX/UJ22
C      S1 IS CALCULATED AT OFSIM2 AS XITN(I).
C      AND STORED IN COMMON.
      IF(XPS.LT.0.) DS1DX = -DS1DX
      XLP1 = DS1DX*CP(ITK)
      FL(ITK) = -XLP1*CCBET1
      FD(ITK) = XLP1*SIBET1
105 CONTINUE
C-----CL AND CD FOR S2 PART.
      VS21=VS2+1
      VS2A=VS2-1
      GAF2 = (SXSI(3)-SXSI(2))/VS2
      DO 338 ITK = 1, NS21
      XRS2 = SXSI(2)+GAP2*(ITK-1)
      JXA = XRS2-SXSI(4)*JSID
      JXA2 = JXA**2
      PXXP = UCOD/(JXA2+UXB2)
      DJDX = DGAP*PXXP*XRS2/PAI
      CCBET2 = -COS(BETAN2(ITK))
      SIBET2 = -SIN(BETAN2(ITK))
      DS2DX = EXP(-ANS2S(ITK))*DJDX/UJ22
C      S2 IS ALREADY CALCULATED AT OFSIM5 AS
C      ANS2S(I), STORED IN COMMON AREA.
      XLP2 = DS2DX*CP2(ITK)
      FL2(ITK) = -XLP2*CCBET2
      FD2(ITK) = XLP2*SIBET2
338 CONTINUE
      SPACE = CSPACE
      CLIFT = 0.5*CSPACE*FL(2)+0.5*FSPACE*FL(LPM1)
      CDKAG = 0.5*CSPACE*FD(2)+0.5*FSPACE*FD(LPM1)
      DO 111 IUA = 2, LPM3, 2
      IF(IUA.GE.LPK) SPACE = FSPACE
      CLIFT = CLIFT+SPACE*(FL(IUA)+4.*FL(IUA+1)+FL(IUA+2))/3.
111 CDKAG = CDKAG+SPACE*(FD(IUA)+4.*FD(IUA+1)+FD(IUA+2))/3.
      DO 321 IUA = 1, NS2A, 2
      CLIFT = CLIFT+GAP2*(FL2(IUA)+4.*FL2(IUA+1)+FL2(IUA+2))/3.
321 CDKAG = CDKAG+GAP2*(FD2(IUA)+4.*FD2(IUA+1)+FD2(IUA+2))/3.

```

```

C-----ADD THE FORCES ON CAVITY PORTIONS.
C   SUBROUTINE XCYC CALCULATES
C   THE POINT ON THE UPPER BLADE PORTION CORRESP. TO THE CAVITY END POINT.
      CXA=XCCC
      CYA=YCCC
      CALL XCYC(XCCCB,YCCCB,CXA,CYA)
      CLIFT = CLIFT+SIGMA*XCCCB
      CDKAG = CDKAG-SIGMA*YCCCB
C-----XCCC AND YCCC ARE THE END POINTS OF CAVITY, CALCULATED IN
C   SUBROUTINE CAVITY
C   STORED IN COMMON.
C
C
C
C.....MAIN INSERT 3 .....
C
C   FIND BINF IN 2-1.
      J2U1=CCS(ALFA1+GAMMA)/COS(SXSI(5)+GAMMA)
      DOWN=CCS(ALFA1+GAMMA)+CCS(SYSI(5)+GAMMA)
      BINF=0.5*SIN(ALFA1+SXSI(5)+2.*GAMMA)/DOWN
      BINF=ATAN(1./BINF)
      AINF=0.5*PI-BINF-GAMMA
C   CDSTAR AND ALSTAR ARE BASED ON VELOCITY AT UPSTREAM INFINITY IN (X,Y).
      CDSTAR=CDKAG
      CLSTAR=CLIFT
      UINF=0.5*SQRT(1.+U2U1**2+2.*U2U1*CCS(ALFA1-SXSI(5)))
      FINF=2.*DGAP*SIN(ALFA1-SYSI(5))/(UINF+CCS(SXSI(5)+GAMMA))
      CLINF=CLSTAR*CCS(AINF)-CDSTAR*SIN(AINF)
      CDINF=CLSTAR*SIN(AINF)+CDSTAR*CCS(AINF)
      CLINF=CLINF/UINF**2
      CDINF=CDINF/UINF**2
      WRITE(6,117) CLINF,CDINF
117 FORMAT(1X,34HCLINF OR CDINF=FORCE/1/2PO.UINF**2,5X,6HCLINF=,E14.7,
      X1X,6HCDINF=,E14.7)
      WRITE(6,116) FINF
116 FORMAT(1X,34HFINF IS OBTAINED FROM MOMENTUM E2V,5HFINF=,E14.7)
      WRITE(6,221)
221 FORMAT(1X,48H---CCLL 3 CCDD ARE BASED ON U1 IN ALFA1 DIRE.---)
      CCLL=CLSTAR*CCS(ALFA1)-CDSTAR*SIN(ALFA1)
      CCDD=CLSTAR*SIN(ALFA1)+CDSTAR*CCS(ALFA1)
      ALDD=CCLL/CCDD
      WRITE(6,191) CCDD,CCLL,ALDD
191 FORMAT(1X,5HCCDD=,E14.7,1X,5HCCLL=,E14.7,1X,4HL/D=,E14.7)
      MSTOP1=MSTOP-1
      IF(ITERA.LE.MSTOP1) GO TO 140
C
C
C.....MAIN INSERT 4 .....
C
C   CAVITY SHAPE.
C   ALREADY CALCULATED IN
C   SUBROUTINE CAVITY.
      WRITE(6,297)
297 FORMAT(2X,7---CAVITY SHAPE-----)
      NCAV1=NCAV+1
      DO 285 KCAV=1,NCAV1,2
285 WRITE(6,286) CAVX(KCAV),CAVY(KCAV)
286 FORMAT(10X,*X=*,E14.7,10X,*Y=*,E14.7)
C

```

CMAIN INSERT 4
 C
 C

```

140 CONTINUE
  XCCC=0.
  YCCC=0.
  WRITE(6,823)
523 FORMAT(//,-----JPPER BOBY SHAPE-----)
  DO 921 ISHP=1,51
    X=.02*(ISHP-1)
    CALL SHAPE (X,Y,BETA,1)
821 WRITE(6,822) X,Y
822 FORMAT(5X,**X**,F10.5,2X,**Y**,F10.5)
  REWIND 7
  WRITE(7,763) SXSI(1),SXSI(2),SXSI(3),SXSI(4),SXSI(5)
763 FORMAT(5E14.7)
  DO 766 IC=1,LPM
  WRITE(7,767) SARC(IC),BETAV(IC)
767 FORMAT(2E14.7)
  DO 1766 IC=1,LPM1
1766 WRITE(7,767) SARC2(IC),BETAV2(IC)
  IF(ITERA.GE.MSTCP) GO TO 999
  LPK1=LPK-1
  SPACE=CSPACE
  HSPACE=HCSPAC
  DO 50 IM=1,LPM1
  IF(IM.EQ.1) GO TO 51
  IF(IM.EQ.LPM1) GO TO 55
  IF(IM.EQ.LPK1) GO TO 97
  IF(IM.EQ.LPK) GO TO 98
  IF(IM.GT.LPK) GO TO 93
  XY=-1.+SPACE*FLOAT(IM-1)+HSPACE
  XZ(1)=-1.+SPACE*FLOAT(IM-2)
  XZ(2)=XZ(1)+SPACE
  XZ(3)=XZ(2)+SPACE
  XZ(4)=XZ(3)+SPACE
  DO TO 99
33 SPACE=FSPACE
  -SPACE=HFSPAC
  XY=XBET+HSPACE+SPACE*FLOAT(IM-LPK)
  XZ(1)=XFEI+SPACE*FLOAT(IM-LPK-1)
  XZ(2)=XZ(1)+SPACE
  XZ(3)=XZ(2)+SPACE
  XZ(4)=XZ(3)+SPACE
99 DO 56 IK=1,4
56 YBE(IK)=BETAN(IM+IK-2)
  BETAN(IM)=ALTKEN(XZ,YBE,XY,3)
  GO TO 151
97 BETAN(LPK1)=0.5*(BETAN(LPK1)+BETAN(LPK))
  GO TO 151
98 BETAN(LPK)=0.5*(BETAN(LPK)+BETAN(LPK+1))
  GO TO 151
51 BETAN(1)=0.5*(BETAN(1)+BETAN(2))
  GO TO 151
55 BETAN(LPM1)=0.5*(BETAN(LPM1)+BETAN(LPM))
151 CONTINUE
50 CONTINUE
  IF(ITERA.EQ.1) GO TO 6
  DO 41 IE=1,LPM

```

```

41 BETAN(IE)=BETAN(IE)*(1.-XXM)+BETANO(IE)*XXM
DO 42 IFG=1,LPM1
42 BETAM(IFG)=BETAM(IFG)*(1.-XXM)+BETA10(IFG)*XXM
DO 425 IFG=1,LPM1
425 BETAN2(IFG) = BETAN2(IFG)*(1.-XXM)+BETA02(IFG)*XXM
DO 452 IKP=1,5
852 SXSI(IRP)=SXSI(IRP)*(1.-XXM)+SXSID(IRP)*XXM
6 ITERA=ITERA+1
IF(ITERA.GT.MSTOP) GO TO 28
GO TO 16C
28 WRITE(6,29)
29 FORMAT(5X,26HITERATION WAS TERMINATED.)
999 CONTINUE
STOP
END

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SUBROUTINE DXFNEW(X,STDL,M,I,JG,DF,FFF4)
DIMENSION F(5),P(50,5),X(5),Z(5,5),KRI(5),XMMI(5)
COMMON/DELTA0/DELTA(5,5)
COMMON YCCC,SBETA2
COMMON XITN(200),XITN(200),AMSG2S(200),SARC2(200)
COMMON CAVX(100),CAVY(100),BETAB,BETAC,XCCC,NCV,LPM,VS2
COMMON AJ(100),ISHARP,NCHBY,BBTAN(100),BBTAN2(100),BETAN2(100)
COMMON FLAPAN,DELTA,DGAP,ALFA1,GAMMA
COMMON SIGMA,SEETA,KXM,ICPI,SARCO(513)
COMMON IDJL,XA,XB,XC,TANG,EP,YC,YR,JSIGS,XLBIGS,BIGS,SMALS,DSS
COMMON XSY(5),CCC1,CLE,ERC,YYY,XM,ITERA,SXSIO(5),SXSIO(5),YXS(5)
COMMON PSIZ,LP,SARC(513),SARCO(513),LPM,DE
COMMON BETAN(513),BETAM(513),IJ,LPK,XII(200),XJJ(200),XDX
COMMON XRCJND,A2AA,B2BB,C2CC
COMMON AAAA,BBBB,CCCC,AB,BB,CC,DD,TGAUS(100),WGAUS(100),NGAUS
PAI=3.141592653
I=0
IF(ITERA.LE.3) GO TO 272
DO 67 IJ=1,5
57 WRITE(6,65) IJ,X(IJ)
65 FORMAT(1X,24X(,I1,24)=,E14.7)
272 CONTINUE
35 SI1=2.*DE
SI1=2.*DG
IF(X(1).LT.SI1) X(1)=SI1
SI10=X(1)+2.*DG
IF(X(2).LT.SI10) X(2)=SI10
SI11=X(2)+2.*DG
IF(X(3).LT.SI11) X(3)=SI11
IF(X(4).LT.SI1) X(4)=SI1
SI5=(0.5*PAI-GAMMA)*(1.-0.02)
IF(X(5).LT.SI5) GO TO 78
IF(X(5).GT.SI5) X(5)=SI5
GO TO 79
78 IF(ABS(X(5)).GT.SI5) X(5)=-SI5
79 CONTINUE
DO 58 IJ=1,5
58 WRITE(6,66) IJ,X(IJ)
IJ=1
C-----F(1)-----
DO 20 IK=1,5
20 YXS(IK)=X(IK)
5 CONTINUE
KCIRL = 1

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C      CALL FIINTL(YINT1,KCTRL)
SUBROUTINE FIINTL CALCULATES THE INTEGRALS IN F(1).
KCTRL = 2
CALL FIINTL (Y1,T2,KCTRL)
KCTRL = 3
CALL FIINTL (YINT3,KCTRL)
KCTRL = 4
CALL FIINTL (YINT4,KCTRL)
CS1 = ALG(COS(YXS(5)+GAMMA)/COS(ALFA1+GAMMA))
IF(10.EQ.1) WRITE(6,423) YINT4
423 FORMAT(1X,'YINT4=',F20.10)
FA = -(Y1/T1/PAI+YINT2-(CCCC1+CS1/PAI)+YINT3
1+YINT4/PAI-YXS(5))
IF (10.EQ.1) F(1) = FA
IF (10.EQ.2) GO TO 3
IF (10.EQ.3) GO TO 4
IF (10.EQ.4) GO TO 320
IF (10.EQ.5) GO TO 321
IF (10.EQ.6) GO TO 322
IF(10.EQ.66) GO TO 3222
P(1,5) = TAN(YXS(5)+GAMMA)+YINT3/PAI-1.
IU = 2
YXS(1) = X(1)+DELT(1,1)
GO TO 5
3 F1P = -FA
IU = 3
YXS(1) = X(1)-DELT(1,1)
GO TO 5
4 F1G = -FA
P(1,1) = (F1P-F1G)/(2.*DELT(1,1))
IU = 4
YXS(1) = X(1)
YXS(2) = X(2)+DELT(1,2)
GO TO 5
320 F1P = -FA
YXS(2) = X(2)-DELT(1,2)
IU = 5
GO TO 5
321 F1G = -FA
P(1,2) = (F1P-F1G)/(2.*DELT(1,2))
YXS(2) = X(2)
YXS(3) = X(3)+DELT(1,3)
IU = 6
GO TO 5
322 F1P = -FA
IU=66
YXS(3)=X(3)-DELT(1,3)
GO TO 5
3222 F1G=-FA
P(1,3) = (F1P-F1G)/(2.*DELT(1,3))
P(1,4) = 0.
C-----F(2) AND F(3)-----
IU=7
DO 30 IY=1,5
30 YXS(IY)=X(IY)
IU = 7
330 CONTINUE
YKKY = ALG(COS(ALFA1+GAMMA)/COS(YXS(5)+GAMMA))
XX1 = YXS(4)*SIN(DELTA)
YY1 = YXS(4)*COS(DELTA)

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YY12=YY1**2
CON1 = CCC1-XKXX/PAI
XRR = 0.
XMM = 0.
DO 331 M1Q = 1,4
CALL XMINT(SOLNR,SOLNM,M1Q)
XRR1(M1Q) = SOLNR
XMM1(M1Q) = SOLNM
XRRR = -XRR1(M1Q)/PAI
XMMM = -XMM1(M1Q)/PAI
IF (M1Q.EQ.1) XRRR = CON1*XRR1(M1Q)
IF (M1Q.EQ.1) XMMM = CON1*XMM1(M1Q)
IF (M1Q.EQ.4) XRRR = -XRR1(M1Q)
IF (M1Q.EQ.4) XMMM = -XMM1(M1Q)
IF (M1Q.EQ.3.AND.IJ.EQ.7) WRITE(6,425) SOLNR,SOLNM
425 FORMAT(1X,'SOLNR=',F20.10,2X,'SOLNM=',F20.10)
XRR = XRR+XRRR
XMM = XMM+XMMM
351 CONTINUE
C-----CALCULATION OF H1(ZETA1)-----
XSIP1 = XX1+1.
XSIMB = XX1-YXS(1)
XSIMF = XX1-YXS(3)
XSIMC = XX1-YXS(2)
XSIP12 = XSIP1**2
XSIMB2 = XSIMB**2
XSIMF2 = XSIMF**2
XSIMC2 = XSIMC**2
KRA = SQRT(XSIP12+YY12)
RRB = SQRT(XSIMB2+YY12)
RRC = SQRT(XSIMF2+YY12)
PRD = SQRT(XSIMC2+YY12)
TH1A = ATAN(YY1/XSIP1)
IF (XSIP1.LE.0.) TH1A = PAI+TH1A
TH1B = ATAN(YY1/XSIMB)
IF (XSIMB.LE.0.) TH1B = PAI+TH1B
TH1C = ATAN(YY1/XSIMF)
IF (XSIMF.LE.0.) TH1C = PAI+TH1C
TH1D = ATAN(YY1/XSIMC)
IF (XSIMC.LE.0.) TH1D = PAI+TH1D
RR1 = SQRT(RRA+RRE+RRC/PRD)
TH1I1 = .5*(TH1A+TH1B+TH1C-TH1D)
COT41 = COS(TH1I1)
SITH1 = SIN(TH1I1)
F2C0 = RR1*(XRR+COT41-XMM*SITH1)-ALFA1
F3C0 = RR1*(XRR*SITH1+XMM*COT41)+YKXX
IF (IJ.EQ.7) F(2) = -F2C0
IF (IJ.EQ.7) F(3) = -F3C0
IF (IJ.EQ.8) GO TO 340
IF (IJ.EQ.9) GO TO 341
IF (IJ.EQ.10) GO TO 342
IF (IJ.EQ.11) GO TO 343
IF (IJ.EQ.12) GO TO 344
IF (IJ.EQ.13) GO TO 345
IF (IJ.EQ.14) GO TO 346
IF (IJ.EQ.15) GO TO 347
TA25 = TAN(YXS(5)+GAMMA)
P(2,5) = -RR1*TA26*(XRR1(1)*COTH1-XMM1(1)*SITH1)
P(2,5) = P(2,5)/PAI
P(3,5) = -RR1*TA26*(XRR1(1)*SITH1+XMM1(1)*COTH1)

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P(3,5) = P(3,5)/PAI+TA2G
IJ = 8
YXS(1) = X(1)*DELTA(1,2)
GO TO 330
340 FP2 = F2C0
FP3 = F3C0
IJ = 9
YXS(1) = X(1)-DELTA(2,1)
GO TO 330
341 P(2,1) = (FP2-F2C0)/(2.*DELTA(2,1))
P(3,1) = (FP3-F3C0)/(2.*DELTA(2,1))
YXS(1) = X(1)
YXS(2) = X(2)+DELTA(2,2)
IJ = 10
GO TO 330
342 FP2 = F2C0
FP3 = F3C0
YXS(2) = X(2)-DELTA(2,2)
IJ=11
GO TO 330
343 P(2,2) = (FP2-F2C0)/(2.*DELTA(2,2))
P(3,2) = (FP3-F3C0)/(2.*DELTA(2,2))
YXS(2) = X(2)
YXS(3) = X(3)+DELTA(2,3)
IJ = 12
GO TO 330
344 FP2 = F2C0
FP3 = F3C0
YXS(3) = X(3)-DELTA(2,3)
IJ = 13
GO TO 330
345 P(2,3) = (FP2-F2C0)/(2.*DELTA(2,3))
P(3,3) = (FP3-F3C0)/(2.*DELTA(2,3))
YXS(4) = X(4)+DELTA(2,4)
YXS(3)=X(3)
IJ=14
GO TO 330
346 FP2=F2C0
FP3=F3C0
YXS(4) = X(4)-DELTA(2,4)
IJ = 15
GO TO 330
347 P(2,4) = (FP2-F2C0)/(2.*DELTA(2,4))
P(3,4) = (FP3-F3C0)/(2.*DELTA(2,4))
YXS(4)=X(4)
C-----F(4)-----
IJ=16
YXS(1)=X(1)+DELTA(4,1)
199 CALL OFSIN2(ANS2)
IF(IJ.EQ.18) GO TO 675
IF(IJ.EQ.16) GO TO 613
IF(IJ.EQ.17) GO TO 614
IF(IJ.EQ.19) GO TO 615
IF(IJ.EQ.20) GO TO 616
IF(IJ.EQ.21) GO TO 617
IF(IJ.EQ.22) GO TO 618
IF(IJ.EQ.23) GO TO 621
IF(IJ.EQ.24) GO TO 622
IF(IJ.EQ.25) GO TO 623
IF(IJ.EQ.26) GO TO 624

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613 ANSP=ANS2
    IJ=17
    YXS(1)=X(1)-DELT(4,1)
    GO TO 199
614 ANSG=ANS2
    IJ=18
    P(4,1)=- (ANSP-ANSG)/(2.*DELT(4,1))
    YXS(1)=X(1)
    GO TO 199
675 ANSF=ANS2
    F(4)=- (BIGS-ANSF)
    IJ=19
    YXS(2)=X(2)+DELT(4,2)*AES(X(2))
    GO TO 199
615 ANSPP=ANS2
    IJ=20
    YXS(2)=X(2)-DELT(4,2)*ABS(X(2))
    GO TO 199
616 ANSGG=ANS2
    P(4,2)=- (ANSPP-ANSQG)/(2.*DELT(4,2)*ABS(X(2)))
    YXS(2)=X(2)
    IJ=21
    YXS(3)=X(3)+DELT(4,3)*X(3)
    GO TO 199
617 ANS1P=ANS2
    IJ=22
    YXS(3)=X(3)-DELT(4,3)*X(3)
    GO TO 199
618 ANS1Q=ANS2
    P(4,3)=- (ANS1P-ANS1Q)/(2.*DELT(4,3)*X(3))
    YXS(3)=X(3)
    IJ=23
    YXS(4)=X(4)+DELT(4,4)*ABS(X(4))
    GO TO 199
621 ANA=ANS2
    IJ=24
    YXS(4)=X(4)-DELT(4,4)*ABS(X(4))
    GO TO 199
622 ANB=ANS2
    P(4,4)=- (ANA-ANB)/(2.*DELT(4,4)*ABS(X(4)))
    YXS(4)=X(4)
    IJ=25
    YXS(5)=X(5)+DELT(4,5)
    GO TO 199
623 ANVA=ANS2
    IJ=26
    YXS(5)=X(5)-DELT(4,5)
    GO TO 199
624 ANVB=ANS2
    P(4,5)=- (ANVA-ANVB)/(2.*DELT(4,5))
    YXS(5)=X(5)
    FFF4=F(4)
    YXS(5) = X(5)
C F(5).
C FIRST CALCULATE THE PHYSICAL COORDINATES
C FOR THE END POINT OF CAVITY.
C THIS SUBROUTINE FINDS THE END POINT OF VACITY.
    IJ = 27
615 CALL CAVITY (XCEND,YCEND)
C THEN FIND S2- THE ARC LENGTH OF THE SECOND WETTED PORTION.

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C CALL SUBROUTINE ARCS2 FOR THIS PURPOSE.
  CALL APC2 (S2,XCEND,YCEND)
  IF(IJ.EQ.27) BIGS2=S2
C FINALLY GO INTO F(5) COMPUTATIONS.
  CALL OFSIM5(ANS5)
  IF(IJ.EQ.27) GO TO 820
  IF(IJ.EQ.29) GO TO 821
  IF (IJ.EQ.29) GO TO 822
  IF (IJ.EQ.30) GO TO 823
  IF (IJ.EQ.31) GO TO 824
  IF (IJ.EQ.32) GO TO 825
  IF (IJ.EQ.33) GO TO 826
  IF (IJ.EQ.34) GO TO 827
  IF(IJ.EQ.34) GO TO 830
  IF (IJ.EQ.35) GO TO 828
  IF (IJ.EQ.36) GO TO 829
820 F(5) = -(S2-ANS5)
  IJ = 28
  YXS(1) = X(1)+DELT(5,1)
  GO TO 815
821 ANP = ANS5-S2
  IJ = 29
  YXS(1) = X(1)-DELT(5,1)
  GO TO 815
822 P(5,1) = -(ANP-(ANS5-S2))/(2.*DELT(5,1))
  YXS(1) = X(1)
  YXS(2) = X(2)+DELT(5,2)*ABS(X(2))
  IJ = 30
  GO TO 815
823 ANP = ANS5-S2
  YXS(2) = X(2)-DELT(5,2)*ABS(X(2))
  IJ = 31
  GO TO 815
824 P(5,2) = -(ANP-(ANS5-S2))/(2.*DELT(5,2)*ABS(X(2)))
  YXS(2) = X(2)
  IJ = 32
  YXS(3) = X(3)+DELT(5,3)*X(3)
  GO TO 815
825 ANP = ANS5-S2
  YXS(3) = X(3)-DELT(5,3)*X(3)
  IJ = 33
  GO TO 815
826 P(5,3) = -(ANP-(ANS5-S2))/(2.*DELT(5,3)*X(3))
  IJ = 34
  YXS(3) = X(3)
  YXS(4) = X(4)+DELT(5,4)*ABS(X(4))
  GO TO 815
827 ANP = ANS5-S2
  YXS(4) = X(4)-DELT(5,4)*ABS(X(4))
  IJ=341
  GO TO 815
830 CONTINUE
  P(5,4) = -(ANP-(ANS5-S2))/(2.*DELT(5,4)*ABS(X(4)))
  YXS(4) = X(4)
  YXS(5) = X(5)+DELT(5,5)
  IJ = 35
  GO TO 815
828 ANP = ANS5-S2
  YXS(5) = X(5)-DELT(5,5)
  IJ = 36

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      GO TO 815
229 P(5,5) = -(ANP-(ANS5-S2))/(2.*DELT(5,5))
      DO 666 IK=1,5
666 WRITE(6,667) (P(IK,J),J=1,5)
667 FORMAT(5X,*,P(I,J)=*,5(E14.7,2X))
      WRITE(6,251) BIGS2,YCCC,YCCC
251 FORMAT(20X,*,BIGS2=*,F10.5,2X,*,XCCC=*,F10.5,2X,*,YCCC=*,F10.5)
      VCAV1=VCAV+1
      DO 253 ICV=1,NCAV1,2
253 WRITE(6,252) CAVX(ICV),CAVY(ICV)
252 FORMAT(10X,*,CAVX=*,F10.5,5X,*,CAVY=*,F10.5)
      DO 129 IIX=1,5
129 WRITE(6,131) ITX,F(ITX)
131 FORMAT(1X,2HP(,I1,24)=,E14.7)
      DO 132 IUP=1,5
      IF(ITERA.LE.3) GO TO 365
      DO 132 IUQ=1,5
132 WRITE(6,133) IUP,IUQ,P(IUP,IUQ)
133 FORMAT(1X,2HP(,I1,14,,I1,24)=,E14.7)
395 CONTINUE
      CALL DETERM(P,5,DET30)
      DO 25 IDET=1,5
      DO 26 LPG=1,5
      Q(LPG,IDET)=P(LPG,IDET)
26 P(LPG,IDET)=F(LPG)
      CALL DETERM(P,5,DETE)
      IF(IDET.EQ.1) DELB=DETE/DET30
      IF(IDET.EQ.2) DELC=DETE/DET30
      IF(IDET.EQ.3) DELD=DETE/DET30
      IF(IDET.EQ.4) DELE=DETE/DET30
      IF(IDET.EQ.5) DELF=DETE/DET30
      DO 27 LPG=1,5
27 P(LPG,IDET)=Q(LPG,IDET)
25 CONTINUE
      X(1)=X(1)+DELB
      X(2)=X(2)+DELC
      X(3)=X(3)+DELD
      X(4)=X(4)+DELE
      X(5)=X(5)+DELF
      DO 60 LMN=1,5
60 WRITE(6,61) LMN,X(LMN)
61 FORMAT(1X,2HX(,I1,24)=,E14.7)
      ABSB=ABS(DELB/X(1))
      ABSC=ABS(DELC/X(2))
      ABSD=ABS(DELD/X(3))
      ABSE=ABS(DELE/X(4))
      ABSF=ABS(DELF/X(5))
      KEIO=0
      IF(ABSB.LT.STOL) KEIO=1
      IF(ABSC.GT.STOL) KEIO=0
      IF(ABSD.GT.STOL) KEIO=0
      IF(ABSE.GT.STOL) KEIO=0
      IF(ABSF.GT.STOL) KEIO=0
      IF(KEIO.EQ.1) GO TO 35
      I=I+1
      WRITE(6,42) I
42 FORMAT(20X,14HITERATION NO.=,I2)
      IF(I.EQ.M) GO TO 35
      GO TO 55
35 IF(I.EQ.M) GO TO 36

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SUBROUTINE OFSIM1(ANS,NOF,XCA)
DIMENSION XST(5)
COMMON YCCC,SBETA2
COMMON XITM(200),XITN(200),ANSG2S(200),SARC2(200)
COMMON CAVX(100),CAVY(100),BETA3,BETAC,XCCC,NCAV,LPM,NS2
COMMON AJ(100),ISHARP,NCHBY,BBTAN(100),BBTAN2(100),BETAN2(100)
COMMON FLAPAN,DELTA,OGAP,ALFA1,GAMMA
COMMON SIGMA,SBETA,XXM,ICPI,SARCO(513)
COMMON ICUL,XA,XB,XC,TANG,EP,YC,YR,JBIGS,XLBIGS,BIGS,SMALS,DSS
COMMON XSN(5),CCCC,CLE,ERC,YYY,XM,ITERA,SXSIO(5),SXSIO(5),YXS(5)
COMMON PSIZ,LP,SARC(513),SARCO(513),LPM,CE
COMMON BETAN(513),BETAM(513),IJ,LPK,XII(200),XJJ(200),XDX
COMMON XROUNO,A2AA,B2BB,C2CC
COMMON AAAA,BBBB,CCCC,AB,BB,CB,DB,TGAUS(100),JGAUS(100),NGAUS
C   NOF = 0 CALLED FROM FIINT.
C   NOF = 1 CALLED FROM RMINT FOR REAL PART.
C   NOF = 2 CALLED FROM RMINT FOR IMAG. PART.
C   NOF = 3 CALLED FROM CAVITY OXFNEW AT F(5)
IF (ICPI.EQ.0) GO TO 9
DO 10 IJ = 1,5
10 XST(IJ) = XSN(IJ)
GO TO 12
9 DO 11 IH = 1,5
11 XST(IH) = YXS(IH)
12 CONTINUE
IF(ITERA.EQ.1) GO TO 222
GO TO 223
222 DO 224 ILK = 1,LPM
224 BETAN(ILK) = SBETA
223 CONTINUE
CSPACE = (1.+XST(1))/FLOAT(LPK)
FSPACE = CSPACE/FLOAT(LPM-LPK)
LPM3=LPM-3
XSET = -1.+CSPACE*FLOAT(LPK-1)
XSI1=-1.+CSPACE
BE1 = BETAN(2)
AP1 = (XSI1-XST(2))/((XSI1+1.)*(XST(1)-XSI1)*(XSI1-XST(3)))
AP1S = SQRT(AP1)
F3 = BE1*AP1S
XX1 = XST(4)*SIN(DELTA)
YY1 = XST(4)*COS(DELTA)
YY12 = YY1**2
PLM = XSI1 -XX1
PLM2 = PLM**2
PLMA = PLM2+YY12
PXS = PLM/PLMA
PXSI = YY1/PLMA
IF(NOF.EQ.1) F3 = F3*PXS
IF(NOF.EQ.2) F3 = F3*PXSI
IF(NOF.EQ.3) F3=F3/(XSI1-XCA)
ANSA=0.
DO 1 I = 2,LPM3*2
F1 = F3
SPACE = CSPACE
IF (I.GE.LPK) GO TO 30
XSI2 = -1.+SPACE*FLOAT(I)
XSI3 = XSI2+SPACE
GO TO 31
30 SPACE = FSPACE
XSI2 = XBET+SPACE*FLOAT(I-LPK+1)

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```
GO TO 38
36 WRITE(6,37)
37 FORMAT(1X,3+HOXFNEW DID NOT CONVERGE WITHIN 144)
  IF(X(1).LT.SI1) X(1)=SI1
  SI10=X(1)+2.*DG
  IF(X(2).LT.SI10) X(2)=SI10
  SI11=X(2)+2.*DG
  IF(X(3).LT.SI11) X(3)=SI11
  IF(X(4).LT.SI6) X(4)=SI6
  SI5=(0.5*PA1-GAMMA)*(1.-0.32)
  IF(X(5).LT.0.) GO TO 91
  IF(X(5).GT.SI5) X(5)=SI5
  GO TO 82
91 IF(ABS(X(5)).GT.SI5) X(5)=-SI5
92 CONTINUE
99 RETURN
END
```

vv

```

XSI3 = XSI2+SPACE
31 BE2 = BETAN(I+1)
BE3 = BETAN(I+2)
AP2 = (XSI2-XST(2))/((XSI2+1.)*(XST(1)-XSI2)*(XSI2-XST(3)))
AP3 = (XSI3-XST(2))/((XSI3+1.)*(XST(1)-XSI3)*(XSI3-XST(3)))
AP2S = SQR(A*2)
AP3S = SQR(A*3)
F2 = BE2*AP2S
F3 = BE3*AP3S
HA2 = XSI2-XX1
HA22 = HA2**2
HB = HA22+YY12
HCR2 = HA2/HB
HCI2 = YY1/HB
HA3 = XSI3-XX1
HA32 = HA3**2
HD=HA32+YY12
HCR3 = HA3/HD
HCI3 = YY1/HD
IF(NOF.EQ.1) F2 = F2+HCR2
IF(NOF.EQ.1) F3 = F3+HCR3
IF (NOF.L3.2) F2 = F2+HCI2
IF(NOF.EQ.2) F3 = F3+HCI3
IF (NOF.L3.3) F2 = F2/(XSI2-XCA)
IF(NOF.EQ.3) F3 = F3/(XSI3-XCA)
FSUM = (F1+4.*F2+F3)*SPACE/3.
ANSA = ANSA+FSUM
1 CONTINUE
SG1 = SQR((-1.-XST(2))/(-1.-XST(3)))
SQ2 = SQR(XST(1)+1.)
SQ3 = SQR((XST(1)-XST(2))/(XST(1)-XST(3)))
ANT1 = BETAN(1)*2.*SQR(CSPACE)*SQ1/SQ2
ANT2 = BETAN(LPM)*2.*SQR(FSPACE)*SQ3/SQ2
APLA = -1.-XX1
APLA2 = APLA**2
APLB = XST(1)-XX1
APLB2 = APLB**2
IF(NOF.EQ.1) ANT1 = ANT1*APLA/(APLA2+YY12)
IF (NOF.EQ.1) ANT2 = ANT2*APLB/(APLB2+YY12)
IF (NOF.EQ.2 ) ANT1 = ANT1+YY1/(APLA2+YY12)
IF (NOF.EQ.2) ANT2 = ANT2+YY1/(APLB2+YY12)
IF (NOF.EQ.3) ANT1 = ANT1/(-1.-XCA)
IF (NOF.EQ.3) ANT2 = ANT2/(XST(1)-XCA)
ANS = ANSA+ANT1+ANT2
RETURN
END
SUBROUTINE OFSIM2(ANS2)
DIMENSION X(3),XIT(3),YY(3),XITC(3),EXU(3),FCN3(3),XST(5)
COMMON YCCC,SBETA2
COMMON XITH(200),XITV(200),ANS2S(200),SARC2(200)
COMMON CAVX(100),CAVY(100),BETAB,BETAC,XCCC,NCAY,LPM,NS2
COMMON AJ(100),ISHARP,NCBY,BBTAN(100),BBTAV2(100),BETAV2(100)
COMMON FLAPAN,DELTA,DGAP,ALFA1,GAMMA
COMMON SIGMA,SBETA,XXM,ICPI,SARCO(513)
COMMON INUL,XA,XB,XC,TANG,EP,YP,YR,JBIGS,XLBIGS,BIGS,SMALS,DSS
COMMON XSN(5),CCC1,CLE,ERC,YYY,XX,ITERA,SXSIO(5),SXSIOO(5),YXS(5)
COMMON PSIZ,LP,SARC(513),SARCO(513),LPM,DF
COMMON BETAN(513),BETAM(513),IJ,LPK,XII(200),XJJ(200),XOX
COMMON XRDJND,A2AA,B2BB,C2CC
COMMON AAAA,BBBB,CCCC,AA,BB,CC,DD,TGAUS(100),GAUS(100),N6AUS

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DO 13 I6=1,5
13 XST(I6)=YXS(I6)
PAI=3.141592653
UU2=COS(ALFA1+GAMMA)/COS(XST(5)+GAMMA)
XXX=ALOG(UJ2)
CSPACE=(1.+XST(1))/FLOAT(LPK)
HCSPAC=0.5*CSPACE
FSPACE=CSPACE/FLOAT(LPM-LPK)
HFSPAC=0.5*FSPACE
XBET=-1.+CSPACE*FLOAT(LPK-1)
CDE=COS(DELTA)
SDE=SIN(DELTA)
GA=XST(1)-XST(4)*SDE
GB=XST(4)*CDE
PPP=CDE/(GA**2+GB**2)
FCN3(3)=DGAP+PPP*XST(1)/(PAI*SQRT(1.+SIGMA))
LPKI=LPM-LPK+1
DO 1 IP=1,LPM
IF(IP.EQ.1) GO TO 2
HSPACE=HFSPAC
SPACE=FSPACE
IF(IP.GT.LPK) GO TO 30
X(1)=XST(1)-SPACE*FLOAT(IP-2)
X(2)=X(1)-HSPACE
X(3)=X(1)-SPACE
GO TO 31
30 HSPACE=HCSPAC
SPACE=CSPACE
X(1)=XBET-SPACE*FLOAT(IP-LPK+1)
X(2)=X(1)-HSPACE
X(3)=X(1)-SPACE
31 FCN3(1)=FCN3(3)
NK=3
IF(IP.EQ.LPM) NK=2
DO 3 I=2,NK
IF(IJ.GE.23) GO TO 3
GO TO 7
3 IF(I.EQ.2) XIT(2)=XITN(LPM-IP+1)
IF(I.EQ.3) XIT(3)=XITN(LPM-IP+1)
GO TO 5
7 CONTINUE
YY(I)=X(I)
C OFSIM3 CALCULATE G1 .
CALL OFSIM3(YY(I),XITC(I),IP,I)
XIT(I)=XITC(I)
IF(IJ.EQ.18) GO TO 6
GO TO 5
6 IF(I.EQ.2) XITN(LPM-IP+1)=XIT(I)
IF(I.EQ.3) XITN(LPM-IP+1)=XIT(I)
5 CONTINUE
EXU(I)=EXP(-XIT(I))
GC=X(I)-XST(4)*SDE
GD=XST(4)*CDE
PXA=GC**2+GD**2
DWOX=DGAP*X(I)*CDE/(PXA+PAI)
FCN3(1)=EXU(I)*DWOX/UJ2
IF(X(I).LE.0.) FCN3(I)=-FCN3(I)
8 CONTINUE
C CHECK IF FCN3(I) IS ALWAYS POSITIVE.
IF(IP.EQ.LPM) GO TO 20

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GO TO 21
20 PPQ=CDE/((-1.-XST(4)*SDE)**2+(XST(4)*CDE)**2)
   FF3=USAP*PPJ/PAI
   FCN3(3)=FF3
21 SUM=(FCN3(1)+FCN3(2)+4.*FCN3(3))+HSPACE/3.
   ANS2=ANS2+SUM
   IF(IJ.EQ.19) SARC(LPM-IP+1)=ANS2
   GO TO 1
2 SARC(LPM)=0.
   ANS2=0.
1 CONTINUE
C XITY(LPM)=G1 AT POINT 6.
C XINT(1)=G1 AT POINT X=1.
   XITN(LPM)=CCC1-XKKK/PAI
   XITN(1)=0.
   RETURN
END

SUBROUTINE OFSIM3(Y,XXII,IP,I)
DIMENSION XST(5),FXLS(100),FA(200)
COMMON YCCC,SBETA2
COMMON XITN(200),XITY(200),ANSG2S(200),SARC2(200)
COMMON CAVX(100),CAVY(100),BETAB,BETAC,XCCC,NCAY,LPM,NS2
COMMON AJ(100),IS1A2,NC13Y,BBTAN(100),BBTAN2(100),BETAN2(100)
COMMON FLAPAN,DELTA,OGAP,ALFA1,GAMMA
COMMON SIGMA,SBETA,XXM,ICPI,SARCO(513)
COMMON IDUL,XA,XB,XC,TANG,EP,YC,YR,JBIGS,XLPIGS,BIGS,SMALS,DSS
COMMON XSN(5),CCC1,CLE,ERC,YYY,XM,ITERA,SXSIO(5),SXSIO(5),YXS(5)
COMMON PSI7,LP,SARC(513),SARCO(513),LPM,DE
COMMON BETAN(513),BETAM(513),IJ,LPK,XII(200),XJJ(200),XDX
COMMON XROUND,A2AA,32BB,C2CC
COMMON AAAA,BBBB,CCCC,AB,BB,CB,DB,IGAUS(100),JGAUS(100),HGAUS
C FOUR INTEGRALS TO BE EVALUATED BEFORE XI IS OBTAINED.
C NOTE THAT PREVIOUSLY ONLY ONE SINGULAR INTEGRAL WAS
C CALCULATED IN GCASCAD AND CASCADE.
C SEE THE NOTE OF TC 3951 FOR FOUR INTEGRALS, OUT OF WHICH
C TWO ARE OF SINGULAR TYPE.
   IF(ICPI.EQ.0) GO TO 9
   DO 11 ISI=1,5
11 XST(ISI)=XSN(ISI)
   GO TO 12
9 DO 13 JTJ=1,5
13 XSI(JTJ)=YXS(JTJ)
12 PAI=3.141592653
C-----FIRS I1-----
   IF(ITERA.EQ.1) GO TO 60
   GO TO 61
60 CONTINUE
   DJ 62 IZU = 1,LPM
   BETAN(IZU) = SBETA
   BETAM(IZU) = SBETA
62 CONTINUE
61 CONTINUE
   CSPACE=(1.+XST(1))/FLOAT(LPK)
   HCSpace=0.5*CSpace
   FSPACE=CSpace/FLOAT(LPM-LPK)
   HFSpace=0.5*FSPACE
   XBET=-1.+CSpace*FLOAT(LPK-1)
   AB2=SQRT(XST(1)+1.)
   AB3=SQRT((1.+Y)*(XST(1)-Y))

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AB6 = SQRT((XST(3)-Y)/(XST(2)-Y))
AB3 = AB3*AB6
IU2=LPM-IP+1
IU3=1
IF(I.EQ.3) IU3=LPM-IP+1
IF(I.EQ.0) IU3=IP
BEC=BETAN(IU3)
IF(I.EQ.2) BEC=BETAN(IU2)
FAA=BEC/AB3
LPM1=LPM-1
DO 1 IW=2,LPM1
SPACE=CSPACE
IF(IW.GT.LPK) GO TO 45
XSK=-1.+SPACE*FLOAT(IW-1)
GO TO 46
45 SPACE=FSPACE
XSK=XRET+SPACE*FLOAT(IW-LPK)
46 IF(I.EQ.2) GO TO 5
IF(IW.EQ.IJ3) GO TO 1
6 FS=SQRT((1.+XSK)*(XST(1)-XSK))
FSA1 = SQRT((XST(3)-XSK)/(XST(2)-XSK))
FS = FS*FSA1
FA(IW)=(BETAN(IW)/FS-FAA)/(XSK-Y)
1 CONTINUE
IF(I.EQ.2) GO TO 30
XP1=-1.+HCSPAC
XP2=XP1+CSPACE
XP4=XST(1)-HFSPAC
XP3=XP4-FSPACE
FS1=BETAN(1)/SQRT((1.+XP1)*(XST(1)-XP1))
FS2=BETAN(2)/SQRT((1.+XP2)*(XST(1)-XP2))
FS3=BETAN(LPM-2)/SQRT((1.+XP3)*(XST(1)-XP3))
FS4=BETAN(LPM-1)/SQRT((1.+XP4)*(XST(1)-XP4))
FSA1 = SQRT((XST(2)-XP1)/(XST(3)-XP1))
FSA2 = SQRT((XST(2)-XP2)/(XST(3)-XP2))
FSA3 = SQRT((XST(2)-XP3)/(XST(3)-XP3))
FSA4 = SQRT((XST(2)-XP4)/(XST(3)-XP4))
FS1 = FS1*FSA1
FS2 = FS2*FSA2
FS3 = FS3*FSA3
FS4 = FS4*FSA4
FP1=(FS1-FAA)/(XP1-Y)
FP2=(FS2-FAA)/(XP2-Y)
FP3=(FS3-FAA)/(XP3-Y)
FP4=(FS4-FAA)/(XP4-Y)
IF(IU3.EQ.2) GO TO 21
IF(IU3.EQ.LPM1) GO TO 22
IF(IU3.EQ.LPK) GO TO 51
FA(IU3)=0.5*(FA(IU3-1)+FA(IJ3+1))
GO TO 30
51 BETJ=2.*BETAN(LPK)-BETAN(LPK+1)
XOA=XRET-FSPACE
FPW=BETO/SQRT((1.+XOA)*(XST(1)-XOA))
FPWA = SQRT((XST(2)-XOA)/(XST(3)-XOA))
FPW=FPWA*FPW
FLPK=(FPW-FAA)/(XOA-Y)
FA(IU3)=0.5*(FA(IU3+1)+FLPK)
GO TO 30
21 FA(IU3)=(FP1+FP2)/2.
GO TO 30

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22 FA(IU3)=(FP3+FP4)/2.
30 XI=0.
   LPM3=LPM-3
   SPACE=CSPACE
   DO 15 JA=2,LPM3,2
   IF(JA.GE.LPK) SPACE=FSPACE
15 XI=X1*(FA(JA)+4.*FA(JA+1)+FA(JA+2))*SPACE/3.
   IF(1.EQ.2) GO TO 35
   XI23=0.5*HCSPAC*(FP1+FA(2))+(FA(LPM-1)+FP4) *0.5*HFSPAC
   XKI=41.
   KU=39
   LPM4=LPM-5
   IF(IU3.GE.LPM4) XKI=201.
   IF(IU3.GE.LPM4) KU=133
   BOZ=(BETAN(1)-BETAN(LPM1))/XKI
   BOY=(BETAN(LPM)-BETAN(LPM1))/XKI
   HFF=HFSPAC/XKI
   HFH=HCSPAC/XKI
   FT3=FP1
   FU3=FP4
   XI4=0.
   XI1=0.
   DO 202 ITM=1,KU,2
   FT1=FT3
   FU1=FU3
   XM2=XST(1)-HFSPAC+HFF*FLOAT(ITM)
   XM3=X*2+HFF
   XT2=-1.+HCSPAC-HFH*FLOAT(ITM)
   XT3=XT2-HFH
   BETA2=BETAN(LPM1)+BOY*FLOAT(ITM)
   BETA3=BETA2+BOY
   BETT2=BETAN(1)-BOZ*FLOAT(ITM)
   BETT3=BETT2-BOZ
   FS2=BETA2/SQRT((1.+XM2)*(XST(1)-XM2))
   FS3=BETA3/SQRT((1.+XM3)*(XST(1)-XM3))
   FV2=BETT2/SQRT((1.+XT2)*(XST(1)-XT2))
   FV3=BETT3/SQRT((1.+XT3)*(XST(1)-XT3))
   FS2A = SQRT((XST(2)-XM2)/(XST(3)-XM2))
   FS3A = SQRT((XST(2)-XM3)/(XST(3)-XM3))
   FV2A = SQRT((XST(2)-XT2)/(XST(3)-XT2))
   FV3A = SQRT((XST(2)-XT3)/(XST(3)-XT3))
   FS2 = FS2*FS2A
   FS3 = FS3*FS3A
   FV2 = FV2*FV2A
   FV3 = FV3*FV3A
   FJ2=(FS2-FAA)/(XM2-Y)
   FU3=(FS3-FAA)/(XM3-Y)
   FT2=(FV2-FAA)/(XT2-Y)
   FT3=(FV3-FAA)/(XT3-Y)
   XI4=XI4+HFF*(FU1+FU2+4.*FU3)/3.
202 XI1=XI1+HFH*(FT1+FT2+4.*FT3)/3.
   XA4=BETAN(LPM)*2.*SQRT(HFF)/(AB2*(XST(1)-Y))
   XA4A = SQRT((XST(2)-XST(1))/(XST(3)-XST(1)))
   XA4 = XA4*XA4A
   XI4=XI4+XA4
   XA1=BETAN(1)*2.*SQRT(HFH)/(AB2*(-1.-Y))
   XA1A = SQRT((XST(2)+1.)/(XST(3)+1.))
   XA1 = XA1*XA1A
   XI1=XI1+XA1
   XI=(XI+XI23+XI1+XI4)*AB3/PAI

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XI=XI+8EC*ALOG((XST(1)-Y-HFF)/(1.+Y-HFH))/PAI
XXI1=-XI
GO TO 36
35 XR1=-1.+0.5*HCSPAC
XR2=XR1+HCSPAC
XR4=XST(1)-0.5*HFSPAC
XR3=XR4-HFSPAC
FT1=0.5*(BETAN(1)+BETAN(1))/SQRT((1.+XR1)*(XST(1)-XR1))
FT2=0.5*(BETAN(1)+BETAN(2))/SQRT((1.+XR2)*(XST(1)-XR2))
FT3=0.5*(BETAN(LPM-1)+BETAN(LPM-1))/SQRT((1.+XR3)*(XST(1)-XR3))
FT4=0.5*(BETAN(LPM-1)+BETAN(LPM-1))/SQRT((1.+XR4)*(XST(1)-XR4))
FT1A = SQRT((XST(2)-XR1)/(XST(3)-XR1))
FT2A = SQRT((XST(2)-XR2)/(XST(3)-XR2))
FT3A = SQRT((XST(2)-XR3)/(XST(3)-XR3))
FT4A = SQRT((XST(2)-XR4)/(XST(3)-XR4))
FT1 = FT1*FT1A
FT2 = FT2*FT2A
FT3 = FT3*FT3A
FT4 = FT4*FT4A
FR1=(FT1-FAA)/(XR1-Y)
FR2=(FT2-FAA)/(XR2-Y)
FR3=(FT3-FAA)/(XR3-Y)
FR4=(FT4-FAA)/(XR4-Y)
XIP1=0.5*HCSPAC*(FR1+FR2)+0.5*HFSPAC*(FR3+FR4)
XIP2=0.25*HCSPAC*(FR2+FA(2))+0.25*HFSPAC*(FA(LPM-1)+FR3)
XI23=XIP1+XIP2
XMI=21.
XMI2=42.
MU=21
M2=MU-2
LPMA=LPM-5
IF(IU2.GE.LPMA) XMI=101.
IF(IU2.GE.LPMA) XMI2=202.
IF(IU2.GE.LPMA) MU=101
IF(IU2.GE.LPMA) M2=MU-2
BETY=(BETAN(LPM)-BETAN(LPM-1))/XMI2
BESS=0.5*(BETAN(LPM)+BETAN(LPM-1))
HSP6=0.5*HFSPAC/XMI
FQ3=FR4
BETY1=(BETAN(1)-BETAN(1))/XMI2
BESS1=0.5*(BETAN(1)+BETAN(1))
HSP61=0.5*HCSPAC/XMI
FQ31=FR1
XI1=0.
XI4=0.
DO 129 IL=1,M2,2
FQ1=FQ3
FQ11=FQ31
X2=XST(1)-HSP6*FLOAT(MU-IL)
X3=X2+HSP6
X21=-1.+HSP61*FLOAT(MU-IL)
X31=X21-HSP61
BETA2=BESS+BETY*FLOAT(IL)
BETA3=BESS+BETY*FLOAT(IL+1)
BETA21=BESS1+BETY1*FLOAT(IL)
BETA31=BETA21-BETY1
FU21=BETA21/SQRT((1.+X21)*(XST(1)-X21))
FU31=BETA31/SQRT((1.+X31)*(XST(1)-X31))
FU21A = SQRT((XST(2)-X21)/(XST(3)-X21))
FU31A = SQRT((XST(2)-X31)/(XST(3)-X31))

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FU21 = FU21*FU21A
FU31 = FU31*FU31A
FQ21=(FU21-FAA)/(X21-Y)
FQ31=(FU31-FAA)/(X31-Y)
FU2=BETA2/ SQRT((1.+X2)*(XST(1)-X2))
FU3=BETA3/ SQRT((1.+X3)*(XST(1)-X3))
FU2A = SQRT((XST(2)-X2)/(XST(3)-X2))
FU3A = SQRT((XST(2)-X3)/(XST(3)-X3))
FU2 = FU2*FU2A
FU3 = FU3*FU3A
FQ2=(FU2-FAA)/(X2-Y)
FQ3=(FU3-FAA)/(X3-Y)
XI1=XI1+HSP61*(FU11+FQ21+4.*FQ31)/3.
129 XI4=XI4+HSP6*(FG1+4.*FG2+FQ3)/3.
XIA=2.*SQRT(HSP6)*BETAN(LPM)/(AB2*(XST(1)-Y))
XIAA = SQRT((XST(2)-XST(1))/(XST(3)-XST(1)))
XIA = XIA*XIAA
XI4=XI4+XIA
XIB=2.*SQRT(HSP61)*BETAN(1)/(AB2*(-1.-Y))
XIBA = SQRT((XST(2)+1)/(XST(3)+1.))
XIB = XIB*XIBA
XI1=XI1+XI3
XI=(XI+XI1+XI23+XI4)*AB3/PAI
XI=XI+BEC*ALOG((XST(1)-Y-HSP6)/(1.+Y-HSP61))/PAI
XXI1=-XI
36 CONTINUE
C-----I2-----
C-----IF Y IS LESS THAN ZERO, THIS IS A
C-----REGULAR INTEGRAL, WHILE Y .GE. 0, THIS IS A
C-----SINGULAR INTEGRAL.
C BUT THIS IS TREATED AS A SINGULAR INTEGRAL ANYWAY
CGAP = XST(1)/41.
DO #1 LSI = 1,41
XLSI = CGAP*FLOAT(LSI-1)
CSA = (XLSI+1.)*(XST(1)-XLSI)*(XLSI-XST(3))
CSB = XLSI-XST(2)
CSC = SQRT(CSB/CSA)
31 FXLS(LSI) = (CSC-1./AB3)/(XLSI-Y)
XXI2 = 0.
DO #2 LSJ = 1,39,2
32 XXI2 = XXI2 + CGAP*(FXLS(LSJ)+4*FXLS(LSJ+1)+FXLS(LSJ+2))/3.
ARGL=(XST(1)-CGAP-Y)/Y
IF(Y.LT.0.) ARGL=-ARGL
XXI2 = XXI2*AB3+ALOG(ARGL)
CTA = (XST(1)+1.)*(XST(1)-XST(3))
CTB = XST(1)-XST(2)
ADX12 = 2.*SQRT(CGAP)*SQRT(CTB/CTA)/(XST(1)-Y)*AB3
XXI2 = XXI2+ADX12
XXI2 = -XXI2
C-----I3-----
C USE CHEBYSHEV-GAUSS QUADRATURE.
C AJ(I) ARE ALREADY CALCULATED IN SUBROUTINE F1INTL
C AND PASSED ONTO HERE BY COMMON STATEMENT.
XXI3 = 0.
BPC5 = (XST(1)+XST(2))*0.5
CMB5 = (XST(2)-XST(1))*0.5
A31 = (BPC5+1.)/CMB5
A32 = (-BPC5+XST(3))/CMB5
DO 120 ISUM = 1,NCHBY
HA1 = 1.-AJ(ISUM)

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HA2 = (AJ(ISUM)+A31)*(A32-AJ(ISJM))
SHA2 = SQRT(HA2)
F3I3 = HA1/SHA2
F3AI3 = CMB5*AJ(ISUM)+BPC5-Y
120 XXI3 = XXI3+F3I3/F3AI3
XXI3 = XXI3*PAI/NCHBY
UJ22 = COS(ALFA1+GAMMA)/COS(XST(5)+GAMMA)
HX3 = CCC1-ALOG(UJ22)/PAI
XXI3 = XXI3*AB3*HX3
C-----14-----
C USE CHEBYSHEV-GAUSS QUADRATURE FORMULA---
C-----BETAN2(I) ARE ALREADY CALCULATED IN
C SUBROUTINE F1INTL AND PASSED ONTO HERE BY
C COMMON STATEMENT.
FPC5 = (XST(3)+XST(2))*0.5
FMC5 = (XST(3)-XST(2))*0.5
A41 = (FPC5+1.)/FMC5
A42 = (FPC5-XST(1))/FMC5
XXI4 = 0.
DO 130 ISUM = 1,NCHBY
RAX = (BBTAN2(ISUM)+PAI)*(1.+AJ(ISUM))
RBX = (AJ(ISUM)+A41)*(AJ(ISJM)+A42)
SRBX = SQRT(RBX)
RCX = RAX/SRBX
ROX = FMC5*AJ(ISUM)+FPC5-Y
130 XXI4 = XXI4 + RCX/ROX
XXI4 = XXI4*PAI/NCHBY
XXI4 = -XXI4*AB3/PAI
XXII = XXI1+XXI2+XXI3+XXI4
RETURN
END

SUBROUTINE OFSIM5(ANS5)
DIMENSION S2SR(101),S2KER(101),XST(5)
COMMON YCCC,SBETA2
COMMON XITH(200),YITV(200),ANSG2S(200),SARC2(200)
COMMON CAVX(100),CAVY(100),PETAR,BETAC,YCCC,NCAY,LFM,NS2
COMMON AJ(100),ISHAP,VCHBY,BBTAN(100),BBTAV2(100),BETAN2(100)
COMMON FLAPAN,DELTA,DGAP,ALFA1,GAMMA
COMMON SIGMA,SBETA,XXM,ICPI,SARCO(513)
COMMON IDJL,XA,XB,XC,TANG,LP,YC,YR,JBIGS,XLBIGS,BIGS,SMALS,DSS
COMMON XSN(5),CCC1,CLE,ERC,YYY,XM,ITERA,SYSIO(5),SXSIO(5),YYS(5)
COMMON PSIZ,LP,SARC(513),SARCO(513),LPM,DE
COMMON BETAN(513),BETAM(513),IJ,LPK,XII(200),XJJ(200),XDX
COMMON XROUND,A2AA,B23B,C2CC
COMMON AAAA,BBEB,CCCC,AB,BB,CS,DB,TS AUS(100),WGAUS(100),NGAUS
PAI=3.141592654
C THIS SUBROUTINE CALLED FROM OXFVW.
C USE SIMPSONS RULE.
DO 1 I=0 = 1,5
1 XST(I) = YXS(I)
CDE = COS(DELTA)
SDE = SIN(DELTA)
C NS2 SHOULD HAVE A FACTOR OF 4.
C NS2=LPM=LPM2
NS21 = NS2+1
NS2A = NS2-1
S2GAP = (XST(3)-XST(2))/NS2
UJ2 = COS(ALFA1+GAMMA)/COS(XST(5)+GAMMA)
DO 2 IS2 = 1,NS21

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XS2 = XST(2)+S2GAP*(IS2-1)
XKD = XS2*CDE
XMAS = XS2-XST(4)*SDE
XMAS2 = XMAS**2
ASD = XST(4)*CDE
ASD2 = ASD**2
DWDX = DGAP*XKD/((XMAS2+ASD2)*PAI)
IF (IS2.EQ.1) GO TO 3
IF (IS2.EQ.NS21) GO TO 4
CALL G2 (XS2,ANSG2,IS2)
C G2 CALCULATES G2 WITH XSI GIVEN.
EG2 = EXP(-ANSG2)
IF(IJ.EQ.27) ANSG2S(IS2)=ANSG2
S2KER(IS2) = EG2*DWDX/UJ2
GO TO 2
3 CONTINUE
S2KER(1) = DWDX/SQRT(1.+SIGMA)
ANSG2S(IS2)=ALOG(SQRT(1.+SIGMA)/UJ2)
GO TO 2
4 CONTINUE
S2KER(NS21) = DWDX/JJ2
ANSG2S(IS2)=0.
2 CONTINUE
S2SR(1) = 0.
DO 10 JS2 = 1,NS2A,2
10 S2SR(JS2+2) = S2SR(JS2)
1+(S2KER(JS2)+4.*S2KER(JS2+1)+S2KER(JS2+2))+S2GAP/3.
IF(IJ.NE.27) GO TO 40
SARC2(1)=0.
DO 50 ISARC=2,NS2,2
50 S2SR(ISARC)=.5*(S2SR(ISARC-1)+S2SR(ISARC+1))
DO 30 ISARC=1,NS21
30 SARC2(ISARC)=S2SR(ISARC)
40 CONTINUE
ANS5 = S2SR(NS21)
RETRN
END

SUBROUTINE F1INTL(YINT,KCTRL)
DIMENSION XST(5),RU3(100)
COMMON YCCC,SBETA2
COMMON XITM(200),XITN(200),ANSG2S(200),SARC2(200)
COMMON CAVX(100),CAVY(100),BETAB,BETAC,XCCC,NCAY,LPM,NS2
COMMON AJ(100),ISHARP,NCHBY,BBTAN(100),BBTAN2(100),BETAN2(100)
COMMON FLAPAN,DELTA,DGAP,ALFA1,GAMMA
COMMON SIGMA,SBETA,XXM,ICP1,SARCO(513)
COMMON IDUL,XA,XB,XC,TANG,EP,YC,YR,JBIGS,XLBIGS,BIGS,SMALS,DSS
COMMON XSN(5),CCC1,CLE,ERC,YYY,XX,ITERA,SXSIC(5),SXSIC(5),YXS(5)
COMMON PSIZ,LP,SARC(513),SARCO(513),LPM,DE
COMMON BETAN(513),BETAM(513),IJ,LPK,XII(200),XJJ(200),XQX
COMMON XROUND,A2AA,B2BB,C2CC
COMMON AAAA,BBBB,CCCC,AB,BB,CB,DB,TJAJ(100),JGAUS(100),NGAUS
C SUBROUTINE F1INTL CALCULATES THE INTEGRALS IN F(1)
C ISHARP = 0 FOR SHARP L.E.FOILS.
C ISHARP = 1 FOR ROUNDED L.E.FOILS.
C IF FOILS HAVE ROUNDED L.E., CHEBYSHEV-GAUSS
C QUADRATURE
C QUADRATURE FORMULA CAN NOT BE USED. SINCE BETA
C IS NOT A SMOOTH FUNCTION.
C NCHBY = NUMBER OF CHEBYSHEV-GAUSS QUADRATURE CONTROL POINTS.

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    PAI = 3.141592654
    IF(ICP1.EQ.0) GO TO 9
    DO 70 I0 = 1,5
70 XST(I0) = XSN(I0)
    GO TO 12
    9 DO 11 I1 = 1,5
11 XST(I1) = YXS(I1)
12 CONTINUE
    5 DN1 = (XST(1)+1.)*.5
    DN2 = (XST(1)-1.)*.5
    A11 = (DN2-XST(2))/DN1
    A12 = (DN2-XST(3))/DN1
    BC5 = (XST(1)+XST(2))*5
    CM85 = (XST(2)-XST(1))*5
    A31 = (BC5+1.)/CM85
    A32 = (-BC5+XST(3))/CM85
    FCA5 = (XST(3)-XST(2))*5
    FC15 = (XST(3)+XST(2))*5
    A41 = (FC15+1.)/FCA5
    A42 = (FC15-XST(1))/FCA5
    SPACE2 = (XST(3)-XST(2))/LPMH
    READ LPMH FOR THE SECOND ARC.
C   IF(KCTRL.GE.2) GO TO 100
    IF(IJ.GE.2) GO TO 100
    CSPACE = (1.+XST(1))/FLOAT(LPK)
    FSPACE = CSPACE/FLOAT(LPM-LPK)
    IOM = 1
    XCHCK = -1.
    SPACE=CSPACE
    DO 20 ICHBY=1,NCHBY
    NCH=NCHBY-ICHBY+1
    AJ(ICHBY)=COS((2*NCH-1)*PAI/(2*NCHBY))
    XSI=DN1*AJ(ICHBY)+DN2
    IF(ITERA.EQ.1) GO TO 488
22 IF(XCHCK.GE.XKSI) GO TO 21
    IF(IOM.GE.LPK) SPACE = FSPACE
    XCHCK = XCHCK+SPACE
    IJM = IOM+1
    GO TO 22
C   XKSI EXISTS BTW XSI(IOM-1) AND XSI(IOM)
21 CONTINUE
    IJ4 = IOM-1
    SBTAN(ICHBY) = BETAN(IOM)+(BETAN(IJ4)-BETAN(IOM4))
    X=(XKSI-XCHCK)/SPACE
C   SBTAN IS USED FOR CHEBYCHEV-GAUSS INSTEAD OF BETAN.
    GO TO 20
488 SBTAN(ICHBY) = SBETA
C   BETAN FOR ITERA.EQ.1 IS SPECIFIED IN OFSIM1.
20 CONTINUE
100 CONTINUE
    IF(KCTRL.EQ.4) GO TO 4
    IF (KCTRL.EQ.3) GO TO 3
    IF (KCTRL.EQ.2) GO TO 2
    IF (ISHARP.EQ.1) GO TO 10
    YINT = 0.
    DO 110 ISUM = 1,NCHBY
    ABC = (AJ(ISUM)+A11)/(AJ(ISJM)+A12)
110 YINT = YINT +SBTAN(ISUM)*SQR(ABC)
    YINT = YINT*PAI/NCHBY
    GO TO 1000

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10 CONTINUE
C THIS IS THE CASE OF HANDLING RVDDED L. E. .
  NOF = 0
  XCA = 0.
  CALL OFSIM1(YINT,NOF,XCA)
C XCA IS DUMMY, ONLY USED FOR F(5) INDXFNEW.
  GO TO 1000
2 CONTINUE
  SINC = XST(1)/21.
  DO 60 ITE = 1,21
  XYIN = FLOAT(ITE-1)*SINC
  XU1 = XYIN-XST(2)
  RU2 = (XYIN+1.)*(XST(1)-XYIN)*(XYIN-XST(3))
  RU3(ITE) = SQRT(RU1/RU2)
50 CONTINUE
  YINT=0.
  DO 61 ILO = 1,19,2
51 YINT = YINT+SINC*(RU3(ILO)+4.*RU3(ILO+1)+RU3(ILO+2))/3.
  ADTN = XST(1)-XST(2)
  ADTM = (XST(1)+1.)*(XST(1)-YST(3))
  ADN = SQRT(ADTN/ADTM)*2.*SQRT(SINC)
  YINT = YINT+ADN
  GO TO 1000
3 CONTINUE
C-----INTEGRAL FOR I3.
C AJ(N) IS CALCULATED AND STORED
  YINT = 0.
  DO 120 ISUM = 1,NCHBY
  AB1 = 1.-AJ(ISUM)
  AB2 = (AJ(ISUM)+A31)*(A32-AJ(ISUM))
  SQA32 = SQRT(AB2)
  ABC = AB1/SQA32
120 YINT = YINT+ABC
  YINT = YINT*PII/NCHBY
  GO TO 1000
C-----INTEGRAL FOR I4
C SINCE BETA(N) BTWN ICI AND IFF ARE
C EXPECTED TO BE ALWAYS SMOOTH, USE GAUSS-
C CHEBYSHEV QUADRATURE FORMULA.
C AJ(N) IS ALREADY CALCULATED.
C IF THIS IS THE FIRST CASE FOR BETAN2,
C USE A CONSTANT FOR BETAN2.
C BBTAN2 IS USED FOR CHEVY-GAUSS INSTEAD OF BETAN2.
4 CONTINUE
  IF(ITERA.GE.2) GO TO 150
  IF(IJ.GE.2) GO TO 181
C SBETA2 MUST BE READ FOR THE FIRST RUN.
  DO 180 ICHBY = 1,NCHBY
180 BBTAN2(ICHBY) = SBETA2
  NS21=NS2+1
  DO 185 IOC=1,NS21
185 BETAN2(IOCI)=SBETA2
  GO TO 181
150 CONTINUE
  IF(IJ.GE.2) GO TO 181
  IOM4 = 1
  XCHCK = XST(2)
  DO 170 ICHBY = 1,NCHBY
  XKSI = FCA5*AJ(ICHBY)+FC15
152 IF(XCHCK.GE.XKSI) GO TO 151

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XCHCK = XCHCK + SPACE2
IUMM = IUMM+1
GO TO 152
151 CONTINUE
IOMMA = IOMM-1
BBTAN2(ICMBY) = BETAN2(IOMM)
1+(BETAN2(IOMM)-BETAN2(IOMMA))*(XKSI-XCHCK)/SPACE2
ILM=ICMBY
XKSI = FCAS*AJ(ILM )+FC15
WRITE(6,250) ILM,BBTAN2(ILM),XKSI
250 FORMAT(15X, *I=*, I3, 2X, *BBTAN2=*, E14.7, 2X, *XKSI=*, E14.7)
170 CONTINUE
181 CONTINUE
YINT = 0.
DO 190 ISUM = 1, NCMBY
A81 = (BBTAN2(ISUM)+PAI)*(1.+AJ(ISUM))
A82 = (AJ(ISUM)+A41)*(AJ(ISUM)+A42)
SGA82 = SGR(A82)
190 YINT = YINT + A81/S7A82
YINT = YINT*PAI/NCMBY
1000 CONTINUE
RETJKV
END

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SUBROUTINE G2 (XS2,AG2,IS2)
DIMENSION XSI(5),XI21S(200),XI22S(200),XI23S(200),XI24S(200)
COMMON YCCC,SBETA2
COMMON XI1M(200),XI1N(200),ANS62S(200),SARC2(200)
COMMON CAVX(100),CAVY(100),BETA3,BETAC,XCCC,NCAY,LPM,NS2
COMMON AJ(100),IS4AP,NCMBY,BBTAN(100),BBTAN2(100),BETAN2(100)
COMMON FLAPAN,DELTA,OGAP,ALFA1,GAMMA
COMMON SIGMA,SBETA,XXM,ICPI,SARCO(513)
COMMON IDJL,XA,XB,XC,TANG,EP,YC,YP,JBIGS,XLSIGS,BIGS,SMALS,DSS
COMMON XSN(5),CCCC,CLE,ERC,YYY,XM,ITERA,SXSIO(5),SXSIOC(5),YXS(5)
COMMON PEIZ,LP,SARC(513),SARCO(513),LPM,DE
COMMON BETAN(513),BETAM(513),IJ,LPK,XII(200),XJJ(200),XOX
COMMON XROUNO,A2AA,529B,C2CC
COMMON AAAA,BBBB,CCCC,AB,BB,C3,D8,TS AUS(100),GAUS(100),VGAUS

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C THIS SUBROUTINE IS CALLED BY OFSIM5.
C THIS SUBROUTINE CALCULATES FUNCTION G2(XS2) WHICH
C INCLUDES I21(XS2) TO I24(XS2).
C XS2 IS XSI- AG2 IS THE SOLUTION OF INTEGRALS.
DO 1 IGP=1,5
1 XST(IGP)=YXS(IGP)
PAI = 3.141592654
IF (IJ.GE.34) GO TO 100

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C----I21(XSI)----.
C THE SAME INTEGRATION AS THAT IN
C SUBROUTINE CAVITY FOR GC(XSI)
NOF = 3
CALL OFSIM1(ANS,NOF,XS2)
XI21 = ANS
IF (IJ.EQ.27) XI21S(IS2) = XI21
C----I22(XSI)----.
C USE THE SAME SUBROUTINE IC2 AS
C USED IN CAVITY .IF4 ISIC=1.
ISIC=1
CALL IC2(SR,SM,XS2,ISIC)
XI22 = SR
C NOTE THAT SM IS DUMMY VARIABLE.

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IF(IJ.EQ.27) XI22S(IS2) = XI22
C-----I23(XSI)-----
C   JSE CHEBYCHEV-GAUSS QUADRATJRE FORMJLA
C   IN EXACTLY SIMILAR MANNER TO THAT IN
C   OFSIM3 FOR I3.
XI23 = 0.
BPC5 = (XST(1)+XST(2))*0.5
CM65 = (XST(2)-XST(1))*0.5
A31 = (BPC5 + 1.)/CM65
A32 = (-BPC5 + XST(3))/CM65
DO 2 ISUM = 1,NCHBY
HA1 = 1.-AJ(ISUM)
HA2 = (AJ(ISUM) + A31)*(A32-AJ(ISUM))
SHA2 = SQRT(HA2)
F3I3 = HA1/SHA2
F3AI3 = CM65*AJ(ISUM)+BPC5-XS2
2 XI23 = XI23+F3I3/F3AI3
XI23 = XI23*PAI/NCHBY
IF (IJ.EQ.27) XI23S(IS2) = XI23
C-----I24-----
C   JSE CHEBYCHEV-GAUSS QUADRATJPE
C   FORMULA BY ASSUMING THAT
C   THE KERNEL FCN. IS SMOOTH.
HU = (XS2+1.)*(XS2-XST(1))*(XST(3)-XS2)
HV = XS2-XST(2)
HW = SQRT(HU/HV)
FPC5 = (XST(3)+XST(2))*0.5
FMC5 = (XST(3)-XST(2))*0.5
A41 = (FPC5+1.)/FMC5
A42 = (FPC5-XST(1))/FMC5
XI24 = 0.
DO 10 ISUM = 1, NCHBY
TPA1 = AJ(ISUM)+A41
TPA2 = AJ(ISUM)+A42
STP = SQRT(TPA1+TPA2)
F4T = (BETAN2(ISUM)+PAI)*(1.+AJ(ISUM))/STP
C   BETAN2 IS CHEBY-GAUSS VERSION FOR BETA ON THE SECOND ARC.
F4A = FMC5*AJ(ISUM)+FPC5-XS2
S12 = SQRT(1.-AJ(ISUM)**2)
F4B = FMC5 *ST2*(BETAN2(IS2)+PAI)/HW
10 XI24 = XI24+(F4T-F4B)/F4A
XI241 = XI24+PAI/NCHBY
C   BETAN2 IS USED FOR SIMPSONS RULE.
XLG = ALOG((XST(3)-XS2)/(XS2-XST(2)))
C   IS2 IS TRANSFERRED THROUGH G2-ARGUMENT.
XI242 = XLG*(BETAN2(IS2)+PAI)/HW
XI24 = XI241+XI242
IF(IJ.EQ.27) XI24S(IS2) = XI24
GO TO 101
100 XI21 = XI21S(IS2)
XI22 = XI22S(IS2)
XI23 = XI23S(IS2)
XI24 = XI24S(IS2)
101 XS2A = -XI21/PAI-XI22
XS2B = CCC1-ALOG(COS(ALFA1+GAMMA)/COS(XST(5)+GAMMA))/PAI
XS2C = XS2B*XI23
XS2D = -XI24/PAI
IF(IJ.EQ.27) WRITE(5,225) XS2D
225 FORMAT(1X,*,XS2D=*,F20.10)
AG2 = (XS2A+XS2C+XS2D)*HW

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RETURN
END

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SUBROUTINE RMINT (SR,SM,MIQ)
DIMENSION XST(5)
COMMON YCCC,SBETA2
COMMON XITM(200),XITV(200),ANSQ2S(200),SARC2(200)
COMMON CAVX(100),CAVY(100),BETAB,BETAC,XCCC,NCAV,LPM,NS2
COMMON AJ(100),ISHARP,NCBY,BBTAN(100),BBTAN2(100),BETAN2(100)
COMMON FLAPAN,DELTA,CGAP,ALFA1,GAMMA
COMMON SIGMA,SEETA,XXM,ICPI,SARCO(513)
COMMON IDJL,XA,XB,XC,TANG,EP,YC,YR,JBIGS,XLBIGS,BIGS,SMALS,DSS
COMMON XSN(5),CCC1,CLE,ERC,YYY,XM,ITERA,SXSIG(5),SXSIO(5),YXS(5)
COMMON PSIZ,LP,SARC(513),SARCO(513),LPM,DE
COMMON BETAN(513),BETAM(513),IJ,LPK,XII(200),XJJ(200),XJC
COMMON XROJND,A2AA,B2BB,C2CC
COMMON AAAA,BBBB,CCCC,AB,BB,CB,DB,TGAUS(100),dGAUS(100),NGAUS
PAI = 3.141592654
IF (ICPI.EQ.0) GO TO 10
DO 12 IS = 1,5
12 XST(IS) = XSN(IS)
GO TO 11
10 DO 1 IS = 1,5
1 XSI(IS) = YXS(IS)
11 CONTINUE
XX1 = XST(4)*SIN(DELTA)
YY1 = XST(4)*COS(DELTA)
YY12 = YY1**2
CB5 = (XST(2)-YST(1))*0.5
BC5 = (XST(1)+XST(2))*0.5
A31 = (BC5+1.)/CB5
A32 = (-BC5+XST(3))/CB5
BP15 = (XST(1)-1.)*0.5
BP15 = (XST(1)+1.)*0.5
A11 = (BP15-XST(2))/BP15
A12 = (BP15-XST(3))/BP15
FPC5 = (XST(3)+XST(2))*0.5
FMC5 = (XST(3)-XST(2))*0.5
A41 = (FPC5+1.)/FMC5
A42 = (FPC5-XST(1))/FMC5
IF (MIQ.EQ.4) GO TO 4
IF (MIQ.EQ.3) GO TO 3
IF (MIQ.EQ.2) GO TO 2
C AJ(I) ARE ALREADY CALCULATED IN SUBROUTINE
C TFINTLT AND STORED IN COMMON AREA.
SR=0.
SM=0.
DO 20 ISUM = 1,NCHBY
GX1 = 1.-AJ(ISUM)
GY1 = (AJ(ISUM)*A31)*(A32-AJ(ISUM))
SGY1 = SQRT(GY1)
FF3 = GX1/SGY1
FX1 = CB5*AJ(ISUM)+BC5
FX2 = FX1-XX1
FX22=FX2**2
FX3 = FX22+YY12
FF31 = FX2/FX3
FF32 = YY1/FX3
SR = SR+FF3+FF31
20 SM = SM+FF3+FF32
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SR = SR*PAI/NCHBY
SM = SM*PAI/NCHBY
GO TO 1000
2 CONTINUE
IF (ISHARP.EQ.1) GO TO 100
C ISHARP = 1 MEANS THAT THE FOIL HAS ROUNDED L.E.
C SO THAT THE SIMPSONS RULE IS USED,
C ISHARP = 0 MEANS THAT THE FOIL HAS SHARP L.E.
C SO THAT CHEBYSHEV GAUSS FORMULA CAN BE USED AS BELOW.
SR = 0
SM = 0
DO 30 ISJM = 1,NCHBY
ST11 = AJ(ISUM)+A11
ST12 = AJ(ISUM)+A12
FK1 = BBTAN(ISUM)*SQRT(ST11/ST12)
UN1 = BP15*AJ(ISJM)+BM15-XX1
UN12 = UN1**2
JY13 = JN12+YY12
FK11 = UN1/UN13
FK12 = YY1/UN13
SR = SR+FK1*FK11
30 SM = SM+FK1*FK12
SR = SR*PAI/NCHBY
SM = SM*PAI/NCHBY
GO TO 1000
100 CONTINUE
C THIS IS THE CASE THAT THE FOIL HAS ROUNDED L.E.
NOF = 1
XCA = 0.
CALL OFSIM1(SR,NOF,XCA)
C XCA IS DUMMY----ONLY USED FOR F(5) IN OXFNEW.
NOF=2
CALL OFSIM1(SM,NOF,XCA)
GO TO 1000
3 CONTINUE
C USE CHEBYSHEV-GAUSS FORMULA SINCE BETA
C IN THIS REGION IS SMOOTH.
C BBTAN2 (ISUM) ARE ALREADY CALCULATED AT 1FINTLT.
SR = 0.
SM = 0.
DO 50 ISJM = 1,NCHBY
PSL = (BBTAN2(ISUM)+PAI)*(1.+AJ(ISJM))
PSM = (AJ(ISUM)+A41)*(AJ(ISJM)+A42)
SQPSM = SQRT(PSM)
FF4 = PSL/SQPSM
PSN = FMC5*AJ(ISUM)+FPC5-XX1
PSN2 = PSN**2
FF41 = PSN/(PSN2+YY12)
FF42 = YY1/(PSN2+YY12)
SR = SR+FF4*FF41
SM = SM+FF4*FF42
50 CONTINUE
SR = SR*PAI/NCHBY
SM = SM*PAI/NCHBY
GO TO 1000
4 CONTINUE
C XCA IS DUMMY, ONLY USED FOR IC2 IN F(5)
XCA = 0.
ISIC = 0
C SJBROUTINE IC2 IS ALSO USED IN F(5).

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CALL IC2(SR,SM,XCA,ISIC)
1000 RETURN
END

SUBROUTINE CAVITY (XCC,YCC)
C THIS SUBROUTINE IS CALLED FROM DXFNEW FOR F(5).
DIMENSION CKEX(100),SKEY(100),ANSI1(100),SRI2(100),SIC3I3(100)
DIMENSION SIC4I4(100),XST(5)
DIMENSION CAVXX(100),CAVYY(100)
COMMON YCCC,SBETA2
COMMON XITM(200),XITN(200),ANSG2S(200),SARC2(200)
COMMON CAVX(100),CAVY(100),BETAB,BETAC,XCCC,NCAV,LPMM,NS2
COMMON AJ(100),ISHARP,NCHBY,BBTAN(100),BBTAN2(100),BETAN2(100)
COMMON FLAPAN,DELTA,JGAP,ALFA1,GAMMA
COMMON SIGMA,SBETA,XXM,ICP1,SARCO(513)
COMMON IDUL,XA,XB,XC,TANG,EP,YC,YR,JBIGC,XLBIGS,BIGS,SMALS,DSS
COMMON XSN(5),CCCL,CLE,ERC,YYY,XM,ITEPA,SXSIO(5),SXSIG(5),YXS(5)
COMMON PSIZ,LP,SARC(513),SARCO(513),LPM,DE
COMMON BETAN(513),BETAN(513),IJ,LPK,XII(200),XJJ(200),XOX
COMMON XRDJND,A2AA,B2BB,C2CC
COMMON AAAA,BBBB,CCCC,A6,B6,C6,D6,T6AUS(100),WGAUS(100),NGAUS
C XCCC IS THE CAVITY END POINT CALCULATED IN SUB. CAVITY.
SCGM = SQRT(1.+SIGMA)
CDEL = COS(DELTA)
SDEL = SIN(DELTA)
PAI = 3.141592654
DO 1 LQA = 1,5
1 XSI(LQA) = YXS(LQA)
NCAV=80
NCAV1=NCAV+1
CAVS = (XST(2)-XST(1))/NCAV
C LEAVE THE LAST POINT OF XSI = 0 SINCE THERE IS A
C SINGULARITY FOR SINGLE SPIRAL VORTEX MODEL.
DO 2 KLM = 1,NCAV1
XCA = XST(1) +CAVS* (KLM-1)
C REAL PART OF OMEGA = BETA+ PAI.
IF (KLM.EQ.1) GO TO 3
IF(KLM.EQ.NCAV1) GO TO 10
C-----IC1(XSI) CALCULATION, CALLING OFSIM1.
IF (IJ.GE.34) GO TO 75
NDF = 3
CALL OFSIM1(ANS,NCF,XCA)
C ANS IS A SOLUTION FOR IC1(XCI), XCI IS IDENTICAL TO XCA.
IF (IJ.EQ.27) ANSI1(KLM) = ANS
GO TO 76
75 ANS = ANSI1(KLM)
76 CONTINUE
C----- IC2(XSI) CALCULATION.
IF(IJ.GE.34) GO TO 77
ISIC = 1
CALL IC2(SR,SM,XCA,ISIC)
C ONLY SR IS UTILIZED-- SM IS FOR RMINT.
IF (IJ.EQ.27) SRI2(KLM) = SR
GO TO 78
77 SR = SRI2(KLM)
78 CONTINUE
C-----IC3 (XSI) CALCULATION-- USE CHEBYSHEV-GAUSS
C QUADRATURE FORMULA.
IF (IJ.GE.34) GO TO 80
BPCS = (XST(1)+XST(2))*0.5

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CM85 = (XST(2)-XST(1))*0.5
A31 = (BPC5+1.)/CM85
A32 = (-BPC5+XST(3))/CM85
EK1 = XCA-XST(2)
EK2 = (XCA+1.)*(XCA-XST(1))*(XCA-XST(3))
EK3 = SQRT(EK1/EK2)
EF35 = CM85*EK3
SIC3 = 0.
DO 5 ISJM = 1,NCHBY
EJ1=(AJ(ISUM)+A31)*(A32-AJ(ISUM))
SEJ1 = SQRT(EJ1)
EF3 = (1.-AJ(ISUM))/SEJ1
EF3A = CM85*AJ(ISUM)+BPC5-XCA
5 SIC3 = SIC3*(EF3-EF35*SQRT(1.-AJ(ISJM)**2))/EF3A
SIC3 = SIC3*PAI/NCHBY
SIC3 = SIC3+ALOG((XST(2)-XCA)/(XCA-XST(1)))*EK3
IF(IJ.EQ.27) SIC3I3(KLM) = SIC3
GO TO 81
80 SIC3 = SIC3I3(KLM)
81 CONTINUE
C-----IC4(XSI)-----
C USE CHEBYSHEV-GAUSS QUADRATURE FORMULA
C IN THE SAME MANNER AS THAT FOR I3 IN
C GFSIM3.
IF(IJ.GE.34) GO TO 82
FPC5 = (XST(3)+XST(2))*0.5
FMC5 = (XST(3)-XST(2))*0.5
A41 = (FPC5+1.)/FMC5
A42 = (FPC5-XST(1))/FMC5
SIC4 = 0.
DO 7 ISUM= 1,NCHBY
XA = (BBTAV2(ISUM)+PAI)*(1.+AJ(ISUM))
RB = (AJ(ISUM)+A41)*(AJ(ISUM)+A42)
SRB = SQRT(RB)
RC = RA/SRB
RD = FMC5*AJ(ISJM)+FPC5-XCA
7 SIC4 = SIC4+RC/RD
SIC4 = SIC4*PAI/NCHBY
IF(IJ.EQ.27) SIC4I4(KLM)= SIC4
GO TO 83
82 SIC4 = SIC4I4(KLM)
83 CONTINUE
C IC(XSI) = 1/EK3 ALREADY CALCULATED.
UU2 = COS(ALFA1+GAMMA)/COS(XST(5)+GAMMA)
GC = (-ANS/PAI-SR*(CCC1-ALOG(UJ2)/PAI)*SIC3
1-SIC4/PAI)/EK3
GO TO 25
3 GC = BETAB+PAI
GO TO 25
10 GC=BETAC+PAI
C BETAB AND BETAC( BODY ANGLES AT B AND C) MUST BE SPECIFIED IN COMMON.
25 CONTINUE
XXS = XCA+COEL
YYT = XCA-XST(4)*SOEL
YYT2 = YYT**2
XXU = XST(4)*CDEL
XXU2 = XXU**2
XYB = YYT2+XXU2
DWOX = DGAP*XXS/(XYB*PAI)
CGC = COS(GC)

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SGC = SIN(GC)
CFC = DWDK/SCGM
CKEX(KLM) = CGC*CFC
SKEY (KLM) = SGC*CFC
2 CONTINUE
CAVXX(1)=0.
CAVYY(1)=0.
DO 15 ICAV=3, NCAV1,2
CAVXX(ICA V) = CAVXX(ICA V-2)+CAVS*(CKEX(ICA V-2)+4.*
1CKEX(ICA V-1)+CKEX(ICA V))/3.
15 CAVYY(ICA V) = CAVYY(ICA V-2)
1+CAVS*(SKEY(ICA V-2)+4.*SKEY(ICA V-1)+SKEY(ICA V))/3.
IF(IJ.EQ.27) GO TO 100
GO TO 101
100 DO 102 ICAV=1, NCAV1,2
CAVX(ICA V)=CAVXX(ICA V)
102 CAVY(ICA V)=CAVYY(ICA V)
101 CONTINUE
XCC=CAVX(NCAV1)
YCC=CAVY(NCAV1)
XCCC=XCC
YCCC=YCC
RETURN
END

SUBROUTINE IC2(SR,SM,XCA,ISIC)
DIMENSION XKER1(100),XKER2(100),XST(5)
COMMON YCCC,SBETA2
COMMON XITN(200),XITN(200),ANS62S(200),SARC2(200)
COMMON CAVX(100),CAVY(100),BETAB,BETAC,YCCC,NCAV,LPM1,NS2
COMMON AJ(100),ISHARP,NCHBY,BBTAN(100),BBTAN2(100),BETAN2(100)
COMMON FLAPAN,DELTA,JGAP,ALFA1,SAMMA
COMMON SIGMA,SBETA,XXM,ICPI,SARCO(513)
COMMON IDUL,XA,XB,XC,TANG,EP,YC,YR,JBIGS,YLBIGS,BIGS,SMALS,DSS
COMMON XSM(5),CCC1,CLE,ERC,YYY,XY,ITERA,SYSD(5),SYSID(5),YXS(5)
COMMON PSIZ,LP,SARC(513),SARCO(513),LPM,DE
COMMON BETAN(513),BETAM(513),IJ,LPK,XII(200),XJJ(200),XJX
COMMON XROUND,A2AA,S2BB,C2CC
COMMON AAAA,BBBB,CCCC,AA,BB,CC,DD,TT,GAUS(100),WGAUS(100),NGAUS
DO 1 IPM = 1,5
1 XST(IPM) = YXS(IPM)
XX1 = XST(4)*SIN(DELTA)
YY1 = XST(4)*COS(DELTA)
YY12 = YY1**2
C ISIC = 0 FOR RMINT
C = 1 IN CAVITY OF OFSIMS FOR F(5) AND IN CAVITY.
SINC = XST(1)/21.
DO 60 ITE = 1,21
XYIN = FLOAT(ITE-1)*SINC
RU1 = XYIN-XST(2)
RU2 = (XYIN+1.)*(XST(1)-XYIN)*(XYIN-XST(3))
RU3 = SQRT(RU1/RU2)
RV1 = XYIN-XX1
RV12 = RV1**2
RV2 = RV12 + YY12
RWR = RV1/RV2
RWI = YY1/RV2
IF (ISIC.EQ.1) RWR = 1./(XYIN-XCA)
C RWI AND XKER2(I) BECOME DUMMY FOR ISIC = 1.
XKER1(ITE) = RU3*RWR

```



```

60 XKER2(ITE) = RU3*RWI
   SR = 0.
   SM = 0.
   DO 61 ILO = 1,19,2
   SK = SX+SINC*(XKER1(ILO)+4.*XKER1(ILO+1)
1+XKER1(ILO+2))/3.
61 SM = SM+SINC*(XKER2(ILO)+4.*XKER2(ILO+1)
1+XKER2(ILO+2))/3.
   ADT1 = XSI(1)-XST(2)
   ADT2 = (XST(1)+1.)*(XST(1)-XST(3))
   ADT3 = SQRT(ADT1/ADT2)
   ADS1 = XST(1)-XX1
   ADS2 = ADS1**2
   ADS3 = ADS2+ YY12
   ADP3 = ADS3*2.*SQRT(SINC)
   ADPL=ADS3*ADS1/ADS2
   IF(1SIC.EQ.1) ADRL = ADS3/(XST(1)-XCA)
   ADIM = ADS3*YY1/ADS2
   SR = SR+ADRL
   SM = SM+ADIM
   RETURN
   END

```

```

SUBROUTINE ARCS2(S2,XC,YC)
COMMON/THICK/TH

```

```

C THIS IS CALLED FROM F(5) AFTER CAVITY SUBROUTINE.
C FOR S2, THE JOIAL ARC LENGTH S2 IS CALCULATED BY THIS SUBROUTINE, BUT
C FOR BETAN2 FINDING, ARCLN AND BBETA ARE USED AS FOR S1.

```

```

PAI=3.141592654
XZ=.5
IF (TH.LE.1.E-6) GO TO 1
YZ = (TH**2-.25)/(2.*TH)
HGZ=ATAN(-XZ/YZ)
XCMZ=XC-XZ
YCMZ=YC-YZ
AL=ATAN(XCMZ/YCMZ)
BT=HGZ-AL
PBT=BT/(2.*PAI)
XCMZ2=XCMZ**2
YCMZ2=YCMZ**2
S2=2.*PAI*SQRT(XCMZ2+YCMZ2)*PBT
GO TO 2
1 S2 = 1.-XC
2 CONTINUE
RETURN
END

```

```

SUBROUTINE ARCLN(XSS,XL,XH,IS1I2)

```

```

COMMON/THICK/TH
COMMON YCCC,SBETA2
COMMON XITN(200),XITN(200),ANSG2S(200),SARC2(200)
COMMON CAVX(100),CAVY(100),BETA3,BETAC,XCCC,NCAY,LPM,YS2
COMMON AJ(100),ISHARP,NCHBY,BBTAN(100),BETAN2(100),BETAN2(100)
COMMON FLAPAN,DELTA,DGAP,ALFA1,GAMMA
COMMON SIGMA,SBETA,XXM,ICPI,SARCO(513)
COMMON IDUL,XA,XB,XC,TANG,EP,YC,YR,UBIGS,XLBIGS,BIGS,SMALS,DSS
COMMON XSV(5),CCC1,CLE,ERC,YYY,XM,ITERA,SXSIO(5),SXSIO(5),YXS(5)
COMMON PS12,LP,SARC(513),SARCO(513),LPM,DE
COMMON BETAN(513),BETAN(513),IJ,LPK,XII(200),XJJ(200),XDX
COMMON XROUND,A2AA,B2BB,C2CC

```

```

COMMON AAAA,BBBB,CCCC,AB,BB,CB,DB,TGAUS(100),WGAUS(100),NGAUS
C FOR PLANO-CONVEX CASCADE OF WADE AND ACOSTA.
IF (IS1I2.EQ.1) GO TO 10
XSS=XH-XL
GO TO 11
10 AT1=2.*XH-1.
AT2=2.*XL-1.
PX2=XCCC**2
PY2=YCCC**2
IF (TH.LE.1.E-6) GO TO 3
CTH = (TH**2-.25)/TH
CEND=PX2+PY2-XCCC+CTH+YCCC
CONS=SQRT(CTH**2+4.*CEND+1.)
AAT1=ASIN(AT1/CONS)
AAT2=ASIN(AT2/CONS)
XSS=.5*(AAT1-AAT2)*CONS
GO TO 11
3 XSS = XH-XL
11 CONTINUE
RETURN
END

```

```

SUBROUTINE XCYC(XCB,YCB,CX,CY)
C THIS IS CALLED FOR PLANO-CONVEX CASCADE.
COMMON/THICK/TH
XZ=.5
IF (TH.LE.1.E-6) GO TO 3
YZ = (TH**2-.25)/(2.*TH)
JK=CY-YZ
DK=CX-XZ
IF (DK.EQ.0.) GO TO 1
AK=JK/DK
AK2=AK**2
XZ2=XZ**2
YZ2=YZ**2
R2=XZ2+YZ2
SR=SQRT(R2/(1.+AK2))
XCB=XZ+SR
IF (DK.LT.0.) XCB=XZ-SR
YCB=AK*(XCB-XZ)+YZ
GO TO 2
1 CONTINUE
XCB=XZ
YCB=TH
GO TO 2
3 XCB = CX
YCB = 0
2 CONTINUE
RETURN
END

```

```

SUBROUTINE SHAPE(X,Y,BETA,IS1I2)
COMMON /THICK/TH
COMMON YCCC,SBETA2
COMMON XITM(200),XITN(200),ANSQPS(200),SARC2(200)
COMMON CAVX(100),CAVY(100),BETAB,BETAC,XCCC,NCAV,LPMM,NS2
COMMON AJ(100),ISHAP,NCHBY,BBTAN(100),BBTAN2(100),BETAV2(100)
COMMON FLAPAN,DELTA,JGAP,ALFA1,GAMMA
COMMON SIGMA,SBETA,XXI,ICPI,SARCOO(513)
COMMON IDUL,XA,XB,XC,TANG,EP,YC,YR,JBIGS,XLBIGS,PIGS,SMALS,DSS

```

```

COMMON XSN(5),CCC1,CLE,ERC,YYY,XM,ITERA,SXSIO(5),SYSIO(5),YXS(5)
COMMON PSIZ,LP,SARC(513),SARCO(513),LPM,DE
COMMON BETA(513),BETAM(513),IJ,LPK,XII(200),XJJ(200),XDX
COMMON XROUND,A2AA,B2BB,C2CC
COMMON AAAA,BBBB,CCCC,AB,BB,C3,DB,TGAUS(100),JGAUS(100),NGAUS
C PLAYO-CONVEX CASCADE CASE.
PAI=3.141592653
IF (IS1I2.EQ.1) GO TO 1
BETA=0.
Y=0.
GO TO 2
1 CONTINUE
IF (TH.LE.1.E-6) GO TO 3
PX2=XCCC**2
PY2=YCCC**2
CTH = -(TH**2-.25)/TH
CEND=PX2+PY2-XCCC+CTH*YCCC
YCO=CTH
YCO2=YCO**2
YSC=YCO2-4.*(X**2-X-CEND)
SYS=SQRT(YSC)
Y=(-YCO+SYS)*.5
YOX=-(2.*X-1.)/(2.*Y+YCO)
BETA=ATAN(YOX)-PAI
GO TO 2
3 CONTINUE
Y = 0.
BETA=-PAI
2 CONTINUE
RETURN
END

```

```

SUBROUTINE MOSEC(A,J,ER1,ER2,X,J,XLPA,IS1I2)
J=0
X1=A
X2=B
4 J=J+1
IF(J.GE.800) GO TO 3
CALL FARC(PFX1,XLPA,X1,IS1I2)
CALL FARC(PFX2,XLPA,X2,IS1I2)
X3=X1+(X2-X1)*PFX1/(PFX1-PFX2)
CALL FARC(PFX3,XLPA,X3,IS1I2)
IF(PFX3)1,2,3
1 X2=X3
X1=X1
IF(A-B)10,10,11
10 Y=X3-ER1
IF(Y.LE.0.) Y=0.
GO TO 12
11 Y=X3+ER1
12 CALL FARC(PFY,XLPA,Y,IS1I2)
IF(PFY) 5,2,2
3 X1=X3
X2=X2
IF(A-B) 20,20,21
20 Z=X3+ER1
GO TO 22
21 Z=X3-ER1
22 CALL FARC(PFZ,XLPA,Z,IS1I2)
IF(PFZ)2,2,5

```

```

5 GO TO 4
2 PP= ABS(PFX3)
  IF (PP-ER2) 6,6,4
6 X=X3
  GO TO 7
8 WRITE(6,9) J
9 FORMAT(1X,2HJ=,I3)
  STOP
7 RETURN
  END

```

```

FUNCTION AITKEN(XX,YY,X,N)
DIMENSION XX(1),YY(1),ZZ(21)
IF (N)1,1,2
1 AITKEN=YY(1)
  RETURN
2 IF (N.GT.20) N=20
  M=N+1
  DO 3 K=1,M
3 ZZ(K)=YY(K)
  DO 4 I=1,N
  DO 4 J=I,N
4 ZZ(J+1)=ZZ(I)+(X-XX(I))*(ZZ(J+1)-ZZ(I))/(XX(J+1)-XX(I))
  AITKEN=ZZ(N+1)
  RETURN
  END

```

```

SUBROUTINE DETERM (A,N,D)
C DETERM REVISED 02-28-73
  REAL M
  DIMENSION A(50,50),SAVEA(50,50)
  IF (N .EQ. 1)GO TO 46
  C = 1.
  NN = N
  DO 9 J = 1,NN
  DO 9 I = 1,NN
9 SAVEA(I,J) = A(I,J)
  K = 1
  GO TO 13
12 K = K + 1
13 I = K + 1
  L = K
  GO TO 17
16 I = I + 1
17 IF (ABS(SAVEA(I,K)) .GT. ABS(SAVEA(L,K))) L = I
  IF (I .NE. NN)GO TO 16
  IF (L .EQ. K)GO TO 29
  J = K
C ROW INTERCHANGE
  GO TO 23
22 J = J + 1
23 SAVEKJ = SAVEA(K,J)
  SAVEA(K,J) = SAVEA(L,J)
  SAVEA(L,J) = SAVEKJ
  IF (J .NE. NN)GO TO 22
  C = -C
28 I = K + 1
  GO TO 31
30 I = I + 1
31 CONTINUE

```

```

IF (SAVEA(K,K) .EQ. 0.) GO TO 48
M = SAVEA(I,K) / SAVEA(K,K)
SAVEA(I,K) = 0.
J = K + 1
GO TO 36
35 J = J + 1
36 SAVEA(I,J) = SAVEA(I,J) - M * SAVEA(K,J)
IF (J .NE. NN) GO TO 35
IF (I .NE. NN) GO TO 30
IF (K .NE. (NN-1)) GO TO 12
D = 1.
DO 43 I = 1, NN
J = I
D = D * SAVEA(I,J)
IF (ABS(D) .LT. 1.E-36) GO TO 48
43 CONTINUE
D = D * C
RETURN
46 J = A(1,1)
RETURN
48 D = 0.
WRITE (6,51)
RETURN
51 FORMAT(//DXX, TERROR MESSAGE FROM DETERM.//
1 5X, 'MATRIX IS SINGULAR. DETERMINANT SET = 0.† //)
END

```

```

C THIS GIVES BETA(X(XS1)).
SUBROUTINE BBBETA(XX, RBETA, IS1I2)
COMMON YCCC, SBETA2
COMMON XITM(200), XITV(200), ANSG2S(200), SARC2(200)
COMMON CAVX(100), CAVY(100), BETAB, BETAC, XCCC, NCAV, LPM, NS2
COMMON AJ(100), ISHAR, NCHBY, BBTAN(100), BBTAV2(100), BETAV2(100)
COMMON FLAPAN, DELTA, DGAP, ALFA1, GAMMA
COMMON SIGMA, SBETA, XXM, ICPI, SARCO(513)
COMMON IDUL, XA, XB, XC, TANG, EP, YC, YR, JBIGS, XLPTS, BIGS, SMALS, DSS
COMMON XSN(5), CCC1, CLE, ERC, YYY, XM, ITERA, SXSIO(5), SXSIOJ(5), YXS(5)
COMMON PSIZ, LP, SARC(513), SARCO(513), LPM, DE
COMMON BETAN(513), BETAM(513), IJ, LPK, XII(200), XJJ(200), XOX
COMMON XJJND, A2AA, B2BB, C2CC
COMMON AAAA, BBBB, CCCC, AB, BB, CB, DB, TGAUS(100), JGAUS(100), NGAUS
ER1=5.E-3
ER2=5.E-3
IF (IS1I2.EQ.1) GO TO 20
C IS1I2=0 FOR S1.
C 1 FOR S2.
LPM=LP-1
SMALS=SARC(LP)
IF (LP.EQ.LPM) GO TO 10
DSS=SARC(LP)-SARC(LP+1)
XLPA=XX
GO TO 21
20 SMALS=SARC2(LP)
IF (LP.EQ.1) GO TO 11
XLPA=XX
DSS=SARC2(LP)-SARC2(LP-1)
21 CONTINUE
X1A=XLPA
4 X1B=X1A+.001
CALL FARC(FAR, XLPA, X1B, IS1I2)

```

```

IF(FAR.LT.0.) GO TO 3
X1A=X1B
GO TO 4
3 CALL MOSEC(X1A,X1B,ER1,ER2,XX,JII,X-PA,IS1I2)
GO TO 11
10 XX=0.
GO TO 11
110 XX=XCCC
11 CALL SHAPE(XX,Y,RBETA,IS1I2)
1ETJRN
END

```

```

SUBROUTINE FARC(FAR,XLPA,X1B,IS1I2)
COMMON YCCC,SBETA2
COMMON XITM(200),XITN(200),ANSG2S(200),SARC2(200)
COMMON CAVX(100),CAVY(100),BETAB,BETAC,XCCC,NCAY,LP4M,NS2
COMMON AJ(100),ISHARP,MCHBY,BBTAN(100),BBTAN2(100),BETAN2(100)
COMMON FLAPAN,DELTA,OGAP,ALFA1,GAMMA
COMMON SIGMA,SBETA,XX1,ICPI,SARCO(513)
COMMON IDUL,XA,XB,XC,TANG,EP,YC,YR,JBIGS,XLBIGS,BIGS,SMALS,DSS
COMMON XSN(5),CCC1,CLE,ERC,YYY,XM,ITERA,SXSIO(5),SXSIO(5),YXS(5)
COMMON PSIZ,LP,SARC(513),SARCO(513),LPM,DE
COMMON BETAN(513),BETAM(513),IJ,LPK,XII(200),XJJ(200),XDX
COMMON XROU4D,A2AA,323B,C2CC
COMMON AAAA,BBBB,CCCC,AB,BB,CB,DB,TGAUS(100),#GAUS(100),NGAUS
IF(XLPA.EQ.X13) GO TO 1
CALL ARCLN(XSS,XLPA,X1B,IS1I2)
GO TO 2
1 XSS=0.
2 CONTINUE
FAR=OSS-XSS
RETURN
END

```

vv

```

READ(5,1321) SBETA ,SBETA2,SF4,BETAB,BETAC
READ(5,551) LPMS,LPKS,LPM2,IFLAG,IREAD,ISHARP
READ(5,201) NITER,*MSTDP,MAXIT,NHK
READ(5,202) ALFA1S,GAMMAS,SOLIS,   CAVLEN
READ(5,229) DE,DG,DF
C CAVLEN IS A CAVITY LENGTH SPECIFIED.
DO 592 IDELTA=1,6
592  WRITE (6,591) (DELT(IDELTA,I),I=1,6)

      WRITE (6,5690) TH,XXM
      WRITE(6,5651) EETA5,BETAC
      WRITE(6,565)  R,AAAA,BBBB,CCCC
      WRITE(6,566)  A8,B8,C8,D8
      WRITE(6,567)  XROUND,A2AA,B2BB,C2CC
      WRITE(6,1229) LPMS,LPKS,SBETA,IREAD,NCHY
      WRITE(6,1324) DE,DG,DF,SF4
      WRITE(6,1521) SBETA2
590  FORMAT (dF10.6)
591  FORMAT (10X,DELTA(I,J)=*,6(F10.6,2X))
5690 FORMAT (20X,*THICKNESS OF PLANO CONVEX FCIL = *,F10.5,10X,*,X*=*,
1F10.5)
565  FORMAT(20X,*R=*,F5.2,2X,*AAAA=*,F10.6,2X,*BBBB=*,F10.6,2X,*CCCC=*,
XF10.6)
566  FORMAT(20X,*A8=*,F10.6,2X,*B8=*,F10.6,2X,*C8=*,F10.6,2X,*D8=*,F10.
X6)
567  FORMAT(20X,*XROUND=*,F10.6,2X,*A2AA=*,F10.6,2X,*B2BB=*,F10.6,2X,*C
X2CC=*,F10.6)
795  FORMAT(F110)
C AAAA,BBBB,CCCC ARE CONSTANTS FOR 2-TERM CAMBER, Y AND SQRT(X)
C -----CALCULATED FROM ANOTHER PROGRAM CALLED *CAMBER-----
C A8,B8,C8 AND D8 ARE COEFFICIENTS FOR POLYNOMIALS FOR X GREATER THAN ...
C C8D AND C8D8 ARE NO. DUMMY.
C SF4 IS USED FOR DETERMINING WHETHER TO CALCULATE BETA.
1321 FORMAT(5E14.7)
C IFLAG=1 NEEDS DATA CARDS FOR SXSI(I). IF=1,F, IREAD MAY BE SET TO 5.
C IF IFLAG=0 , DATA WILL BE READ EITHER FROM
C   DATA CARD, IF IREAD=5
C   TAPE1   , IF IREAD=1.
551  FORMAT(10I8)
201  FORMAT(4I8)
202  FORMAT(4E14.7)
C DE,DG,DF ARE THE INCREMENTS FOR DERIVATIVES IN OXFNEW.
C D8=1.E-3 & DF=1.E-5 ARE USED BEFORE.
229  FORMAT(3E14.7)
1229 FORMAT(5X,4HLPM=,I4,2X,4HLPK=,I4,2X,6HSBETA=,E14.7,5X,6HIREAD=,I1,
X2X,*NCHY=*,I3)
5651 FORMAT(20X,*BETAS AND BETAC AS FIRST GUESS=*,F10.5,2X,F10.5)
1324 FORMAT(10X,3HDE=,E14.7,2X,3HDF=,E14.7,1HDF=,E14.7,2X,4HSF4=,E14.7)
1521 FORMAT(10X,*SBETA2=*,E14.7)
      SBETA2=SBETA2*PI/180.
      BETAB=BETAB*PI/180.
      BETAC=BETAC*PI/180.
C   LPM=LPM2=NS2
      LPM=LPM2
      VS2=L242
      LPM1=LPM+1
      WRITE(6,1459) LPM2,ISHARP
1459  FORMAT(10X,*LPM2=*,I3,2X,*ISHARP=*,E14.7)
C ISHARP=0 FOR SHARP L.L.

```



```

C      1 FOR ROUNDED L.E.
      SBETA=SBETA*PAI/180.
      DO 999 IJKL=1,NITER
C FFF4 IS PROVIDED FROM DXFNE1, BUT IF THE LOOP DOES NOT GO THROUGH
C IT, FFF4 OF PRESET VALUE MUST BE USED.
      FFF4=0.
      ALFA1D=ALFA1S
      GAMMAD=GAMMAS
      SOLID=SCLIS
      IF(NHK.EG.1) GO TO 240
      IF(NHK.EG.2) GO TO 241
      SOLID=SCLIS+0.1*FLOAT(IJKL-1)
      GO TO 243
241  GAMMAD=GAMMAS+2.*FLOAT(IJKL-1)
      GO TO 243
240  ALFA1D=ALFA1S-2.*FLOAT(IJKL-1)
243  CONTINUE
      XM=XXM
      ALFA1=ALFA1D*PAI/180.
      DGAP=1./SOLID
      GAMMA=GAMMAD*PAI/180.
      DELTA=ALFA1+GAMMA
      FLAPAN=0.
      *RITE(6,666) ALFA1D,GAMMAD,SOLID
666  FORMAT(1X,16HINCIDENCE ANGLE=,E14.7,1Y,6HGAMMA=,E14.7,1X,9MSOLIDIT
      XY=,E14.7)
      *RITE(6,663) FLAPAN
663  FORMAT(5X,11HFLAP ANGLE=,E14.7)
      STULL=2.E-4
      STULS=5.E-4
      ERC=1.E-2
      CLE=1.E-4
      *RITE(6,511) CAVLEN
      E11  FORMAT(10X,*,CAVITY LENGTH=*,E14.7)
C SPECIFY HYDROFOIL'S CHARACTERISTICS AND SEP. POINTS.
      XC=0.
      YC=0.
      XB=0.
      XA=1.
      *RITE(6,502)XA,XB,XC,YC,XXDD,YYDD
502  FORMAT(10X,6HCHORD=,E14.7,2Y,17HUPPER SEP. POINT=,E14.7,2X,20HDOWN
      X, POINT(XC,YC)=(,E14.7,1H,,E14.7,1H)/*, XXDD=*,F10.6,2Y,*,YYDD=*,
      Y F10.6)
C START ITERATIVE PROCEDURE.
C -----BASIC FLOW IS THAT OF FLAT PLATE-----
C ITERAT IS INDEX FOR NUMBER OF ITERATIONS.
      ITERA=1
      IF(IFLAG.EG.0) ITERA=2
      IF(IFLAG.EG.0) IREAD=1
      BIGS=0.
      XHIGH=0.
      XLOW=0.
      IS112=0
      XINCRT=XI/50.
      DO 248 IINC=1,50
      XLOW=YHIGH
      XHIGH=XLOW+XINCRT
      CALL ARCLEV(S,XLOW,*,XHIGH,*,IS112)
248  BIGS=BIGS+S
C -----FIND FIGS2-----

```

```

C      FIRST CALL SHAPE TO FIND A CORRESPONDING TO CAVLEN.
      XCCC=0.
      YCCC=0.
      CALL SHAPE(CAVLEN,Y,BETA,1)
      CALL ARCS2(BIGS2,CAVLEN,Y)
      WRITE(6,504) BIGS,BIGS2
504  FORMAT(10X,5H8BIGS=,E14.7,5X,*,9BIGS2=*,E14.7)
      STOL=1.E-5
      LPM=LPMS
      LPK=LPKS
      LPM1=LPM-1
      LPM3=LPM-3
C  ICPI IS USED FOR CONTROLLING PROGRAM; 0 FOR ITER. 1 FOR THE REST.
C  FIND XSIS,XSIC,XSIF,A,ALFA2 BY USING NEWTON'S METHOD.
C  SXSI(1)=XSIE
C  SXSI(2)=XSIC
C  SXSI(3)=XSIF
C  SXSI(4)=A WHICH IS THE COEFFT. OF MAPPING FCM.
C  SXSI(5)=ALF2
C  SXSI(6)=SIGMA
      IF(IJKL.GE.2) GO TO 630
      IF(IFLAG.EQ.0) GO TO 779
C  INITIAL GUESS FOR SXSI(I) IS -----
      READ(5,768) SXSI(1),SXSI(2),SXSI(3),SXSI(4),SXSI(5),SXSI(6)
      GO TO 160
779  READ(IREAD,620) SXSI(1),SXSI(2),SXSI(3),SXSI(4),SXSI(5),SXSI(6)
620  FORMAT(6E13.7)
629  DO 621 IC=1,LPM
621  READ(IREAD,622) SARC(IC),BETAN(IC)
622  FORMAT(2E14.7)
      DO 1621 IC=1,LPM1
1621  READ(IREAD,622) SARC2(IC),BETAN2(IC)
      IF(IFLAG.EQ.0) GO TO 480
      GO TO 481
480  DO 482 IBT=1,LPM1
482  BETAN(IBT)=.5*(BETAN(IBT)+BETAN(IBT+1))
481  CONTINUE
160  ICPI=0
      WRITE(6,102) ITERA
102  FORMAT(10X,14HITERATION NO. =,I2)
      DO 650 IRP=1,6
650  SXSI(IRP)=SXSI(1)
      IF(ITERA.GE.2) STOL=STOLS
      IF(ITERA.EG.MSTOP) STOL=STOLL
C
C
C
C
C
C
      CALL OXFREW(SXSI,STOL,MAXIT,ITN,DS,DF,FFF4)
C
630  CONTINUE
      DO 637 IC1=1,6
      XSM(IC1)=SXSI(IC1)
637  WRITE(6,535) IC1,SXSI(IC1)
635  FORMAT(10X,5nSXSI(,I1,2H)=,E14.7)
      CSPACE=(1.+SXSI(1))/FLOAT(LPK)
      HCSPACE=0.E+CSPACE

```



```

C      ANSG2S IN COMMON = G2.
      DO 660 NCP = 1,LPMM1
      IF(NCP.EQ.1) GO TO 681
      IF (NCP.EQ.LPMM1) GO TO 682
      G2 = EXP(ANSG2S(NCP))
      G2 = G2**2
      CP2(NCP) = 1.-G2*UU22
      GO TO 680
681  CP2(NCP)=SXS1(6)
      GO TO 680
682  CP2(NCP) = 1.-UU22
690  CONTINUE

C
C
C-----*MAIN INSERT 1*-----
C
      AF4=ABS(FFF4)
      IF(AF4.GE.SF4) GO TO 1135
      GO TO 1134
1135  WRITE(6,1136)
1136  FORMAT(5X,'F(4) IS TOO LARGE TO CALCULATE BETA')
      STOP
C FIND XXX(XSIP) FIRST.
1134  CONTINUE
      IS1S2=0
C-----FIRST BETA FOR ARC 1-----
      DO 100 LLP=1,LFM
      LP=_PH-LLP+1
      CALL BBBETA(XYX,BETA,IS1S2)
      XXX(LP)=XYX
      BETAN(LP)=BETA
      IF(LP.EQ.LPM) BETAB=BETA
      IF(ITERA.LE.MSTOP1) GO TO 100
      WRITE(6,101) LP,SARC(LP),XXX(LP),CP(LP),BETAN(LP)
100  CONTINUE
101  FORMAT(1X,2H I=,I3,1X,5HSARC=,E14.7,1X,4HXXX=,E14.7,1X,3HCP=,E14.7,
1X,6HBETAN=,E14.7)

C
C
C-----*MAIN INSERT 2*-----
C
C-----BETA FOR ARC S1-----
C      SARC2 HAS BEEN CALCULATED
C      IN SUBROUTINE OFSIMS AND
C      STORED IN COMMON AREA.
      IS1S2 = 1
      DO 429 LLP=1,LPMM1
      LP=LLP
      CALL BBBETA(XYX,BETA,IS1S2)
      IF(LP.EQ.1) BETAC=BETA
      XXX2(LP) = XYX
      BETAN2(LP) = BETA
      IF(ITERA.LE.MSTOP1) GO TO 329
      WRITE(6,239) LP,SARC2(LP),XXX2(LP),CP2(LP),BETAN2(LP)
239  FORMAT(5X,'1=,',I3,1X,'SARC2=,',E14.7,1X,'XXX2=,',
'E14.7,1X,'CP2=,',E14.7,1X,'BETAN2=,',E14.7)
329  CONTINUE
429  CONTINUE

```

```

C
C
C-----*MAIN INSERT 2*-----
C
C-----*MAIN INSERT 3 *-----
C
C
C FIND LIFT AND DRAG.
C-----FIRST CL AND CD FOR S1 PART.
  JSID = SIN(DELTA)
  UCDD = COS(DELTA)
  JXB = SXSI(4)*UCDD
  JXB2 = UXB**2
  DO 106 ITK = 1, LPM
  IF (ITK.GT.LPK) GO TO 106
  XPS = -1.+CSPACE*FLCAT(ITK-1)
  GO TO 106
106 XPS = XBET+FSIZE*FLCAT(ITK-LPK)
108 CONTINUE
  JXA = XPS-SXSI(4)*JSID
  UXA2 = UXA**2
  PXXP = UCDD/(UXA2+UXB2)
  DWDX = DGAP*PXXP*XPS/PAI
  COBET1 = COS(BETAN(ITK))
  SIBET1 = SIN(BETAN(ITK))
  DS1DX = -EXP(-XITV(ITK))*DWDX/UU22
C  G1 IS CALCULATED AT OFSIM2 AS XITV(I).
C  AND STORED IN COMMON.
  IF (XPS.LT.0.) DS1DX = -DS1DX
  XLP1 = DS1DX*CP(ITK)
  FL(ITK) = -XLP1*COBET1
  FD(ITK) = XLP1*SIBET1
108 CONTINUE
C-----CL AND CD FOR S2 PART.
  NS21=NS2+1
  VS2A=VS2-1
  GAP2 = (SXSI(3)-SXSI(2))/NS2
  DO 338 ITK = 1, NS21
  YRS2 = SXSI(2)+GAP2*(ITK-1)
  JXA = YRS2-SXSI(4)*JSID
  UXA2 = JXA**2
  PXXP = UCDD/(UXA2+UXB2)
  DWDX = DGAP*PXXP*YRS2/PAI
  COBET2 = -COS(BETAN2(ITK))
  SIBET2 = -SIN(BETAN2(ITK))
  DS2DX = EXP(-ANS2S(ITK))*DWDY/UU22
C  G2 IS ALREADY CALCULATED AT OFSIM5 AS
C  ANS2S(I), STORED IN COMMON AREA.
  XLP2 = DS2DX*CP2(ITK)
  FL2(ITK) = -XLP2*COBET2
  FD2(ITK) = XLP2*SIBET2
338 CONTINUE
  SPACE = CSPACE
  CLIFT = 0.5*CSPACE*FL(2)+0.5*FSIZE*FL(LPM1)
  CDRA6 = 0.5*CSPACE*FD(2)+0.5*FSIZE*FD(LPM1)
  DO 111 IUA = 2, LPM3, 2
  IF (IUA.GE.LPK) SPACE = FSPACE
  CLIFT = CLIFT+SPACE*(FL(IUA)+4.*FL(IUA+1)+FL(IUA+2))/3.
111 CDRA6 = CDRA6+SPACE*(FD(IUA)+4.*FD(IUA+1)+FD(IUA+2))/3.

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      DO 321 IUA = 1, NS2A*2
      CLIFT = CLIFT+GAP2*(FL2(IUA)+4.*FL2(IUA+1)+FL2(IUA+2))/3.
321 CDRAG = CDRAG+GAP2*(FD2(IUA)+4.*FD2(IUA+1)+FD2(IUA+2))/3.
C-----ADD THE FORCES ON CAVITY PORTIONS.
C      SUBROUTINE XCYC CALCULATES
C      THE POINT ON THE UPPER BLADE PORTION CORRESP. TO THE CAVITY END POINT.
      CXA=XCCC
      CYA=YCCC
      CALL XCYC(XCCCB,YCCCB,CXA,CYA)
      CLIFT = CLIFT+SXSI(6)*XCCCB
      CDRAG = CDRAG-SXSI(6)*YCCCB
C-----XCCC AND YCCC ARE THE END POINTS OF CAVITY, CALCULATED IN
C      SUBROUTINE CAVITY
C      STORED IN COMMON.
C
C
C
C*****MAIN INSERT 3 *****
C
C      FIND BINF IN 2-1.
      U2U1=CCS(ALFA1+GAMMA)/COS(SXSI(5)+GAMMA)
      DO*H=CCS(ALFA1+GAMMA)+COS(SXSI(5)+GAMMA)
      BINF=0.5*SIN(ALFA1+SXSI(5)+2.*GAMMA)/DO*H
      BINF=ATAN(1./BINF)
      AINF=0.5*PI-BINF-GAMMA
C      CDSTAR AND ALSTAR ARE BASED ON VELOCITY AT UPSTREAM INFINITY IN (X,Y).
      CDSTAR=CDRAG
      CLSTAR=CLIFT
      UINF=0.5*SQRT(1.+U2U1**2+2.*U2U1*CCS(ALFA1-SXSI(5)))
      FINF=2.*DGAP*SIN(ALFA1-SXSI(5))/(UINF*CCS(SXSI(5)+GAMMA))
      CLINF=CLSTAR*CCS(AINF)-CDSTAR*SIN(AINF)
      CDINF=CLSTAR*SIN(AINF)+CDSTAR*CCS(AINF)
      CLINF=CLINF/UINF**2
      CDINF=CDINF/UINF**2
      WRITE(6,117) CLINF,CDINF
117  FORMAT(1X,34HCLINF OR CDINF=FORCE/1/2RHO.UINF**2,5X,6HCLINF=,E14.7,
      X1X,6HCDINF=,E14.7)
      WRITE(6,118) FINF
118  FORMAT(1X,34HFINF IS OBTAINED FROM MOMENTUM EQN,6HFINF=,E14.7)
      WRITE(6,221)
221  FORMAT(1X,48H---CCLL & CCDD ARE BASED ON U1 IN ALFA1 DIRE.---)
      CCLL=CLSTAR*CCS(ALFA1)-CDSTAR*SIN(ALFA1)
      CCDD=CLSTAR*SIN(ALFA1)+CDSTAR*CCS(ALFA1)
      ALDD=CCLL/CCDD
      WRITE(6,191) CCDD,CCLL,ALDD
191  FORMAT(1X,54HCCDD=,E14.7,1X,5HCCLL=,E14.7,1X,44HALDD=,E14.7)
      MSTOP1=MSTOP-1
      IF(ITERA.LE.MSTOP1) GO TO 140
C
C
C*****MAIN INSERT 4 *****
C
C      CAVITY SHAPE.
C      ALREADY CALCULATED IN
C      SUBROUTINE CAVITY.
      WRITE(6,287)
287  FORMAT(2X,----CAVITY SHAPE-----)
      NCAV1=NCAV+1
      DO 288 KCAV=1,NCAV1,2

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255 WRITE(6,255) CAVX(KCAV ),CAVY(KCAV )
256 FORMAT(10X,**X**E14.7,10X,**Y**E14.7)
C
C
C*****MAIN INSERT 4 *****
C
C
140 CONTINUE
XCCC=0.
YCCC=0.
WRITE(6,623)
623 FORMAT(//,-----JPPER BOBY SHAPE-----)
DO 821 ISHP=1,51
X=.02*(ISHP-1)
CALL SHAPE (X,Y,BETA,1)
621 WRITE(6,622) X,Y
622 FORMAT(5X,**X**F10.5,2X,**Y**F10.5)
REWIND 7
WRITE(7,755) SXSI(1),SXSI(2),SXSI(3),SXSI(4),SXSI(5),SYSI(6)
755 FORMAT(6E13.7)
DO 765 IC=1,LPM
756 WRITE(7,767) SARC(IC),BETAN(IC)
757 FORMAT(2E14.7)
DO 1755 IC=1,LPMM1
1755 WRITE(7,767) SARC2(IC),BETAN2(IC)
IF(ITERA.GE.MSTCP) GO TO 999
LPK1=LPK-1
SPACE=CSPACE
HSPACE=HCSPAC
DO 50 IM=1,LPK1
IF(IM.EQ.1) GO TO 51
IF(IM.EQ.LPK1) GO TO 55
IF(IM.EQ.LPK) GO TO 97
IF(IM.EG.LPK) GO TO 96
IF(IM.GT.LPK) GO TO 93
XY=-1.+SPACE*FLOAT(IM-1)+HSPACE
XZ(1)=-1.+SPACE*FLOAT(IM-2)
XZ(2)=XZ(1)+SPACE
XZ(3)=XZ(2)+SPACE
XZ(4)=XZ(3)+SPACE
GO TO 95
92 SPACE=FSPACE
HSPACE=HFSPAC
XY=XBET+HSPACE+SPACE*FLOAT(IM-LPK)
XZ(1)=XBET+SPACE*FLOAT(IM-LPK-1)
XZ(2)=XZ(1)+SPACE
XZ(3)=XZ(2)+SPACE
XZ(4)=XZ(3)+SPACE
99 DO 56 IK=1,4
56 YBE(IK)=BETAN(IM+IK-2)
BETAN(IM)=AITKEN(XZ,YBE,XY,3)
GO TO 151
97 BETAN(LPK1)=0.5*(BETAN(LPK1)+BETAN(LPK))
GO TO 151
98 BETAN(LPK)=0.5*(BETAN(LPK)+BETAN(LPK+1))
GO TO 151
51 BETAN(1)=0.5*(BETAN(1)+BETAN(2))
GO TO 151
55 BETAN(LPM1)=0.5*(BETAN(LPM1)+BETAN(LPM))
151 CONTINUE

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50 CONTINUE
  IF(ITERA.EQ.1) GO TO 6
  DO 41 IE=1,LPM
41  BETAN(IE)=BETAN(IE)*(1.-XXM)+BETAN0(IE)*XXM
  DO 42 IFG=1,LPM1
42  BETAM(IFG)=BETAM(IFG)*(1.-XXM)+BETA10(IFG)*XXM
  DO 425 IFG=1,LPMM1
425  BETAV2(IFG) = BETAV2(IFG)*(1.-XXM)+BETA02(IFG)*XXM
  DO 552 IRP=1,5
552  SXSI(IRP)=SXSI(IRP)*(1.-XXM)+SXSID(IRP)*XXM
  6  ITERA=ITERA+1
  IF(ITERA.GT.MSTOP) GO TO 25
  GO TO 100
25  WRITE(6,29)
29  FORMAT(5X,26nITERATION WAS TERMINATED.)
999 CONTINUE
  STOP
  END

```

vv


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SUBROUTINE OXFNEW(X,STOL,M,I,DG,CF,FFF4)
DIMENSION F(6),P(50,5),X(6),Q(6,6),XRR1(5),XMM1(5)
COMMON/DELTAD/DELT(5,5)
COMMON /CVTYL/CAVLEV,BIGS2
COMMON/FRECAV/XFREED,YFREED
COMMON YCCC,SSETA2
COMMON XITM(200),XITN(200),ANSG2S(200),SARC2(200)
COMMON CAVX(100),CAVY(100),BETA3,BETAC,XCCC,NCAV,LPMY,MS2
COMMON AJ(100),ISHARP,NCHBY,BBTAN(100),EBTAV2(100),EBTAV2(100)
COMMON FLAPAN,DELTA,DGAP,ALFA1,GAMMA
COMMON SBETA,XXM,ICPI,SARCO(513)
COMMON IDJL,XA,XB,XC,TANG,EP,YC,YP,JBIGS,XLBIGS,BIGS,SMALS,CSS
COMMON XSN(6),CLE,ERC,YYY,XM,ITEPA,SXSIC(6),SXSIC(6),YXS(6)
COMMON PSIZ,LP,SARC(513),SARCO(513),LPM,CE
COMMON BETAN(513),BETAM(513),IJ,LPK,YII(200),XJJ(200),XCK
COMMON XROUND,A2AA,B2BB,C2CC
COMMON AAAA,BBBB,CCCC,AB,BB,CB,DB,TGAUS(100),GAUS(100),NGAUS
PAI=3.141592653
I=0
IF(ITERA.LE.3) GO TO 272
DO 67 IJ=1,6
57 WRITE(6,66) IJ,X(IJ)
66 FORMAT(1X,2+X(,I1,2+)=,E14.7)
272 CONTINUE
65 SI1=2.*DE
SI6=2.*DG
IF(X(1).LT.SI1) X(1)=SI1
SI10=X(1)+2.*DG
IF(X(2).LT.SI10) X(2)=SI10
SI11=X(2)+2.*DG
IF(X(3).LT.SI11) X(3)=SI11
IF(X(4).LT.SI6) X(4)=SI6
SI5=(0.5*PAI-GAMMA)*(1.-0.02)
IF(X(5).LT.C.) GO TO 78
IF(X(5).GT.SI5) X(5)=SI5
GO TO 79
78 IF(ABS(X(5)).GT.SI5) X(5)=-SI5
79 CONTINUE
IF(X(6).LE..001) X(6)=.001
DO 66 IJ=1,6
66 WRITE(6,66) IJ,X(IJ)
IJ=1
-----
C F(1)
DO 20 IK=1,6
20 YXS(IK)=X(IK)
5 CONTINUE
KCTRL = 1
CALL F1INTL(YINT1,KCTRL)
C SUBROUTINE F1INTL CALCULATES THE INTEGRALS IN F(1).
KCTRL = 2
CALL F1INTL (YINT2,KCTRL)
KCTRL = 3
CALL F1INTL (YINT3,KCTRL)
KCTRL = 4
CALL F1INTL (YINT4,KCTRL)
CCCC=ALOG(1.+YXS(6))/(2.*PAI)
C )ECLAPSE/)AMMAG+1AFLA(SCC/)AMMAG+)F(SXY(SCC(GOLA=1SC
CS1 = ALOG(COS(YXS(5)+GAMMA)/COS(ALFA1+GAMMA))
FA = -(YINT1/PAI+YINT2-(CCCC+CS1/PAI)+YINT3

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1+YINT4/PAI-YXS(5)
IF (IJ.EQ.1) WRITE (5,70) YINT1,YINT2,YINT3,YINT4
70 FORMAT (10X, '----I1,I2,I3,I4 OF F(1) ARE----',4(E14.7,2X))
IF (IJ.EQ.1) F(1) = FA
IF (IJ.EQ.2) GO TO 3
IF (IJ.EQ.3) GO TO 4
IF (IJ.EQ.4) GO TO 320
IF (IJ.EQ.5) GO TO 321
IF (IJ.EQ.6) GO TO 322
IF (IJ.EQ.66) GO TO 3222
P(1,5) = TAN(YXS(5)+GAMMA)*YINT3/PAI-1.
P(1,6)=-YINT3/(2.*PAI*(1.+YXS(6)))
IJ = 2
YXS(1) = X(1)+DELT(1,1)
GO TO 5
3 F1P = -FA
IJ = 3
YXS(1) = X(1)-DELT(1,1)
GO TO 5
4 F1G = -FA
P(1,1) = (F1P-F1G)/(2.*DELT(1,1))
IJ = 4
YXS(1) = X(1)
YXS(2) = X(2)+DELT(1,2)
GO TO 5
320 F1P = -FA
YXS(2) = X(2)-DELT(1,2)
IJ = 5
GO TO 5
321 F1G = -FA
P(1,2) = (F1P-F1G)/(2.*DELT(1,2))
YXS(2) = X(2)
YXS(3) = X(3)+DELT(1,3)
IJ = 6
GO TO 5
322 F1P = -FA
IJ=66
YXS(3) = X(3)-DELT(1,3)
GO TO 5
3222 F1G=-FA
YXS(3) = X(3)
P(1,3) = (F1P-F1G)/(2.*DELT(1,3))
P(1,4) = 0.
C-----F(2) AND F(3)-----
IJ = 7
330 CONTINUE
C )ECAPSE/)AMMAG+)5(SXV(SQC/)AMMAG+1AFLA(SQC(CCLA=XKXX
XKXX = ALOG(COS(ALFA1+GAMMA)/COS(YXS(5)+GAMMA))
XX1 = YXS(4)*SIN(DELTA)
YY1 = YXS(4)*COS(DELTA)
YY12=YY1**2
CCC1=ALOG(1.+YXS(6))/(2.*PAI)
CON1 = CCC1-XKXX/PAI
XRP = G.
XMM = G.
DO 331 MIG = 1,4
CALL RMINT(SOLNR,SOLNM,MIG)
XRR1(MIG) = SOLNR
XMMI (MIG) = SOLNM
XRRR = -XRR1(MIG)/PAI

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XMMM = -XMMI(MIG)/PAI
IF (MIG.EQ.1) XRRR = CON1*XRRR(MIG)
IF (MIG.EQ.1) XMMM = CON1*XMMI(MIG)
IF (MIG.EQ.4) XRRR = -XRRR(MIG)
IF (MIG.EQ.4) XMMM = -XMMI(MIG)
IF (IJ.EQ.7) WRITE (6,71) (XRRR(I),I=1,4)
IF (IJ.EQ.7) WRITE (6,72) (XMMI(I),I=1,4)
71 FORMAT(10X,----XRRR(I),I=1,4 OF F(2) AND F(3) ARE----,4(E14.7,2X))
72 FORMAT(10X,----XMMI(I),I=1,4 OF F(2) AND F(3) ARE----,4(E14.7,2X))
XRR = XRR+XRRR
XMM = XMM+XMMM
331 CONTINUE
C-----CALCULATION OF  $\eta_1$ (ZETA1)-----
XSIP1 = XX1+1.
XSIMB = XX1-YXS(1)
XSIMF = XA1-YXS(3)
XSIMC = XX1-YXS(2)
XSIP12 = XSIP1**2
XSIMB2 = XSIMB**2
XSIMF2 = XSIMF**2
XSIMC2 = XSIMC**2
FRA = SGRT(XSIP12+YY12)
FRE = SGRT(XSIMB2+YY12)
FRF = SGRT(XSIMF2+YY12)
FRD = SGRT(XSIMC2+YY12)
THIA = ATAN(YY1/XSIP1)
IF (XSIP1.LE.0.) THIA = PAI+THIA
THIB = ATAN(YY1/XSIMB)
IF (XSIMB.LE.0.) THIB = PAI+THIB
THIC = ATAN(YY1/XSIMF)
IF (XSIMF.LE.0.) THIC = PAI+THIC
THID = ATAN(YY1/XSIMC)
IF (XSIMC.LE.0.) THID = PAI+THID
RR1 = SGRT(XRA*FRE*FRF/FRD)
THIT1 = .5*(THIA+THIB+THIC+THID)
COTH1 = COS(THIT1)
SITH1 = SIN(THIT1)
F2C0 = RR1*(XRR+COTH1-XMM*SITH1)-ALFA1
F3C0 = RR1*(XRR+SITH1+XMM*COTH1)+XKXX
IF (IJ.EQ.7) F(2) = -F2C0
IF (IJ.EQ.7) F(3) = -F3C0
IF (IJ.EQ.8) GO TO 340
IF (IJ.EQ.9) GO TO 341
IF (IJ.EQ.10) GO TO 342
IF (IJ.EQ.11) GO TO 343
IF (IJ.EQ.12) GO TO 344
IF (IJ.EQ.13) GO TO 345
IF (IJ.EQ.14) GO TO 346
IF (IJ.EQ.15) GO TO 347
TA2G = TAN(YXS(5)+GAMMA)
P(2,5) = -RR1*TA2G*(XRRR(1)+COTH1-XMMI(1)+SITH1)
P(2,5) = P(2,5)/PAI
P(3,5) = -RR1*TA2G*(XRRR(1)+SITH1+XMMI(1)+COTH1)
P(3,5) = P(3,5)/PAI+TA2G
BPY = 2.*PAI*(1.+YXS(5))
P(2,6) = RR1*(XRRR(1)+COTH1-XMMI(1)+SITH1)/BPY
P(3,6) = RR1*(XRRR(1)+SITH1+XMMI(1)+COTH1)/BPY
IJ = 5
YXS(1) = X(1)+DELT(1,2)
GO TO 330

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```

340 FP2 = F200
    FP3 = F300
    IU = 9
    YXS(1) = X(1)-DELT(2,1)
    GO TO 330
341 P(2,1) = (FP2-F200)/(2.*DELT(2,1))
    P(3,1) = (FP3-F300)/(2.*DELT(2,1))
    YXS(1) = X(1)
    YXS(2) = X(2)+DELT(2,2)
    IU = 10
    GO TO 330
342 FP2 = F200
    FP3 = F300
    YXS(2) = X(2)-DELT(2,2)
    IU=11
    GO TO 330
343 P(2,2) = (FP2-F200)/(2.*DELT(2,2))
    P(3,2) = (FP3-F300)/(2.*DELT(2,2))
    YXS(2) = X(2)
    YXS(3) = X(3)+DELT(2,3)
    IU = 12
    GO TO 330
344 FP2 = F200
    FP3 = F300
    YXS(3) = X(3)-DELT(2,3)
    IU = 13
    GO TO 330
345 P(2,3) = (FP2-F200)/(2.*DELT(2,3))
    P(3,3) = (FP3-F300)/(2.*DELT(2,3))
    YXS(4) = X(4)+DELT(2,4)
    YXS(3)=X(3)
    IU=14
    GO TO 330
346 FP2=F200
    FP3=F300
    YXS(4) = X(4)-DELT(2,4)
    IU = 15
    GO TO 330
347 P(2,4) = (FP2-F200)/(2.*DELT(2,4))
    P(3,4) = (FP3-F300)/(2.*DELT(2,4))
    YXS(4)=X(4)
-----
    IU=16
    YXS(1)=Y(1)+DELT(4,1)
199 CALL DFSIM2(ANS2)
    IF(IJ.EQ.16) GO TO 613
    IF(IJ.EQ.17) GO TO 614
    IF(IJ.EQ.18) GO TO 675
    IF(IJ.EQ.19) GO TO 615
    IF(IJ.EQ.20) GO TO 616
    IF(IJ.EQ.21) GO TO 617
    IF(IJ.EQ.22) GO TO 618
    IF(IJ.EQ.23) GO TO 621
    IF(IJ.EQ.24) GO TO 622
    IF(IJ.EQ.25) GO TO 623
    IF(IJ.EQ.26) GO TO 624
    IF(IJ.EQ.261) GO TO 6241
    IF(IJ.EQ.262) GO TO 6242
613 ANSP=ANS2
    IU=17

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```

YXS(1)=Y(1)-DELT(4,1)
GO TO 199
614 ANSG=ANS2
IJ=18
P(4,1)=-((ANSP-ANSQ)/(2.*DELT(4,1)))
YXS(1)=X(1)
GO TO 199
675 ANSF=ANS2
F(4)=-((BIGS-ANSF))
IJ=19
YXS(2)=Y(2)+DELT(4,2)*ABS(X(2))
GO TO 199
615 ANSPP=ANS2
IJ=20
YXS(2)=Y(2)-DELT(4,2)*ABS(X(2))
GO TO 199
616 ANSGG=ANS2
P(4,2)=-((ANSPP-ANSQQ)/(2.*DELT(4,2)*ABS(X(2))))
YXS(2)=X(2)
IJ=21
YXS(3)=X(3)+DELT(4,3)*X(3)
GO TO 199
617 ANS1P=ANS2
IJ=22
YXS(3)=X(3)-DELT(4,3)*X(3)
GO TO 199
618 ANS1G=ANS2
P(4,3)=-((ANS1P-ANS1Q)/(2.*DELT(4,3)*X(3)))
YXS(3)=X(3)
IJ=23
YXS(4)=X(4)+DELT(4,4)*ABS(X(4))
GO TO 199
621 ANA=ANS2
IJ=24
YXS(4)=X(4)-DELT(4,4)*ABS(X(4))
GO TO 199
622 ANB=ANS2
P(4,4)=-((ANA-ANB)/(2.*DELT(4,4)*ABS(X(4))))
YXS(4)=X(4)
IJ=25
YXS(5)=X(5)+DELT(4,5)
GO TO 199
623 BVA=ANS2
IJ=26
YXS(5)=X(5)-DELT(4,5)
GO TO 199
624 BVB=ANS2
P(4,5)=-((BVA-BVB)/(2.*DELT(4,5)))
YXS(5)=X(5)
FFF4=F(4)
YXS(5) = X(5)
YXS(5)=X(6)+DELT(4,6)
IJ=261
GO TO 199
6241 BNA=ANS2
IJ=262
YXS(6)=Y(6)-DELT(4,6)
GO TO 199
6242 BNB=ANS2
P(4,6)=-((BNA-BNB)/(2.*DELT(4,6)))

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```

      YXS(6)=X(6)
C-----F(5)-----
C   THIS SUBROUTINE FINDS THE END POINT OF CAVITY.
      IU = 27
815 CALL CAVITY (XCEND,YCEND)
      IF(IJ.EQ.27) GO TO 820
      IF(IJ.EQ.28) GO TO 821
      IF (IJ.EQ.29) GO TO 822
      IF (IJ.EQ.30) GO TO 823
      IF (IJ.EQ.31) GO TO 824
      IF (IJ.EQ.32) GO TO 825
      IF (IJ.EQ.33) GO TO 826
      IF (IJ.EQ.34) GO TO 827
      IF(IJ.EQ.341) GO TO 830
      IF (IJ.EQ.35) GO TO 828
      IF (IJ.EQ.36) GO TO 829
      IF(IJ.EQ.37) GO TO 840
      IF(IJ.EQ.38) GO TO 841
820 F(5)=- (XCEND-CAVLEN)
      IU = 26
      YXS(1) = X(1)+DELT(5,1)
      GO TO 815
821 ANP=XCEND
      IU = 29
      YXS(1) = X(1)-DELT(5,1)
      GO TO 815
822 P(5,1)=(ANP-XCEND)/(2.*DELT(5,1))
      YXS(1) = X(1)
      YXS(2) = X(2)+DELT(5,2)*ABS(X(2))
      IU = 30
      GO TO 815
823 ANP=XCEND
      YXS(2) = X(2)-DELT(5,2)*ABS(X(2))
      IU = 31
      GO TO 815
824 P(5,2)=(ANP-XCEND)/(2.*DELT(5,2)*ABS(X(2)))
      YXS(2) = X(2)
      IU = 32
      YXS(3) = X(3)+DELT(5,3)*X(3)
      GO TO 815
825 ANP=XCEND
      YXS(3) = X(3)-DELT(5,3)*X(3)
      IU = 33
      GO TO 815
826 P(5,3)=(ANP-XCEND)/(2.*DELT(5,3)*X(3))
      IU = 34
      YXS(3) = X(3)
      YXS(4) = X(4)+DELT(5,4)*ABS(X(4))
      GO TO 815
827 ANP=XCEND
      YXS(4) = X(4)-DELT(5,4)*ABS(X(4))
      IU=341
      GO TO 815
830 CONTINUE
      P(5,4)=(ANP-XCEND)/(2.*DELT(5,4)*ABS(X(4)))
      YXS(4) = X(4)
      YXS(5) = X(5)+DELT(5,5)
      IU = 35
      GO TO 815
828 ANP=XCEND

```

```

      YXS(5) = X(5)-DELT(5,5)
      IJ =36
      GO TO 815
829 P(5,5)=(ANP-XCEND)/(2.*DELT(5,5))
      YXS(5)=X(5)
      YXS(6)=X(6)+DELT(5,5)
      IJ=37
      GO TO 815
840 ANP=XCEND
      YXS(6)=X(6)-DELT(5,5)
      IJ=38
      GO TO 815
841 P(5,6)=(ANP-XCEND)/(2.*DELT(5,6))
      YXS(6)=X(6)
-----F(6)-----
      IJ=40
850 CALL DFSIMS(ANS5)
      IF(IJ.EQ.40) GO TO 851
      IF(IJ.EQ.41) GO TO 852
      IF(IJ.EQ.42) GO TO 853
      IF(IJ.EQ.43) GO TO 854
      IF(IJ.EQ.44) GO TO 855
      IF(IJ.EQ.45) GO TO 856
      IF(IJ.EQ.46) GO TO 857
      IF(IJ.EQ.47) GO TO 858
      IF(IJ.EQ.48) GO TO 859
      IF(IJ.EQ.49) GO TO 860
      IF(IJ.EQ.50) GO TO 861
      IF(IJ.EQ.51) GO TO 862
      IF(IJ.EQ.52) GO TO 863
851 F(6)=- (ANS5-SIGS2)
      IJ=41
      YXS(1)=X(1)+DELT(6,1)
      GO TO 850
852 ANP=ANS5
      IJ=42
      YXS(1)=X(1)-DELT(6,1)
      GO TO 850
853 P(6,1)=(ANP-ANS5)/(2.*DELT(6,1))
      YXS(1)=X(1)
      IJ=43
      YXS(2)=X(2)+DELT(6,2)
      GO TO 850
854 ANP=ANS5
      IJ=44
      YXS(2)=X(2)-DELT(6,2)
      GO TO 850
855 P(6,2)=(ANP-ANS5)/(2.*DELT(6,2))
      IJ=45
      YXS(2)=X(2)
      YXS(3)=X(3)+DELT(6,3)
      GO TO 850
856 ANP=ANS5
      IJ=46
      YXS(3)=X(3)-DELT(6,3)
      GO TO 850
857 P(6,3)=(ANP-ANS5)/(2.*DELT(6,3))
      IJ=47
      YXS(3)=X(3)
      YXS(4)=X(4)+DELT(6,4)

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      GO TO 850
856 ANP=ANS5
      IJ=48
      YXS(4)=X(4)-DELT(6,4)
      GO TO 850
859 P(6,4)=(ANP-ANS5)/(2.*DELT(6,4))
      IJ=49
      YXS(4)=X(4)
      YXS(5)=X(5)+DELT(6,5)
      GO TO 850
860 ANP=ANS5
      IJ=50
      YXS(5)=X(5)-DELT(6,5)
      GO TO 850
861 P(6,5)=(ANP-ANS5)/(2.*DELT(6,5))
      YXS(5)=X(5)
      YXS(6)=X(6)+DELT(6,6)
      IJ=51
      GO TO 850
862 ANP=ANS5
      YXS(6)=X(6)-DELT(6,6)
      IJ=52
      GO TO 850
863 P(6,6)=(ANP-ANS5)/(2.*DELT(6,6))
      YXS(6)=X(6)
      DO 866 IK=1,6
866 WRITE(6,867) (P(IK,J),J=1,6)
867 FORMAT(2X,*,P(I,J)=*,6(E14.7,2Y))
      NCAV1=NCAV+1
      DO 253 ICV=1,NCAV1,2
253 WRITE(6,252) CAVX(ICV),CAVY(ICV)
252 FORMAT(10X,*,CAVX=*,F10.5*5X,*,CAVY=*,F10.5)
      DO 129 ITX=1,6
129 WRITE(6,131) ITX,F(ITX)
131 FORMAT(1X,2HF(,I1,2H)=,E14.7)
      DO 132 IUP=1,6
      IF(ITER4.LE.3) GO TO 365
      DO 132 IUG=1,6
132 WRITE(6,133) IUP,IUG,P(IUP,IUG)
133 FORMAT(1X,2HF(,I1,1H,,I1,2H)=,E14.7)
365 CONTINUE
      CALL DETERM(P,6,DETS0)
      DO 25 IDET=1,6
      DO 26 LFG=1,6
      G(LFG,IDET)=P(LFG,IDET)
26 F(LFG,IDET)=F(LFG)
      CALL DETERM(P,6,DETE)
      IF(IDET.EQ.1) DELB=DETE/DETS0
      IF(IDET.EQ.2) DELC=DETE/DETS0
      IF(IDET.EQ.3) DELD=DETE/DETS0
      IF(IDET.EQ.4) DELE=DETE/DETS0
      IF(IDET.EQ.5) DELF=DETE/DETS0
      IF(IDET.EQ.6) DELG=DETE/DETS0
      DO 27 LFG=1,6
27 P(LFG,IDET)=Q(LFG,IDET)
25 CONTINUE
      X(1)=X(1)+DELB
      X(2)=X(2)+DELC
      X(3)=X(3)+DELD
      X(4)=X(4)+DELE

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X(5)=X(5)+DELF
X(6)=X(6)+DELG
DO 60 LMN=1,6
60 WRITE(6,61) LMN,X(LMN)
61 FORMAT(1X,2HX(,I1,2+)=,E14.7)
ABSB=ABS(DELB/X(1))
ABSC=ABS(DELC/X(2))
ABSD=ABS(DELD/X(3))
ABSE=ABS(DELE/X(4))
ABSF=ABS(DELF/X(5))
ABSG=ABS(DELG/X(6))
KEIC=0
IF(ABSE.LT.STOL) KEIC=1
IF(ABSC.GT.STOL) KEIC=0
IF(ABSD.GT.STOL) KEIC=0
IF(ABSE.GT.STOL) KEIC=0
IF(ABSF.GT.STOL) KEIC=0
IF(ABSG.GT.STOL) KEIC=0
IF(KEIC.EQ.1) GO TO 35
I=I+1
WRITE(6,42) I
42 FORMAT(20X,14M ITERATION NO.=,I2)
IF(I.EQ.M) GO TO 35
GO TO 55
35 IF(I.EQ.M) GO TO 35
GO TO 32
36 WRITE(6,37)
37 FORMAT(1X,34MCYFNE. DID NOT CONVERGE WITHIN 100)
IF(X(1).LT.SI1) X(1)=SI1
SI10=X(1)+2.*06
IF(X(2).LT.SI10) X(2)=SI10
SI11=X(2)+2.*05
IF(X(3).LT.SI11) X(3)=SI11
IF(X(6).LE.1.E-3) X(6)=1.E-3
IF(X(4).LT.SI5) X(4)=SI5
SI5=(.5*FA1-GAMMA)*(1.-.02)
IF(X(5).LT.0.) GO TO R1
IF(X(5).GT.SI5) X(5)=SI5
GO TO R2
R1 IF(ABS(X(5)).GT.SI5) X(5)=-SI5
R2 CONTINUE
38 RETURN
END

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SUBROUTINE CFSIM1(ANS,NOF,XCA)
DIMENSION XST(6)
COMMON YCCC,SBETA2
COMMON XIT*(200),XITN(200),ANSQ2S(200),SARC2(200)
COMMON CAVX(100),CAVY(100),BETAB,BETAC,XCCC,NCAV,LPM,NSZ
COMMON AJ(100),ISHARP,NCHBY,BBTAN(100),BBTAN2(100),BETAN2(100)
COMMON FLAPAN,DELTA,DGAP,ALFA1,GAMMA
COMMON SBETA,XXM,ICPI,SARCO(513)
COMMON IDUL,XA,XB,XC,TANG,EP,YC,YR,JEIGS,XLBIGS,BIGS,SMALS,DSS
COMMON XSN(6),CLE,EPC,YYY,XM,ITERA,SYSL(6),SXSID(6),YXS(6)
COMMON PSIZ,LP,SARCO(513),SARCO(513),LPM,DE
COMMON BETAN(513),BETAN(513),IJ,LPK,XII(200),XIJ(200),XDJ
COMMON XRGUND,A2AA,B2BB,C2CC
COMMON AAAA,BBBB,CCCC,AA,BB,CC,DD,TEAUS(100),GAUS(100),VGAUC
C NOF = 0 CALLED FROM FLINT.
C NOF = 1 CALLED FROM RMINT FOR REAL PART.
C NOF = 2 CALLED FROM RMINT FOR IMAG. PART.
C NOF = 3 CALLED FROM CAVITY DXFNEW AT F(5)
IF (ICPI.EQ.0) GO TO 9
DO 10 IQ = 1,6
10 XST(IQ) = XSN(IQ)
GO TO 12
9 DO 11 IH = 1,6
11 XST(IH) = YXS(IH)
12 CONTINUE
IF (ITERA.EQ.1) GO TO 222
GO TO 223
222 DO 224 ILK = 1,LPM
224 BETAN(ILK) = SBETA
223 CONTINUE
CSPACE = (1.+XST(1))/FLOAT(LPK)
FSPACE = CSPACE/FLOAT(LPK-LPK)
LPM3=LPM-3
XSII = -1.+CSPACE*FLOAT(LPK-1)
XSII1=-1.+CSPACE
BE1 = BETAN(2)
AP1 = (XSII-XST(2))/((XSII+1.)*(XST(1)-XSII)+(XSII-XST(3)))
AP1S = SQRT(AP1)
F3 = BE1*AP1S
XX1 = YST(4)*SIN(DELTA)
YY1 = XST(4)*COS(DELTA)
YY12 = YY1**2
PLM = XSII -XX1
PLM2 = PLM**2
PLM4 = PLM**2+YY12
PXSR = PLM/PLM4
PXSI = YY1/PLM4
IF(NOF.EQ.1) F3 = F3*PXSR
IF(NOF.EQ.2) F3 = F3*PXSI
IF(NOF.EQ.3) F3=F3/(XSII-XC4)
ANSA=0.
DO 1 I = 2,LPM3,2
F1 = F3
SPACE = CSPACE
IF (I.GE.LPK) GO TO 30
XSII2 = -1.+SPACE*FLOAT(I)
XSII3 = XSII2+SPACE
GO TO 31
30 SPACE = FSPACE

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AD-A064 743

TETRA TECH INC PASADENA CALIF

F/G 20/4

COMPUTER PROGRAM FOR CALCULATING PARTIALLY CAVITATING CASCADE F--ETC(U)

JAN 79 O FURUYA

N00014-78-C-0146

UNCLASSIFIED

TETRAT-TC-3951-02

NL

2 of 2

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XSI2 = XBET+SPACE*FLD(JAT(I-LPK+1))
XSI3 = XSI2+SPACE
31 BE2 = BETAN(I+1)
BE3 = BETAN(I+2)
AP2 = (XSI2-XST(2))/((XSI2+1.)*(XST(1)-XSI2)+(XSI2-XST(3)))
AP3 = (XSI3-XST(2))/((XSI3+1.)*(XST(1)-XSI3)+(XSI3-XST(3)))
AP2S = SQRT(AP2)
AP3S = SQRT(AP3)
F2 = BE2*AP2S
F3 = BE3*AP3S
HA2 = XSI2-XX1
HA22 = HA2**2
HB = HA22+YY12
HCR2 = HA2/HB
HCI2 = YY1/HB
HA3 = XSI3-XX1
HA32 = HA3**2
HD = HA32+YY12
HCR3 = HA3/HD
HCI3 = YY1/HD
IF(NOF.EG.1) F2 = F2+HCR2
IF(NOF.EG.1) F3 = F3+HCR3
IF(NOF.EG.2) F2 = F2+HCI2
IF(NOF.EG.2) F3 = F3+HCI3
IF(NOF.EG.3) F2 = F2/(XSI2-XCA)
IF(NOF.EG.3) F3 = F3/(XSI3-XCA)
FSUM = (F1+4.*F2+F3)*SPACE/3.
ANSA = ANSA+FSUM
1 CONTINUE
SG1 = SQRT((-1.-XST(2))/(-1.-XST(3)))
SG2 = SQRT(XST(1)+1.)
SG3 = SQRT((XST(1)-XST(2))/(XST(1)-XST(3)))
ANT1 = BETAN(1)*2.*SQRT(CSPACE)*SG1/SG2
ANT2 = BETAN(LPK)*2.*SQRT(CSPACE)*SG3/SG2
APLA = -1.-XX1
APLA2 = APLA**2
APLB = XST(1)-XX1
APLB2 = APLB**2
IF(NOF.EG.1) ANT1 = ANT1*APLA/(APLA2+YY12)
IF(NOF.EG.2) ANT1 = ANT1*YY1/(APLA2+YY12)
IF(NOF.EG.1) ANT2 = ANT2*APLB/(APLB2+YY12)
IF(NOF.EG.2) ANT2 = ANT2*YY1/(APLB2+YY12)
IF(NOF.EG.3) ANT1 = ANT1/(-1.-XCA)
IF(NOF.EG.3) ANT2 = ANT2/(XST(1)-XCA)
ANS = ANSA+ANT1+ANT2
RETURN
END

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SUBROUTINE OFSIM2(ANS2)
DIMENSION X(3),XIT(3),YY(3),XITC(3),EXU(3),FCN3(3),XST(6)
COMMON YCCC,SBETA2
COMMON XITM(200),XITV(200),ANSG2S(200),SARC2(200)
COMMON CAVX(100),CAVY(100),BETAS,BETAC,YCCC,NDAV,LPM,NS2
COMMON AJ(100),ISHARP,NCHBY,BETAN(100),SBETAN2(100),SBETAN2(100)
COMMON FLAPAN,DELTA,DGAP,ALFA1,GAMMA
COMMON SBETA,XXM,ICPI,SARCO(513)
COMMON IDJL,XA,XB,XC,TANG,EP,YC,YR,JEIGS,XLEIGS,BIGS,SMALS,CSS
COMMON XSN(6),CLE,ERC,YYY,XM,ITEPA,SXSIC(6),SXSIC(6),YXS(6)
COMMON PSIZ,LP,SARC(513),SARCO(513),LPM,DE
COMMON BETAN(513),BETAM(513),IJ,LPK,XII(200),YJJ(200),XDX
COMMON XKOUND,A2AA,B2BB,C2CC
COMMON AAAA,BBBB,CCCC,AA,BB,CC,Dd,TGAUS(100),JGAUS(100),KGAUS
DO 13 I6=1,6
13 XST(I5)=YXS(I6)
PAI=3.141592653
CCC1=ALOG(1.+XST(6))/(2.*PAI)
UU2=COS(ALFA1+GAMMA)/COS(XST(5)+GAMMA)
      ECAPSE/AMMAG+5(TSX(SOC)/AMMAG+1AFLA(SOC=2UJ)
X<KK=ALOG(UU2)
CSPACE=(1.+XST(1))/FLOAT(LPK)
HCSPACE=0.5*CSPACE
FSPACE=CSPACE/FLOAT(LPM-LPK)
HFSPACE=0.5*FSPACE
XBET=-1.+CSPACE*FLOAT(LPK-1)
CDE=COS(DELTA)
SDE=SIN(DELTA)
GA=XST(1)-XST(4)*SDE
GB=XST(4)*CDE
PPP=CDE/(GA**2+GB**2)
FCN3(3)=DGAP+PPP*XST(1)/(PAI*SQRT(1.+XST(6)))
LPKI=LPM-LPK+1
DO 1 IP=1,LPM
IF(IP.EQ.1) GO TO 2
HSPACE=HFSPACE
SPACE=FSPACE
IF(IP.GT.LPKI) GO TO 30
X(1)=XST(1)-SPACE*FLOAT(IP-2)
X(2)=X(1)-HSPACE
X(3)=X(1)-SPACE
GO TO 31
30 HSPACE=HCSPACE
SPACE=CSPACE
X(1)=XBET-SPACE*FLOAT(IP-LPKI-1)
X(2)=X(1)-HSPACE
X(3)=X(1)-SPACE
31 FCN3(1)=FCN3(3)
NK=3
IF(IP.EQ.LPM) NK=2
DO 5 I=2,NK
IF(IJ.GE.23) GO TO 3
GO TO 7
2 IF(I.EQ.2) XIT(2)=XITM(LPM-IP+1)
IF(I.EQ.3) XIT(3)=XITV(LPM-IP+1)
GO TO 5
7 CONTINUE
YY(I)=X(I)
C OFSIM3 CALCULATE 61 .

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CALL DFSIM3(YY(I),XITC(I),IP,I)
XIT(I)=XITC(I)
IF(IJ.EG.18) GO TO 6
GO TO 5
5 IF(I.EG.2) XITM(LPM-IP+1)=XIT(I)
IF(I.EG.3) XITN(LPM-IP+1)=XIT(I)
5 CONTINUE
EXU(I)=EXP(-XIT(I))
GC=X(I)-XST(4)*SDE
GD=XST(4)*CDE
PYA=GC**2+GD**2
D=Dx=BGAP*X(I)*CDE/(PXA*PAI)
FCN3(I)=EXU(I)*GD/DX/JJ2
IF(X(I).LE.0.) FCN3(I)=-FCN3(I)
5 CONTINUE
C CHECK IF FCN3(I) IS ALWAYS POSITIVE.
IF(IP.EG.LPM) GO TO 20
GO TO 21
20 PPL=CDE/((-1.-XST(4)*SDE)**2+(XST(4)*CDE)**2)
FF3=BGAP*PPL/PAI
FCN3(3)=FF3
21 SJM=(FCN3(1)+FCN3(2)+4.*FCN3(3))+4SPACE/3.
ANS2=ANS2+SJM
IF(IJ.EG.18) SARC(LPM-IP+1)=ANS2
GO TO 1
2 SARC(LPM)=0.
ANS2=0.
1 CONTINUE
C XITN(LPM)=G1 AT POINT B.
C XINT(1)=G1 AT POINT X=1.
XITN(LPM)=CCC1-XKKK/PAI
XITN(1)=0.
RETURN
END
vv

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SUBROUTINE OFSIM3(Y,XXII,IP,I)
DIMENSION XST(6),FA(200)
COMMON YCCC,SBETA2
COMMON XITM(200),XITV(200),ANS62S(200),SARC2(200)
COMMON CAVX(100),CAVY(100),BETAB,SETAC,XCCC,NCVV,LPM,NS2
COMMON AU(100),ISHAPP,NCHBY,BBTAN(100),BBTAN2(100),BETAN2(100)
COMMON FLAPAN,DELTA,DGAP,ALFA1,GAMMA
COMMON SEETA,XXM,ICPI,SARCO(513)
COMMON IDUL,XA,XB,XC,TANG,EP,YC,YR,JEIGS,XLEIGS,BIGS,SMALS,DSS
COMMON XSN(6),CLE,ERC,YYY,XM,ITERA,SXSIC(6),SXSIC(6),YXS(6)
COMMON PSIZ,LP,SARC(513),SARCO(513),LPM,DE
COMMON BETAN(513),BETAM(513),IJ,LPK,XII(200),XJU(200),XCX
COMMON XROUND,A2A4,B2B6,C2C0
COMMON AAAA,BBBB,CCCC,AB,BR,CB,DB,TRSAUS(100),NGAUS(100),NGAUS
C FOUR INTEGRALS TO BE EVALUATED BEFORE XI IS OBTAINED.
C NOTE THAT PREVIOUSLY ONLY ONE SINGULAR INTEGRAL WAS
C CALCULATED IN GCASCAD AND CASCADE.
C SEE THE NOTE OF TC 3951 FOR FOUR INTEGRALS, OUT OF WHICH
C TWO ARE OF SINGULAR TYPE.
IF(ICPI.EQ.0) GO TO 9
DO 11 ISI=1,6
11 XST(ISI)=XSN(ISI)
GO TO 12
9 DO 13 JIJ=1,6
13 XST(JIJ)=YXS(JIJ)
12 PAI=3.141592653
CCC1=ALOG(1.+XST(6))/(2.*PAI)
C-----FIRS 11-----
IF(ITERA.EQ.1) GO TO 60
GO TO 61
60 CONTINUE
DO 62 IZU = 1,LPM
BETAN(IZU) = SBETA
BETAM(IZU) = SBETA
62 CONTINUE
61 CONTINUE
CSPACE=(1.+ XST(1))/FLOAT(LPK)
HCSPACE=0.3*CSPACE
FSPACE=CSPACE/FLOAT(LPM-LPK)
HFSPACE=0.5*FSPACE
XBET=-1.+CSPACE*FLOAT(LPK-1)
AB2=SQRT(XST(1)+1.)
AB3=SQRT((1.+Y)*(XST(1)-Y))
AB6 = SQRT((XST(3)-Y)/(XST(2)-Y))
AB3 = AB3*AB6
IJ2=LPM-IP+1
IJ3=1
IF(I.EQ.3) IJ3=LPM-IP+1
IF(I.EQ.6) IJ3=IP
BEC=BETAN(IJ3)
IF(I.EQ.2) BEC=BETA*(IJ2)
FAA=BEC/AB3
LPM1=LPM-1
DO 1 IW=2,LPM1
SPACE=CSPACE
IF(I.GT.LPK) GO TO 45
XSK=-1.+SPACE*FLOAT(IJ-1)
GO TO 45
45 SPACE=HFSPACE

```



```

XSK=XBET+ SPACE*FLOAT(IJ-LPK)
46 IF(I.EG.2) GO TO 6
   IF(I.EG.IJ3) GO TO 1
6 FS=SQRT((1.+XSK)*(XST(1)-XSK))
  FSA1 = SQRT((XST(3)-XSK)/(XST(2)-XSK))
  FS = FS+FSA1
  FA(I)= (BETAN(I)/FS-FAA)/(XSK-Y)
1 CONTINUE
  IF(1.EG.2) GO TO 30
  XP1=-1.+HCSPAC
  XP2=XP1+CSPACE
  XP4=XST(1)-HFSPAC
  XP3=XP4-FSPACE
  FS1=BETAN(1)/ SQRT((1.+XP1)*(XST(1)-XP1))
  FS2=BETAN(2)/ SQRT((1.+XP2)*(XST(1)-XP2))
  FS3=BETAN(LPM-2)/ SQRT((1.+XP3)*(XST(1)-XP3))
  FS4=BETAN(LPM-1)/ SQRT((1.+XP4)*(XST(1)-XP4))
  FSA1 = SQRT((XST(2)-XP1)/(XST(3)-XP1))
  FSA2 = SQRT((XST(2)-XP2)/(XST(3)-XP2))
  FSA3=SQRT((XST(2)-XP3)/(XST(3)-XP3))
  FSA4=SQRT((XST(2)-XP4)/(XST(3)-XP4))
  FS1=FS1+FSA1
  FS2=FS2+FSA2
  FS3=FS3+FSA3
  FS4=FS4+FSA4
  FP1=(FS1-FAA)/(XP1-Y)
  FP2=(FS2-FAA)/(XP2-Y)
  FP3=(FS3-FAA)/(XP3-Y)
  FP4=(FS4-FAA)/(XP4-Y)
  IF(IU3.EG.2) GO TO 21
  IF(IU3.EG.LPM1) GO TO 22
  IF(IU3.EG.LPK) GO TO 51
  FA(IU3)=0.5*(FA(IU3-1)+FA(IU3+1))
  GO TO 30
51 BETD=2.+BETAN(LPK)-BETAN(LPK+1)
  XCA=XBET-FSPACE
  FPW=BETD/SQRT((1.+XCA)*(XST(1)-XCA))
  FPA = SQRT((XST(2)-XCA)/(XST(3)-XCA))
  FPA=FPW+FPA
  FLPK=(FPW-FAA)/(XCA-Y)
  FA(IU3)=0.5*(FA(IU3+1)+FLPK)
  GO TO 30
21 FA(IU3)=(FP1+FP2)/2.
  GO TO 30
22 FA(IU3)=(FP3+FP4)/2.
30 XI=0.
  LPM3=LPM-3
  SPACE=CSPACE
  DU 15 JA=2,LPM3+2
  IF(JA.GE.LPK) SPACE=FSPACE
15 XI=XI+(FA(JA)+4.*FA(JA+1)+FA(JA+2))*SPACE/3.
  IF(1.EG.2) GO TO 35
  XI23=0.5*HCSPAC*(FP1+FA(2))+(FA(LPM-1)+FP4) *0.5*HFSPAC
  XKI=41.
  KU=39
  LPM4=LPM-5
  IF(IU3.GE.LPM4) XKI=201.
  IF(IU3.GE.LPM4) KU=159
  BJZ=(BETAN(1)-BETAN(1))/XKI
  BOY=(BETAN(LPM)-BETAN(LPM1))/XKI

```

```

HFF=HFSPAC/XKI
HFH=HCSPAC/XKI
FT3=FP1
FU3=FP4
XI4=0.
XI1=0.
DC 202 ITM=1,KU,2
FT1=FT3
FU1=FU3
XM2=XST(1)-HFSPAC+HFF*FLOAT(ITM)
XM3=XM2+HFF
XT2=-1.+HCSPAC-HFH*FLOAT(ITM)
XT3=XT2-HFH
BETA2=BETAM(LPM1)+BDY*FLOAT(ITM)
BETA3=BETA2+BCY
BETT2=BETAM(1)-BDZ*FLOAT(ITM)
BETT3=BETT2-BDZ
FS2=BETA2/SQRT((1.+XM2)*(XST(1)-XM2))
FS3=BETA3/SQRT((1.+XM3)*(XST(1)-XM3))
FV2=BETT2/SQRT((1.+XT2)*(XST(1)-XT2))
FV3=BETT3/SQRT((1.+XT3)*(XST(1)-XT3))
FS2A = SQRT((XST(2)-XM2)/(XST(3)-XM2))
FS3A = SQRT((XST(2)-XM3)/(XST(3)-XM3))
FV2A = SQRT((XST(2)-XT2)/(XST(3)-XT2))
FV3A = SQRT((XST(2)-XT3)/(XST(3)-XT3))
FS2 = FS2*FS2A
FS3 = FS3*FS3A
FV2 = FV2*FV2A
FV3 = FV3*FV3A
FU2=(FS2-FAA)/(XM2-Y)
FU3=(FS3-FAA)/(XM3-Y)
FT2=(FV2-FAA)/(XT2-Y)
FT3=(FV3-FAA)/(XT3-Y)
XI4=XI4+n*FF*(FU1+FU2*4.+FU3)/3.
202 XI1=XI1+HFH*(FT1+FT2*4.+FT3)/3.
XA4=BETAN(LPM)*2.*SQRT(HFF)/(AB2*(XST(1)-Y))
XA4A = SQRT((XST(2)-XST(1))/(XST(3)-XST(1)))
XA4 = XA4*XA4A
XI4=XI4+XA4
XA1=BETAN(1)*2.*SQRT(HFH)/(AB2*(-1.-Y))
XA1A = SQRT((XST(2)+1.)/(XST(3)+1.))
XA1 = XA1*XA1A
XI1=XI1+XA1
XI=(XI+XI23+XI1+XI4)*AB3/PAI
XI=XI+3EC*ALOG((XST(1)-Y-HFF)/(1.+Y-HFH))/PAI
XXI1=-XI
GO TO 36
3E XR1=-1.+0.5*HCSPAC
XR2=XR1+HCSPAC
XR4=XST(1)-0.5*HFSPAC
XR3=XR4-n*SPAC
FT1=0.5*(BETAN(1)+BETAN(1))/SQRT((1.+XP1)*(XST(1)-XR1))
FT2=0.5*(BETAN(1)+BETAN(2))/SQRT((1.+XP2)*(XST(1)-XR2))
FT3=0.5*(BETAN(LPM-1)+BETAN(LPM-1))/SQRT((1.+XR3)*(XST(1)-XR3))
FT4=0.5*(BETAN(LPM-1)+BETAN(LPM))/SQRT((1.+XR4)*(XST(1)-XR4))
FT1A = SQRT((XST(2)-XR1)/(XST(3)-XR1))
FT2A = SQRT((XST(2)-XR2)/(XST(3)-XR2))
FT3A = SQRT((XST(2)-XR3)/(XST(3)-XR3))
FT4A = SQRT((XST(2)-XR4)/(XST(3)-XR4))
FT1 = FT1*FT1A

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```

FT2 = FT2+FT2A
FT3 = FT3+FT3A
FT4 = FT4+FT4A
FR1=(FT1-FAA)/(XR1-Y)
FR2=(FT2-FAA)/(XR2-Y)
FR3=(FT3-FAA)/(XR3-Y)
FR4=(FT4-FAA)/(XR4-Y)
XIP1=0.5*HCSPAC*(FR1+FR2)+0.5*HFSAC*(FR3+FR4)
XIP2=0.25*HCSPAC*(FR2+FR3)+0.25*HFSAC*(FR4+FR1)
XI23=XIP1+XIP2
XMI=21.
XMI2=42.
MJ=21
M2=MU-2
LPMA=LPM-5
IF(IU2.GE.LPMA) XMI=101.
IF(IU2.GE.LPMA) XMI2=202.
IF(IU2.GE.LPMA) MJ=101
IF(IU2.GE.LPMA) M2=MU-2
BETY=(BETAN(LPM)-BETAM(LPM-1))/XMI2
BESS=0.5*(BETAN(LPM)+BETAM(LPM-1))
HSP6=0.5*HFSAC/XMI
FG3=FR4
BETY1=(BETAM(1)-BETAN(1))/XMI2
BESS1=0.5*(BETAM(1)+BETAN(1))
HSP61=0.5*HCSPAC/XMI
FG31=FR1
XI1=0.
XI4=0.
DO 129 IL=1,M2,2
Fw1=FG3
FG11=FG31
X2=XST(1)-HSP6*FLOAT(MU-IL)
X3=X2+HSP6
X21=-1.+HSP61*FLOAT(MU-IL)
X31=X21-HSP61
BETA2=BESS+BETY*FLOAT(IL)
BETA3=BESS+3*BETY*FLOAT(IL+1)
BETA21=BESS1-BETY1*FLOAT(IL)
BETA31=BETA21-BETY1
FU21=BETA21/ SQRT((1.+X21)*(XST(1)-X21))
FU31=BETA31/ SQRT((1.+X31)*(XST(1)-X31))
FU21A = SQRT((XST(2)-X21)/(XST(3)-X21))
FU31A = SQRT((XST(2)-X31)/(XST(3)-X31))
FU21 = FU21+FU21A
FU31 = FU31+FU31A
FG21=(FU21-FAA)/(X21-Y)
FG31=(FU31-FAA)/(X31-Y)
FU2=BETA2/ SQRT((1.+X2)*(XST(1)-X2))
FU3=BETA3/ SQRT((1.+X3)*(XST(1)-X3))
FU2A = SQRT((XST(2)-X2)/(XST(3)-X2))
FU3A = SQRT((XST(2)-X3)/(XST(3)-X3))
FU2 = FU2+FU2A
FU3 = FU3+FU3A
FG2=(FU2-FAA)/(X2-Y)
FG3=(FU3-FAA)/(X3-Y)
XI1=XI1+HSP61*(FG11+FG21+4.*FG31)/3.
129 XI4=XI4+HSP6*(FG1+4.*FG2+FG3)/3.
XIA=2.*SQRT(HSP6)*BETA4(LPM)/(AB2*(XST(1)-Y))
XIAA = SQRT((XST(2)-XST(1))/(XST(3)-XST(1)))

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XIA = XIA*XIAA
XI4=XI4+XIA
XIB=2.*SGRT(HSP61)*BETAN(1)/(AB2*(-1.-Y))
XIB4 = SGRT((XST(2)+1)/(XST(3)+1.))
XIS = XIB*XISA
XI1=XI1+XIB
XI=(XI+XI1+XI23+XI4)*AB3/PAI
XI=XI+BEC*ALOG((XST(1)-Y-HSP6)/(1.+Y-HSP61))/PAI
XXI1=-XI
36 CONTINUE
C-----I2-----
C-----IF Y IS LESS THAN ZERO, THIS IS A
C-----REGULAR INTEGRAL, WHILE Y .GE. 0, THIS IS A
C-----SINGULAR INTEGRAL.
C-----BUT THIS IS TREATED AS A SINGULAR INTEGRAL ANYWAY
ISIC=3
XCA=Y
CALL IC2(SR,SM,XCA,ISIC)
XXI2=SR
ARGL=(XST(1) -Y)/Y
IF (ARGL.LT.0.) ARGL=-AF6L
XXI2=XXI2*AB3+ALOG(ARGL)
XXI2=-XXI2
C-----I3-----
C-----USE CHEBYSHEV-GAUSS QUADRATURE.
C-----AJ(I) ARE ALREADY CALCULATED IN SUBROUTINE FIINTL
C-----AND PASSED ONTC HERE BY COMMON STATEMENT.
XXI3 = 0.
BPC5 = (XST(1)+XST(2))*0.5
CM55 = (XST(2)-XST(1))*0.5
A31 = (BPC5+1.)/CM55
A32 = (-BPC5+XST(3))/CM55
DO 120 ISUM = 1,NCHBY
HA1 = 1.-AJ(ISUM)
HA2 = (AJ(ISUM)+A31)*(A32-AJ(ISUM))
SHA2 = SQRT(HA2)
F3I3 = HA1/SHA2
F3A13 = CM55*AJ(ISUM)+BPC5-Y
120 XXI3 = XXI3+F3I3/F3A13
XXI3 = XXI3*PAI/NCHBY
UU22 = COS(ALFA1+GAMMA)/COS(XST(5)+GAMMA)
HX3 = CCC1-ALOG(UU22)/PAI
XXI3 = XXI3*AB3*HX3
C-----I4-----
C-----USE CHEBYSHEV-GAUSS QUADRATURE FORMULA---
C-----BBETAN2(I) ARE ALREADY CALCULATED IN
C-----SUBROUTINE FIINTL AND PASSED ONTC HERE BY
C-----COMMON STATEMENT.
FPC5 = (XST(3)+XST(2))*0.5
FMC5 = (XST(3)-XST(2))*0.5
A41 = (FPC5+1.)/FMC5
A42 = (FPC5-XST(1))/FMC5
XXI4 = 0.
DO 130 ISUM = 1,NCHBY
PAX = (BBETAN2(ISUM)+PAI)*(1.+AJ(ISUM))
PEY = (AJ(ISUM)+A41)*(AJ(ISUM)+A42)
SRBX = SQRT(PEY)
RCX = PAX/SRBX
RDX = FMC5*AJ(ISUM)+FPC5-Y
130 XXI4 = XXI4 + RCX/RDX

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XIA = XIA*XIAA
XI4=XI4+XIA
XIE=2.*SGRT(HSP61)*BETAN(1)/(AB2*(-1.-Y))
XIB1 = SGRT((XST(2)+1)/(XST(3)+1.))
XIB = XIB*XIB1
XI1=XI1+XIB
XI=(XI+XI1+XI23+XI4)*AB3/PAI
XI=XI+BEC*ALOG((XST(1)-Y-HSP6)/(1.+Y-HSP61))/PAI
XXI1=-XI
35 CONTINUE
C-----I2-----
C-----IF Y IS LESS THAN ZERO, THIS IS A
C-----REGULAR INTEGRAL, WHILE Y GE. 0, THIS IS A
C-----SINGULAR INTEGRAL.
C-----BUT THIS IS TREATED AS A SINGULAR INTEGRAL ANYWAY
ISIC=3
XCA=Y
CALL IC2(SR,SM,XCA,ISIC)
XXI2=SR
ARGL=(XST(1) -Y)/Y
IF (ARGL.LT.0.) ARGL=-ARGL
XXI2=XXI2+AB3+ALOG(ARGL)
XXI2=-XXI2
C-----I3-----
C USE CHEBYSHEV-GAUSS QUADPTURE.
C AJ(I) ARE ALREADY CALCULATED IN SUBROUTINE F1INTL
C AND PASSED ONTO HERE BY COMMON STATEMENT.
XXI3 = 0.
BPC5 = (XST(1)+XST(2))*0.5
CMB5 = (XST(2)-XST(1))*0.5
A31 = (BPC5+1.)/CMB5
A32 = (-BPC5+XST(3))/CMB5
DO 120 ISUM = 1,NCHBY
HA1 = 1.-AJ(ISUM)
HA2 = (AJ(ISUM)+A31)+(A32-AJ(ISUM))
SHA2 = SGRT(HA2)
F3I3 = HA1/SHA2
F3A13 = CMB5*AJ(ISUM)+BPC5-Y
120 XXI3 = XXI3+F3I3/F3A13
XXI3 = XXI3+PAI/NCHBY
UU22 = COS(ALFA1+GAMMA)/COS(XST(5)+GAMMA)
HX3 = CCC1-ALOG(UU22)/PAI
XXI3 = XXI3+AB3*HX3
C-----I4-----
C USE CHEBYSHEV-GAUSS QUADPTURE FORMULA---
C-----BETAN2(1) ARE ALREADY CALCULATED IN
C SUBROUTINE F1INTL AND PASSED ONTO HERE BY
C COMMON STATEMENT.
FPC5 = (XST(3)+XST(2))*0.5
FMC5 = (XST(3)-XST(2))*0.5
A41 = (FPC5+1.)/FMC5
A42 = (FPC5-XST(1))/FMC5
XXI4 = 0.
DO 130 ISUM = 1,NCHBY
FAX = (BETAN2(ISUM)+PAI)*(1.+AJ(ISUM))
REY = (AJ(ISUM)+A41)*(AJ(ISUM)+A42)
SR0X = SGRT(RBX)
RCY = FAX/SRBX
RDX = FMC5*AJ(ISUM)+FPC5-Y
130 XXI4 = XXI4 + RCY/RDX

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XXI4 = XXI4*PAI/NCHBY
XXI4 = -XXI4*AE3/PAI
XXI1 = XXI1+XXI2+XXI3+XXI4
IWRIT1=2
IWRIT2=30
IWRIT3=60
IF (IJ.EQ.18.AND.IP.EQ.IWRIT1) WRITE(6,55) XXI1,XXI2,XXI3,XXI4,IP
IF (IJ.EQ.18.AND.IP.EQ.IWRIT2) WRITE(6,55) XXI1,XXI2,XXI3,XXI4,IP
IF (IJ.EQ.18.AND.IP.EQ.IWRIT3) WRITE(6,55) XXI1,XXI2,XXI3,XXI4,IP
55 FORMAT (10X, '----I1,I2,I3,I4 OF F(4) ARE----',4(E14.7,2X),2X,
A*IP=*,I4)
RETURN
END

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SUBROUTINE OFSINE(ANS5)
DIMENSION S2SR(101),S2KER(101),XST(6)
COMMON YCCC,SBETA2
COMMON XITM(200),XITV(200),ANSG2S(200),SARC2(200)
COMMON CAVX(100),CAVY(100),BETAB,BETAC,XCCC,NCAV,LPM,NS2
COMMON AJ(100),ISHARP,NCHBY,SBTAN(100),BSTAN2(100),BETAV2(100)
COMMON FLAPAN,DELTA,DGAP,ALFA1,GAMMA
COMMON SEETA,XXM,ICPI,SARCO(513)
COMMON IDUL,XA,XB,XC,TANG,EP,YC,YR,JBIGS,XLEIGS,BIGS,SMALS,CSS
COMMON XSV(6),CDE,ERC,YYY,XM,ITERA,SXSIC(6),SYSICO(6),YXS(6)
COMMON PSIZ,LP,SARC(513),SARCO(513),LPM,DE
COMMON BETAN(513),BETAM(513),IU,LPK,XII(200),XJU(200),XJX
COMMON XROUVD,A2AA,B2BB,C2CC
COMMON AAAA,BBBB,CCCC,A5,B6,C6,D6,GAUS(100),WGAUS(100),NGAUS
PAI=3.141592654
C THIS SUBROUTINE CALLED FROM OXFNE.
C USE SIMPSON'S RULE.
DO 1 IMC = 1,6
1 XST(IMC) = YXS(IMC)
CDE = COS(DELTA)
SDE = SIN(DELTA)
C NS2 SHOULD HAVE A FACTOR OF 4.
C NS2=LPM=LPM2
NS21 = NS2+1
NS2A = NS2-1
S2GAP = (XST(3)-XST(2))/NS2
C ECAPSE/(AMMAG+5(TSX(SOC)/AMMAG+1AFLA(SOC = 2UJ
JU2 = COS(ALFA1+GAMMA)/COS(XST(5)+GAMMA)
DO 2 IS2 = 1,NS21
XST(2) = XST(2)+S2GAP*(IS2-1)
XKD = XST(2)+CDE
XMAS = XST(4)+SDE
XMAS2 = XMAS**2
ASD = XST(4)*CDE
ASD2 = ASD**2
DWDX = DGAP*XKD/((XMAS2+ASD2)+PAI)
IF (IS2.EQ.1) GO TO 3
IF (IS2.EQ.NS21) GO TO 4
CALL G2 (XST,ANSG2,IS2)
G2 CALCULATES G2 WITH XSI GIVEN.
EG2 = EXP(-ANSG2)
IF (IU.EQ.40) ANSG2S(IS2)=ANSG2
S2KER(IS2) = EG2*DWDX/JU2
GO TO 2
3 CONTINUE
S2KER(1) = DWDX/SQRT(1.+XST(6))
ANSG2S(IS2)=ALOG(SQRT(1.+XST(6)))/JU2
GO TO 2
4 CONTINUE
S2KER(NS21) = DWDX/JU2
ANSG2S(IS2)=0.
2 CONTINUE
S2SR(1) = 0.
DO 10 JS2 = 1,NS2A+2
10 S2SR(JS2+2) = S2SR(JS2)
1+(S2KER(JS2)+4.*S2KER(JS2+1)+S2KER(JS2+2))*S2GAP/3.
IF (IU.NE.40) GO TO 40
SARC2(1)=0.
DO 50 ISARC=2,NS2+2

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50 S2SR(ISARC)=.5*(S2SR(ISARC-1)+S2SR(ISARC+1))
DO 30 ISARC=1,NS21
30 SARC2(ISARC)=S2SR(ISARC)
40 CONTINUE
ANSS = S2SR(NS21)
RETURN
END
```

vv


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SUBROUTINE IC2(SR,SM,XCA,ISIC)
DIMENSION XST(6)
COMMON YCCC,SBETA2
COMMON XITM(200),XITV(200),ANSG2S(200),SARC2(200)
COMMON CAVX(100),CAVY(100),BETAB,BETAC,XCCC,NCAV,LPMM,NS2
COMMON AJ(100),ISHARP,NCHBY,BBTAN(100),EBTAN2(100),PETAN2(100)
COMMON FLAPAN,DELTA,DGAP,ALFA1,SAMMA
COMMON SBETA,AXM,ICPI,SARCO(513)
COMMON IDUL,XA,XB,XC,TANG,EP,YC,YR,JBIGS,XLBIGS,BIGS,SMALS,ESS
COMMON XSN(6),CLE,ERC,YYY,XM,ITERA,SXSIC(6),SXSICC(6),YXS(6)
COMMON PSIZ,LP,SARCO(513),SARCO(513),LPM,JE
COMMON BETAN(513),BETAM(513),IU,LPK,XII(200),XJU(200),XDX
COMMON XROUND,AZAA,B2BB,C2CC
COMMON AAAA,B2BB,CCCC,AS,B2,CS,DE,TGAUS(100),JGAUS(100),NGAUS
DO 1 IPN = 1,6
1 XST(IPN) = YXS(IPN)
XX1 = XST(4)*SIN(DELTA)
YY1 = XST(4)*COS(DELTA)
YY12 = YY1**2
ISIC = 0 FOR RMINT
      = 1 IN CAVITY OF OFSIMS FOR F(5) AND IN CAVITY.
      = 2 CALLED FROM FIINTL FOR F(1).
      = 3 FOR I2 OF F(4).

SR=0.
SM=0.
BH=XST(1)**5
BHMC=BH-XST(2)
BHP1=BH+1.
BHMF=BH-XST(3)
B11=BHMC/BH
B12=BHP1/BH
B13=BHMF/BH
IF (ISIC.NE.3) GO TO 20
AP1=(XCA+1.)*(XST(1)-XCA)+(XCA-XST(3))
AP2=XCA-XST(2)
APS=SQRT(AP1/AP2)
20 CONTINUE
DO 7 ISUM=1,NCHBY
RA=(AJ(ISUM)+B11)*(AJ(ISUM)+1.)
RB=(AJ(ISUM)+B12)*(AJ(ISUM)+B13)
SAB=SQRT(RA/RB)
SAC=B4+SQRT(1.-AJ(ISUM)**2)/SAB
XSIP=BH+AJ(ISUM)*PH
XPXP=XSIP-XX1
XPXP2=XPXP**2
RV2=XPXP2+YY12
RWR=XPXP/RV2
RWI=YY1/RV2
IF (ISIC.EQ.1) RW=1./(XSIP-XCA)
IF (ISIC.EQ.2) RW=1.
IF (ISIC.EQ.3) RW=(1.-SAC/APS)/(XSIP-XCA)
SR=SR+SAB**RW
7 SM=SM+SAC**RW
PAI=3.141592654
SK=SR*PAI/NCHBY
SM=SM*PAI/NCHBY
RETURN
END

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SUBROUTINE FIINTL(YINT,KCTRL)
DIMENSION XST(6)
COMMON YCCC,SBETA2
COMMON XITM(200),XITN(200),ANS62S(200),SARC2(200)
COMMON CAVX(100),CAVY(100),BETAB,BETAC,XCCC,NCAV,LPM,NS2
COMMON AJ(100),ISHARP,NCHBY,BRTAN(100),BBTAN2(100),BETAN2(100)
COMMON FLAPAN,DELTA,DGAP,AL=A1,GAMMA
COMMON SBETA,XXM,ICPI,SARCO(513)
COMMON IDUL,XA,XB,XC,TANG,EP,YC,YR,JBIGS,XLBIGS,BIGS,SMALS,DSS
COMMON XSN(6),CLE,ERC,YYY,XM,ITERA,SXSIC(6),SXSIC(6),YXS(6)
COMMON FSIZ,LP,SARC(513),SARCO(513),LPM,DE
COMMON BETAN(513),BETAM(513),IJ,LPK,XII(200),XJJ(200),XDX
COMMON XROUND,A2AA,B2BB,C2CC
COMMON AAAA,BBBB,CCCC,AA,BB,CC,JB,TS,GAUS(100),NGAUS
SUBROUTINE FIINTL CALCULATES THE INTEGRALS IN F(1)
ISHARP = 0 FOR SHARP L.E.FOILS.
ISHARP = 1 FOR ROUNDED L.E.FOILS.
IF FOILS HAVE ROUNDED L.E., CHEBYSHEV-GAUSS
QUADRATURE
QUADRATURE FORMULA CAN NOT BE USED. SINCE BETA
IS NOT A SMOOTH FUNCTION.
NCHBY = NUMBER OF CHEBYSHEV-GAUSS QUADRATURE CONTROL POINTS.
PAI = 3.141592654
IF(ICPI.EQ.0) GO TO 9
DO 70 IQ = 1,6
70 XST(IQ) = XSN(IQ)
GO TO 12
9 DO 11 IH = 1,6
11 XST(IH) = YXS(IH)
12 CONTINUE
5 DN1 = (XST(1)+1.)*.5
DN2 = (XST(1)-1.)*.5
A11 = (DN2-XST(2))/DN1
A12 = (DN2-XST(3))/DN1
BC5 = (XST(1)+XST(2))*5
CM55 = (XST(2)-XST(1))*5
A31 = (BC5+1.)/CM55
A32 = (-BC5+XST(3))/CM55
FC15 = (XST(3)-XST(2))*5
FC15 = (XST(3)+XST(2))*5
A41 = (FC15+1.)/FC15
A42 = (FC15-XST(1))/FC15
SPACE2 = (XST(3)-XST(2))/LPM
READ LPM FOR THE SECOND ARC.
IF(KCTRL.GE.2) GO TO 100
IF(IJ.GE.2) GO TO 100
CSPACE = (1.+XST(1))/FLDAT(LPK)
FSPACE = CSPACE/FLDAT(LPM-LPK)
IOM = 1
XCHCK = -1.
SPACE=CSPACE
DO 20 ICHBY=1,NCHBY
NCH=NCHBY-ICHBY+1
AJ(ICHBY)=COS((2.*NCH-1)*PAI/(2.*NCHBY))
XKSI=DN1+AJ(ICHBY)*DN2
IF(ITERA.EQ.1) GO TO 489
22 IF(XCHCK.GE.XKSI) GO TO 21
IF(IOM.GE.LPK) SPACE = FSPACE
XCHCK = XCHCK+SPACE

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      ICM = ICM+1
      GO TO 22
C   XKSI EXISTS BTW XSI(ICM-1) AND XSI(ICM)
      21 CONTINUE
      IOMA = ICM-1
      BBTAN(ICHBY) = BETAN(ICM)+(BETAN(ICM)-BETAN(IOMA))
      X*(XKSI-XCHK)/SPACE
C   BBTAN IS USED FOR CHEBYCHEV-GAUSS INSTEAD OF BETAN.
      GO TO 20
      438 BBTAN(ICHBY) = SBETA
C   BETAN FOR ITERA.EG.1 IS SPECIFIED IN OFSIM1.
      20 CONTINUE
      100 CONTINUE
      IF(KCTRL.EG.4) GO TO 4
      IF (KCTRL.EG.3) GO TO 3
      IF (KCTRL.EG.2) GO TO 2
      IF (ISHARP.EG.1) GO TO 10
      YINT = 0.
      DO 110 ISUM = 1,NCHBY
      ABC = (AJ(ISUM)+A11)/(AJ(ISUM)+A12)
      110 YINT = YINT +BETAN(ISUM)*SQRT(ABC)
      YINT = YINT*PI/NCHBY
      GO TO 1000
      10 CONTINUE
C   THIS IS THE CASE OF HANDLING ROUNDED L. E. .
      NOF = 0
      XCA = 0.
      CALL OFSIM1(YINT,NOF,XCA)
C   XCA IS DUMMY, ONLY USED FOR F(5) INDXFNE..
      GO TO 1000
      2 CONTINUE
      XCA=0.
C   XCA IS DUMMY.
      ISIC=2
      CALL IC2(SR,SM,XCA,ISIC)
      YINT=SR
      GO TO 1000
      3 CONTINUE
C-----INTEGRAL FOR I3.
C   AJ(N) IS CALCULATED AND STORED
      YINT = 0.
      DO 120 ISUM = 1,NCHBY
      AB1 = 1.-AJ(ISUM)
      AB2 = (AJ(ISUM)+A31)+(A32-AJ(ISUM))
      SQAB2 = SQRT(AB2)
      ABC = AB1/SQAB2
      120 YINT = YINT+ABC
      YINT = YINT*PI/NCHBY
      GO TO 1000
C-----INTEGRAL FOR I4
C   SINCE BETAN(N) BTW IGT AND IFT ARE
C   EXPECTED TO BE ALWAYS SMOOTH, USE GAUSS-
C   CHEBYSHEV QUADRATURE FORMULA.
C   AJ(N) IS ALREADY CALCULATED.
C   IF THIS IS THE FIRST CASE FOR BETAN2,
C   USE A CONSTANT FOR BETAN2.
C   BETAN2 IS USED FOR CHEVY-GAUSS INSTEAD OF BETAN2.
      4 CONTINUE
      IF(ITERA.SE.2) GO TO 150
      IF(IJ.GE.2) GO TO 151

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C SBETA2 MUST BE READ FOR THE FIRST RUN.
  DO 160 ICHBY = 1,NC4BY
180 BBTAN2 (ICHBY) = SBETA2
  NS21=NS2+1
  DO 185 IOC=1,NS21
135 BETAN2(IOC)=SBETA2
  GO TO 181
150 CONTINUE
  IF(IJ.GE.2) GO TO 131
  IOMM = 1
  XCHCK = XST(2)
  DO 170 ICHBY = 1,NC4BY
  XKSI = FCAS*AJ(ICHBY)+FC15
152 IF(XCHCK.GE.XKSI) GO TO 151
  XCHCK = XCHCK + SPACE2
  IOMM = IOMM+1
  GO TO 152
151 CONTINUE
  IOMMA = IOMM-1
  BBTAN2(ICHBY) = BETAN2(IOMM)
  I+(BETAN2(IOMM)-BETAN2(IOMMA))*(XKSI-XCHCK)/SPACE2
  ILM=ICHBY
  XKSI = FCAS*AJ(ILM )+FC15
  WRITE(6,250) ILM,BBTAN2(ILM),XKSI
250 FORMAT(15X,*,I=*,13,2X,*,BBTAN2=*,E14.7,2X,*,XKSI=*,E14.7)
170 CONTINUE
181 CONTINUE
  YINT = 0.
  DO 190 ISUM = 1,NC4BY
  AB1 = (BBTAN2(ISUM)+PAI)*(1.+AJ(ISUM))
  AB2 = (AJ(ISUM)+A41)*(AJ(ISUM)+A42)
  SGAB2 = SGRT(AB2)
190 YINT = YINT + AB1/SGAB2
  YINT = YINT*PAI/NC4BY
1000 CONTINUE
  RETURN
  END

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SUBROUTINE CAVITY (XCC,YCC)
C THIS SUBROUTINE IS CALLED FROM DXFNEW FOR F(5).
DIMENSION CKEX(100),SKEY(100),ANSI1(100),SRI2(100),SIC3I3(100)
DIMENSION SIC4I4(100),XST(6)
DIMENSION CAVXX(100),CAVYY(100)
COMMON YCCC,SBETA2
COMMON XITM(200),XITN(200),ANSG2S(200),SARC2(200)
COMMON CAVX(100),CAVY(100),BETAB,BETAC,XCCC,NCAV,LPM,NS2
COMMON AJ(100),ISHARP,NCHBY,BBTAN(100),BBTAN2(100),BETAN2(100)
COMMON FLAPAN,DELTA,DGAP,ALFA1,GAMMA
COMMON SBETA,XXM,ICPI,SARCO(513)
COMMON IDUL,XA,XB,XC,TANG,EP,YC,YR,JEIGS,XLBIGS,BTGS,SMALS,SS
COMMON XSV(6), CLE,ERC,YYY,XM,ITERA,SXST(6),SXSIC(6),YXS(6)
COMMON PSIZ,LP,SARC(513),SARCO(513),LPM,DE
COMMON BETAN(513),BETAM(513),IJ,LPK,XII(200),XJJ(200),XCX
COMMON XROUND,A2AA,B2BB,C2CC
COMMON AAAA,BBBB,CCCC,AB,BB,CC,DE,TS(AUS(100)),WGAUS(100),NGAUS
C XCCC IS THE CAVITY END POINT CALCULATED IN SUB. CAVITY.
CDEL = COS(DELTA)
SDEL = SIN(DELTA)
PAI = 3.141592654
DO 1 LJA = 1,6
1 XST(LJA) = YXS(LJA)
SCGM = SQRT(1.+XST(5))
CCC1=ALOG(1.+XST(6))/(2.+PAI)
NCAV=80
NCAV1=NCAV+1
CAVS = (XST(2)-XST(1))/NCAV
C LEAVE THE LAST POINT OF XSI = 0 SINCE THERE IS A
C SINGULARITY FOR SINGLE SPIRAL VORTEX MODEL.
DO 2 KLM = 1,NCAV1
XCA = XST(1) +CAVS* (KLM-1)
C REAL PART OF OMEGA = BETA+ PAI.
IF (KLM.EQ.1) GO TO 3
IF(KLM.EQ.NCAV1) GO TO 10
C-----IC1(XSI) CALCULATION, CALLING OFSIM1.
IF (IJ.EQ.34) GO TO 75
NOF = 3
CALL OFSIM1(ANS,NOF,XCA)
C ANS IS A SOLUTION FOR IC1(XCI), XCI IS IDENTICAL TO XCA.
IF (IJ.EQ.27) ANSI1(KLM) = ANS
GO TO 76
75 ANS = ANSI1(KLM)
76 CONTINUE
C----- IC2(XSI) CALCULATION.
IF(IJ.EQ.34) GO TO 77
ISIC = 1
CALL IC2(SR,SM,XCA,ISIC)
C ONLY SR IS UTILIZED-- SM IS FOR RMINT.
IF (IJ.EQ.27) SRI2(KLM) = SR
GO TO 76
77 SR = SRI2(KLM)
76 CONTINUE
C-----IC3 (YSI) CALCULATION-- USE CHEBYSHEV-GAUSS
C QUADRATURE FORMULA.
IF (IJ.EQ.34) GO TO 80
BPC5 = (XST(1)+XST(2))*0.5
CMB5 = (XST(2)-XST(1))*0.5
A31 = (BPC5+1.)/CMB5

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A32 = (-BPC5+XST(3))/CMB5
EK1 = XCA-XST(2)
EK2 = (XCA+1.)*(XCA-XST(1))*(XCA-XST(3))
EK3 = SQRT(EK1/EK2)
EF3B = CMB5*EK3
SIC3 = 0.
DO 5 ISUM = 1,NCHBY
EJ1=(AJ(ISUM)+A31)*(A32-AJ(ISUM))
SEJ1 = SQRT(EJ1)
EF3 = (1.-AJ(ISUM))/SEJ1
EF3A = CMB5*AJ(ISUM)+BPC5-XCA
5 SIC3 = SIC3+(EF3-EF3B*SQRT(1.-AJ(ISUM)**2))/EF3A
SIC3 = SIC3*PAI/NCHBY
SIC3 = SIC3+ALOG((XST(2)-XCA)/(XCA-XST(1)))*EK3
IF(IJ.EQ.27) SIC3I3(KLM) = SIC3
GO TO 81
80 SIC3 = SIC3I3(KLM)
81 CONTINUE
C-----IC4(XSI)-----
C USE CHERYSHEV-GAUSS QUADRATURE FORMJLA
C IN THE SAME MANNER AS THAT FOR I4 IN
C UFSM3.
IF(IJ.GE.34) GO TO 82
FPC5 = (XST(3)+XST(2))*0.5
FMC5 = (XST(3)-XST(2))*0.5
A41 = (FPC5+1.)/FMC5
A42 = (FPC5-XST(1))/FMC5
SIC4 = 0.
DO 7 ISUM= 1,NCHBY
RA = (BETAN2(ISUM)+PAI)*(1.+AJ(ISUM))
RB = (AJ(ISUM)+A41)*(AJ(ISUM)+A42)
SRB = SQRT(RB)
RC = RA/SRB
RD = FMC5*AJ(ISUM)+FPC5-XCA
7 SIC4 = SIC4+RC/RD
SIC4 = SIC4*PAI/NCHBY
IF(IJ.EQ.27) SIC4I4(KLM) = SIC4
GO TO 83
82 SIC4 = SIC4I4(KLM)
83 CONTINUE
IF (IJ.EQ.27.AND.KL4.EQ.2) WRITE(6,55) ANS,SR,SIC3,SIC4,KLM
IF (IJ.EQ.27.AND.KL4.EQ.40) WRITE(6,55) ANS,SR,SIC3,SIC4,KLM
IF (IJ.EQ.27.AND.KL4.EQ.80) WRITE(6,55) ANS,SR,SIC3,SIC4,KLM
55 FORMAT (10X,-----I1,I2,I3,I4 OF CAVITY ARE-----,4(E14.7+2X),2Y,
A*KLM=*,I4)
C HC(XSI) = 1/EK3 ALREADY CALCULATED.
UU2 = COS(ALFA1+GAMMA)/COS(XST(5)+GAMMA)
GC = (-ANS/PAI-SR+(COS1-ALOG(UU2)/PAI)*SIC3
1-SIC4/PAI)/EK3
GO TO 25
3 GC = BETAB+PAI
GO TO 25
10 GC=BETAC+PAI
C BETAB AND BETAC( BODY ANGLES AT B AND C) MUST BE SPECIEED IN COMMON.
25 CONTINUE
XXS = XCA+CDEL
YYT = XCA-XST(4)+SDEL
YYT2 = YYT**2
XXU = XST(4)+CDEL
XXU2 = XXU**2

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XYB = Y*Y2+X*X2
D*DX = DGAP*X*X/(X*Y3+*PAI)
CGC = COS(GC)
SGC = SIN(GC)
CFC = D*DX/SCGM
CKEX(KLM) = CGC+CFC
SKEY (KLM) = SGC+CFC
2 CONTINUE
CAVXX(1)=0.
CAVYY(1)=0.
DO 15 ICAV=3,NCAV1,2
CAVXX(ICA) = CAVXX(ICA-2)+CAVS*(CKEX(ICA-2)+4.*
1CKEX(ICA-1)+CKEX(ICA))/3.
15 CAVYY(ICA) = CAVYY(ICA-2)
1+CAVS*(SKEY(ICA-2)+4.*SKEY(ICA-1)+SKEY(ICA))/3.
IF(IJ.EQ.27) GO TO 100
GO TO 101
100 DO 102 ICAV=1,NCAV1,2
CAVX(ICA)=CAVXX(ICA)
102 CAVY(ICA)=CAVYY(ICA)
XCCC=CAVX(NCAV1)
YCCC=CAVY(NCAV1)
101 CONTINUE
XCC=CAVXX(NCAV1)
YCC=CAVYY(NCAV1)
RETRN
END

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SUBROUTINE G2 (XS2,AG2,IS2)
DIMENSION XST(6),XI21S(200),XI22S(200),XI23S(200),XI24S(200)
COMMON YCCC,SBETA2
COMMON XITM(200),XITN(200),ANSG2S(200),SARC2(200)
COMMON CAVX(100),CAVY(100),BETAS,BETAC,XCCC,NCAV,LPM,NS2
COMMON AJ(100),ISHARP,NCHBY,BBTAN(100),EBTAN2(100),BETAN2(100)
COMMON FLAPAN,DELTA,OGAP,ALFA1,GAMMA
COMMON SBETA,XXM,ICPI,SARCCO(513)
COMMON IDJL,XA,XB,XC,TANG,EP,YC,YR,JBIGS,ALBIDS,BIGS,SMALS,DSS
COMMON XSN(6),CLE,ERC,YYY,XM,ITERA,SXSTO(6),SXSIC(6),YXS(6)
COMMON PSIZ,LP,SARC(513),SARCO(513),LPM,DE
COMMON BETAN(513),BETAM(513),IJ,LPK,XII(200),YJJ(200),XDX
COMMON XROUND,A2AA,B2BB,C2CC
COMMON AAAA,BBBB,CCCC,AA,BB,CC,DD,TEGAUS(100),WGAUS(100),NGAUS
C THIS SUBROUTINE IS CALLED BY DFSIM5.
C THIS SUBROUTINE CALCULATES FUNCTION G2(XS2) WHICH
C INCLUDES I21(XS2) TO I24(XS2).
C XS2 IS XSI- AG2 IS THE SOLUTION OF INTEGRALS.
DO 1 IGP=1,6
1 XST(IGP)=YXS(IGP)
PAI = 3.141592654
CCC1=ALOG(1.+XST(6))/(2.*PAI)
IF (IJ.GE.47) GO TO 100
C----I21(XSI)-----
C THE SAME INTEGRATION AS THAT IN
C SUBROUTINE CAVITY FOR G0(XSI)
NCF = 3
CALL DFSIM1(ANS,NCF,XS2)
XI21 = ANS
IF (IJ.EQ.40) XI21S(IS2) = XI21
C----I22(XSI)-----
C USE THE SAME SUBROUTINE IC2 AS
C USED IN CAVITY WITH ISIC=1.
ISIC=1
CALL IC2(SR,SM,XS2,ISIC)
XI22 = SR
C NOTE THAT SM IS DUMMY VARIABLE.
IF (IJ.EQ.40) XI22S(IS2) = XI22
C----I23(XSI)-----
C USE CHEBYCHEV-GAUSS QUADRATURE FORMULA
C IN EXACTLY SIMILAR MANNER TO THAT IN
C DFSIM3 FOR I3.
XI23 = 0.
BPC5 = (XST(1)+XST(2))*5
CM55 = (XST(2)-XST(1))*5
A31 = (BPC5 + 1.)/CM55
A32 = (-BPC5 + XST(3))/CM55
DO 2 ISUM = 1,NCHBY
HA1 = 1.-AJ(ISUM)
HA2 = (AJ(ISUM) + A31)*(A32-AJ(ISUM))
SHA2 = SGRT(HA2)
F3I3 = HA1/SHA2
F3AI3 = CM55*AJ(ISUM)+BPC5-XS2
2 XI23 = XI23+F3I3/F3AI3
XI23 = XI23*PAI/NCHBY
IF (IJ.EQ.40) XI23S(IS2) = XI23
C----I24-----
C USE CHEBYCHEV-GAUSS QUADRATURE
C FORMULA BY ASSUMING THAT

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C      THE KERNEL FCN. IS SMOOTH.
HJ = (XS2+1.)*(XS2-XST(1))*(XST(3)-XS2)
HV = XS2-XST(2)
HW = SQRT(HU/HV)
FPC5 = (XST(3)+XST(2))*0.5
FMC5 = (XST(3)-XST(2))*0.5
A41 = (FPC5+1.)/FMC5
A42 = (FPC5-XST(1))/FMC5
XI24 = 0.
DO 10 ISUM = 1, NCHBY
TPA1 = AJ(ISUM)+A41
TPA2 = AJ(ISUM)+A42
STP = SQRT(TPA1+TPA2)
F4T = (BBTAN2(ISUM)+PAI)*(1.+AJ(ISUM))/STP
C      BETAN2 IS CHEBY-GAUSS VERSION FOR BETA ON THE SECOND ARC.
F4A = FMC5*AJ(ISUM)+FPC5-XS2
ST2 = SQRT(1.-AJ(ISUM)**2)
F4B = FMC5 *ST2*(BETAN2(IS2 )+PAI)/HW
10 XI24 = XI24+(F4T-F4B)/F4A
XI241 = XI24*PAI/NCHBY
C      BETAN2 IS USED FOR SIMPSON'S RULE.
XLG = ALOG((XST(3)-XS2)/(XS2-XST(2)))
C      IS2 IS TRANSFERRED THROUGH 32-ARGUMENT.
XI242 = XLG*(BETAN2(IS2)+PAI)/HW
XI24 = XI241+XI242
IF(IJ.EQ.40) XI24S(IS2) = XI24
GO TO 101
100 XI21 = XI21S(IS2)
XI22 = XI22S(IS2)
XI23 = XI23S(IS2)
XI24 = XI24S(IS2)
101 XS24 = -XI21/PAI-XI22
C      IAP//ECAFSE//)A**MAG+)E(TSX(SOC//)A**MAG+1AFLA(SOC(GOLA-1CCC=B2SX
XS25 = CCC1-ALOG(COS(ALFA1+SAMMA)/COS(XST(5)+SAMMA))/PAI
XS2C = XS2B+XI23
XS2D = -XI24/PAI
AG2 = (XS24+XS2C+XS2D)*HW
IF (IJ.EQ.27.AND.IS2.EQ.2) WRITE(6,52) XI21,XI22,XI23,XI24,IS2
IF (IJ.EQ.27.AND.IS2.EQ.10) WRITE(6,52) XI21,XI22,XI23,XI24,IS2
IF (IJ.EQ.27.AND.IS2.EQ.30) WRITE(6,52) XI21,XI22,XI23,XI24,IS2
52 FORMAT(10X,---I1,I2,I3,I4 OF F(5) ARE---,4(E14.7,2X),2X,
A *IS2=*,I4)
RETURN
END

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SUBROUTINE RMINT (SR,SM,MIG)
DIMENSION XST(6)
COMMON YCCC,SBETA2
COMMON XITM(200),XITV(200),ANS92S(200),SARC2(200)
COMMON CAVX(100),CAVY(100),BETAB,BETAC,XCCC,NCAV,LPM,NS2
COMMON AJ(100),IS,IRP,NCHBY,BSTAN(100),BETAN2(100),BETAN2(100)
COMMON FLAPAN,DELTA,DSAP,ALFA1,GAMMA
COMMON SBETA,XXM,ICPI,SARCC(513)
COMMON IDUL,XA,XB,XC,TANG,EP,YC,YR,JBIGS,XLEIGS,BIGS,SMALS,CSS
COMMON XSV(6),CLE,ERC,YYY,XM,ITERA,SXSIG(6),SXSIG(6),YXS(6)
COMMON PS12,LP,SARC(513),SARCC(513),LPM,DE
COMMON BETAN(513),BETAM(513),I,J,LPK,XII(200),XJJ(200),YCX
COMMON XRDJVD,A2AA,B2BB,C2CC
COMMON AAAA,BBBB,CCCC,A6,B6,C6,D6,TAUS(100),GAUS(100),NGAUS
PAI = 3.141592654
IF (ICPI.EQ.0) GO TO 10
DO 12 IS = 1,6
12 XST(IS) = XSN(IS)
GO TO 11
10 DO 1 IS = 1,6
1 XST(IS) = YXS(IS)
11 CONTINUE
XX1 = XST(4)*SIN(DELTA)
YY1 = XST(4)*COS(DELTA)
YY12 = YY1**2
CB5 = (XST(2)-XST(1))*E
BC5 = (XST(1)+XST(2))*E
A31 = (BC5+1.)/CB5
A32 = (-BC5+XST(3))/CB5
BP15 = (XST(1)-1.)*E
BP15 = (XST(1)+1.)*E
A11 = (BM15-XST(2))/BP15
A12 = (BM15-XST(3))/BP15
FPC5 = (XST(3)+XST(2))*E
FMC5 = (XST(3)-XST(2))*E
A41 = (FPC5+1.)/FMC5
A42 = (FPC5-XST(1))/FMC5
IF(MIG.EQ.4) GO TO 4
IF (MIG.EQ.3) GO TO 3
IF (MIG.EQ.2) GO TO 2
C AJ(I) ARE ALREADY CALCULATED IN SUBROUTINE
C 1FINTL1 AND STORED IN COMMON AREA.
SR=0.
SM=0.
DO 20 ISUM = 1,NCHBY
GX1 = 1.-4J(ISUM)
GY1 = (AJ(ISUM)+A31)*(A32-AJ(ISUM))
SGY1 = SQRT(GY1)
FF3 = GX1/SGY1
FY1 = CB5*AJ(ISUM)+BC5
FX2 = FX1-XX1
FX22=FX2**2
FX3 = FX22+YY12
FF31 = FX2/FX3
FF32 = YY1/FX3
SR = SR+FF3*FF31
20 SM = SM+FF3*FF32
SR = SR*PAI/NCHBY
SM = SM*PAI/NCHBY

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GO TO 1000
2 CONTINUE
IF (ISHARP.EQ.1) GO TO 100
C ISHARP = 1 MEANS THAT THE FOIL HAS ROUNDED L.E.
C SO THAT THE SIMPSONS RULE IS USED.
C ISHARP = 0 MEANS THAT THE FOIL HAS SHARP L.E.
C SO THAT CHEBYSHEV GAUSS FORMULA CAN BE USED AS BELOW.
SR = 0
SM = 0
DO 30 ISUM = 1,NCHBY
ST11 = AJ(ISUM)+A11
ST12 = AJ(ISUM)+A12
FK1 = BBTAN(ISUM)*SQRT(ST11/ST12)
UN1 = BF15*AJ(ISUM)+B*15-XX1
UN12 = UN1**2
UN13 = UN12+YY12
FK11 = UN1/UN13
FK12 = YY1/UN13
SR = SR+FK1+FK11
30 SM = SM+FK1+FK12
SR = SR*PAI/NCHBY
SM = SM*PAI/NCHBY
GO TO 1000
100 CONTINUE
C THIS IS THE CASE THAT THE FOIL HAS ROUNDED L.E.
NOF = 1
XCA = 0.
CALL JFSIM1(SR,NOF,XCA)
C XCA IS DUMMY-----ONLY USED FOR F(5) IN DXFNEW.
NOF=2
CALL JFSIM1(SM,NOF,XCA)
GO TO 1000
3 CONTINUE
C USE CHEBYSHEV-GAUSS FORMULA SINCE BETA
C IN THIS REGION IS SMOOTH.
C BBTAN2 (ISUM) ARE ALREADY CALCULATED AT FINTLY.
SR = 0.
SM = 0.
DO 50 ISUM = 1,NCHBY
PSL = (BBTAN2 (ISUM)+PAI)*(1.+AJ (ISUM))
PSM = (AJ (ISUM)+A41)*(AJ (ISUM)+A42)
SQPSM = SQRT (PSM)
FF4 = PSL/SQPSM
PSN = FPC5+AJ (ISUM)+FPC5-XX1
PSN2 = PSN**2
FF41 = PSN/(PSN2+YY12)
FF42 = YY1/(PSN2+YY12)
SR = SR+FF4+FF41
SM = SM+FF4+FF42
50 CONTINUE
SR = SR*PAI/NCHBY
SM = SM*PAI/NCHBY
GO TO 1000
4 CONTINUE
C XCA IS DUMMY, ONLY USED FOR IC2 IN F(5)
XCA = 0.
ISIC = 0
C SUBROUTINE IC2 IS ALSO USED IN F(5).
CALL IC2(SR,SM,XCA,ISIC)
1000 RETURN

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SUBROUTINE ARCS2(S2,XC,YC)
COMMON/THICK/TH
C THIS IS CALLED FROM F(S) AFTER CAVITY SUBROUTINE.
C FOR S2, THE TOTAL ARC LENGTH S2 IS CALCJAATED BY THIS SUBROUTINE, BUT
C FOR BETAN2 FINDING, ARCLEN AND BETA ARE USED AS FOR S1.
PAI=3.141592654
XZ=.5
IF (TH.LE.1.E-6) GO TO 1
YZ = (TH**2-.25)/(2.*TH)
HGZ=ATAN(-XZ/YZ)
XCMZ=XC-XZ
YCMZ=YC-YZ
AL=ATAN(XCMZ/YCMZ)
BT=HGZ-AL
PBT=BT/(2.*PAI)
XCMZ2=XCMZ**2
YCMZ2=YCMZ**2
S2=2.*PAI*SQRT(XCMZ2+YCMZ2)*PBT
GO TO 2
1 S2 = 1.-XC
2 CONTINUE
RETURN
END

```

```

SUBROUTINE ARCLN(XSS,XL,Y4,IS1I2)
COMMON/THICK/TH
COMMON YCCC,SBETA2
COMMON XITH(200),XITV(200),ANSG2S(200),SARC2(200)
COMMON CAVX(100),CAVY(100),BETAB,BETAC,XCCC,NCAV,LPMM,NS2
COMMON AJ(100),ISHARP,NCHBY,BETAN(100),BETAN2(100),BETAN2(100)
COMMON FLAPAN,DELTA,JGAP,ALFA1,GAMMA
COMMON SBETA,XXM,ICPI,SARCO(513)
COMMON IDUL,XA,XB,XC,TANG,EP,YC,YR,JBIGS,XLBIGS,BIGS,SMALS,DSS
COMMON XSV(6),CLE,ERC,YYY,XM,ITEPA,SXSIL(6),SXSIC(6),YXS(6)
COMMON PSIZ,LP,SARC(513),SARCU(513),LPM,DE
COMMON BETAN(513),BETAM(513),IU,LPK,XII(200),XJJ(200),XDX
COMMON XROUND,A2AA,B2BB,C2CC
COMMON AAAA,BBBB,CCCC,A8,B8,C8,DB,TGAUS(100),#GAUS(100),NGAUS
C FOR PLANO-CONVEX CASCADE OF WADE AND ACOSTA.
IF(1S1I2.EQ.1) GO TO 10
XSS=X4-XL
GO TO 11
10 AT1=2.*XM-1.
AT2=2.*XL-1.
PX2=XCCC**2
PY2=YCCC**2
IF (TH.LE.1.E-6) GO TO 3
CTH = (TH**2-.25)/TH
CEND=PX2+PY2-XCCC+CTH+YCCC
CONS=SQRT(CTH**2+4.*CEND+1.)
AAT1=ASIN(AT1/CONS)
AAT2=ASIN(AT2/CONS)
XSS=.5*(AAT1-AAT2)*CONS
GO TO 11
3 XSS = X--XL
11 CONTINUE
RETURN
END

```

```

SUBROUTINE XCYC(XCB,YCB,CX,CY)
C THIS IS CALLED FOR FLAND-CONVEX CASCADE.
COMMON/THICK/TH
XZ=.5
IF (TH.LE.1.E-6) GO TO 3
YZ = (TH**2-.25)/(2.*TH)
JK=CX-YZ
DK=CX-XZ
IF(DK.EQ.0.) GO TO 1
AK=DK/DK
AK2=AK**2
XZ2=XZ**2
YZ2=YZ**2
R2=XZ2+YZ2
SR=SQRT(R2/(1.+AK2))
XCB=XZ+SR
IF(DK.LT.0.) XCS=XZ-SR
YCB=AK*(XCB-XZ)+YZ
GO TO 2
1 CONTINUE
XCB=XZ
YCB=TH
GO TO 2
3 XCB = CX
YCB = 0
2 CONTINUE
RETURN
END

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vv

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SUBROUTINE SHAPE(X,Y,BETA,IS1I2)
COMMON /THICK/TH
COMMON YCCC,SBETA2
COMMON XITM(200),XITN(200),ANSQ2S(200),SARC2(200)
COMMON CAVX(100),CAVY(100),BETAB,BETAC,XCCC,NCAV,LPM,NS2
COMMON AJ(100),ISHARP,NCHBY,BBTAN(100),BBTAN2(100),BETAN2(100)
COMMON FLAPAN,DELTA,DGAP,ALFA1,GAMMA
COMMON SBETA,XXM,ICPI,SARCO(513)
COMMON IDUL,XA,XB,XC,TANG,EP,YP,YR,JBIGS,XLBIGS,BIGS,SMALS,DSS
COMMON XSN(6),CLE,ERC,YYY,XM,ITERA,SXSIC(6),SXSIO(6),YXS(6)
COMMON PSIZ,LP,SARC(513),SARCO(513),LPM,DE
COMMON BETAN(513),BETAM(513),IJ,LPK,XII(200),XJJ(200),XDX
COMMON XROUND,A2AA,B2BB,C2CC
COMMON AAAA,B5BB,C5CC,AB,BB,CB,DE,TGAUS(100),RGAUS(100),RGAUS
C PLAND-CURVEX CASCADE CASE.
PAI=3.141592653
IF (IS1I2.EQ.1) GO TO 1
BETA=0.
Y=0.
GO TO 2
1 CONTINUE
IF (TH.LE.1.E-6) GO TO 3
PX2=XCCC**2
PY2=YCCC**2
CTH = -(TH**2-.25)/TH
CEND=PX2+PY2-XCCC+CTH*YCCC
YCC=CTH
YCC2=YCC**2
YSC=YCC-4.*(X**2-X-CEND)
SYS=SQRT(YSC)
Y=(-YCC+SYS)*.5
YCX=-(2.*X-1.)/(2.*Y+YCC)
BETA=ATAN(YCX)-PAI
GO TO 2
3 CONTINUE
Y = 0.
BETA=-PAI
2 CONTINUE
RETURN
END

```

vv

```

SUBROUTINE MOSEC(A,B,ER1,ER2,X,J,XLPA,IS1I2)
J=0
X1=A
X2=B
4 J=J+1
IF(J.GE.800) GO TO 3
CALL FARC(PFX1,XLPA,X1,IS1I2)
CALL FARC(PFX2,XLPA,X2,IS1I2)
X3=X1+(X2-X1)*PFX1/(PFX1-PFX2)
CALL FARC(PFX3,XLPA,X3,IS1I2)
IF(PFX3)1,2,3
1 X2=X3
X1=X1
IF(A-B)10,10,11
10 Y=X3-ER1
IF(Y.LE.0.) Y=0.
GO TO 12
11 Y=X3+ER1
12 CALL FARC(PFY,XLPA,Y,IS1I2)
IF(PFY) 5,2,2
3 X1=Y3
X2=X2
IF(A-B) 20,20,21
20 Z=X3-ER1
GO TO 22
21 Z=X3+ER1
22 CALL FARC(PFZ,XLPA,Z,IS1I2)
IF(PFZ)2,2,5
5 GO TO 4
2 PP=ABS(PFX3)
IF(PP-ER2) 6,6,4
6 X=X3
GO TO 7
8 WRITE(6,9) J
9 FORMAT(1X,2HJ=,I3)
STOP
7 RETURN
END

```

vv


```

FUNCTION AITKEN(XX,YY,X,N)
DIMENSION XX(1),YY(1),ZZ(21)
IF (N)1,1,2
1 AITKEN=YY(1)
RETURN
2 IF (N.GT.20) N=20
M=N+1
DO 3 K=1,M
3 ZZ(K)=YY(K)
DO 4 I=1,N
DO 4 J=I,N
4 ZZ(J+1)=ZZ(I)+(X-XX(I))*(ZZ(J+1)-ZZ(I))/(XX(J+1)-XX(I))
AITKEN=ZZ(N+1)
RETURN
END

```

```

SUBROUTINE DETERM (A,V,D)
C DETERM REVISED 02-29-73
REAL M
DIMENSION A(50,50),SAVEA(50,50)
IF (N .EQ. 1)GO TO 46
C = 1.
NN = N
DO 9 J = 1,NN
DO 9 I = 1,NN
9 SAVEA(I,J) = A(I,J)
K = 1
GO TO 13
12 K = K + 1
13 I = K + 1
L = K
GO TO 17
16 I = I + 1
17 IF (ABS(SAVEA(I,K)) .GT. ABS(SAVEA(L,K))) L = I
IF (I .NE. NN)GO TO 16
IF (L .EQ. K)GO TO 28
J = K
C INTERCHANGE
GO TO 23
22 J = J + 1
23 SAVEKJ = SAVEA(K,J)
SAVEA(K,J) = SAVEA(L,J)
SAVEA(L,J) = SAVEKJ
IF (J .NE. NN)GO TO 22
C = -C
26 I = K + 1
GO TO 31
30 I = I + 1
31 CONTINUE
IF (SAVEA(K,K) .EQ. 0.) GO TO 46
M = SAVEA(I,K) / SAVEA(K,K)
SAVEA(I,K) = 0.
J = K + 1
GO TO 36
35 J = J + 1
36 SAVEA(I,J) = SAVEA(I,J) - M * SAVEA(K,J)
IF (J .NE. NN)GO TO 35
IF (I .NE. NN)GO TO 30
IF (K .NE. (NN-1))GO TO 12

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```
D = 1.
DO 43 I = 1,NN
J = I
D = D * SAVEA(I,J)
IF (ABS(D) .LT. 1.E-36) GO TO 48
43 CONTINUE
D = D * C
RETURN
46 D = A(1,1)
RETURN
48 D = 0.
WRITE (6,51)
RETURN
51 FORMAT(//5X,TERROR MESSAGE FROM DETERM.//
1 5X,MATRIX IS SINGULAR. DETERMINANT SET = 0.1 //)
END
```

vv

```

C THIS GIVES BETA(X(XSI)).
SUBROUTINE BBETA(XX, RBETA, IS1I2)
COMMON YCCC, SBETA2
COMMON XITM(200), XITW(200), ANSG2S(200), SARC2(200)
COMMON CAVX(100), CAVY(100), BETAS, BETAC, XCCC, NCAV, LPM, NS2
COMMON AJ(100), ISHARP, NCHRY, BETAN(100), BETAN2(100), BETAN2(100)
COMMON FLAPAN, DELTA, JGAP, ALFA1, GAMMA
COMMON SEETA, XXM, ICPI, SARCC(513)
COMMON IDUL, XA, XB, XC, TANG, EP, YC, YP, JBIGS, XLBIS, BIGS, SMALS, DSS
COMMON XSN(6), CLE, ERC, YYY, XM, ITERA, XSIC(6), SYSIC(6), YYS(6)
COMMON PSIZ, LP, SARC(513), SARCC(513), LPM, DE
COMMON BETAN(513), BETAM(513), IJ, LPK, XII(200), XJU(200), XDX
COMMON XROUND, A2AA, B2BB, C2CC
COMMON AAAA, BBBB, CCCC, AS, B6, CE, DB, TGAUS(100), GAUS(100), NGAUS
ER1=5.E-3
ER2=5.E-3
IF(IS1I2.EQ.1) GO TO 20
C IS1I2=C FOR S1.
C 1 FOR S2.
LPM=LP-1
SMALS=SARC(LP)
IF(LP.EQ.LPM) GO TO 10
DSS=SARC(LP)-SARC(LP+1)
XLPA=XX
GO TO 21
20 SMALS=SARC2(LP)
IF(LP.EQ.1) GO TO 110
XLPA=XX
DSS=SARC2(LP)-SARC2(LP-1)
21 CONTINUE
X1A=XLPA
4 X1B=X1A+.001
CALL FARC(FAR, XLPA, X1B, IS1I2)
IF(FAR.LT.0.) GO TO 3
X1A=X1B
GO TO 4
3 CALL MOSEC(X1A, X1B, ER1, ER2, YX, JII, XLPA, IS1I2)
GO TO 11
10 XX=0.
GO TO 11
110 XX=XCCC
11 CALL SHAPE(XX, Y, RBETA, IS1I2)
RETURN
END

```

```

SUBROUTINE FARC(FAR,XLPA,X1B,IS1I2)
COMMON YCCC,SBETA2
COMMON XITN(200),XITN(200),ANSG2S(200),SARC2(200)
COMMON CAVX(100),CAVY(100),BETAB,BETAC,YCCC,NCAV,LFMM,NS2
COMMON AJ(100),IS1ARP,NCHBY,BBTAN(100),BBTAN2(100),BBTAN2(100)
COMMON FLAPAN,DELTA,DGAP,ALFA1,GAMMA
COMMON SBETA,XXM,ICFI,SARCO(513)
COMMON IDJL,XA,XB,XC,TANG,EP,YC,YP,JBIGS,XLBIGS,BIGS,SMALS,DSS
COMMON XSN(6),CLE,ERC,YYY,XM,ITERA,SXSIG(6),SXSIOC(6),YYS(6)
COMMON PSIZ,LP,SARC(513),SARCO(513),LPM,DE
COMMON BETAN(513),BETAM(513),IJ,LPK,XII(200),XJJ(200),XIX
COMMON XROUND,A2AA,B2BB,C2CC
COMMON AAAA,BBBB,CCCC,A0,B0,C0,D0,T0,AUS(100),GAUS(100),NGAUS
IF(XLPA.EQ.X1B) GO TO 1
CALL ARCLEV(XSS,XLPA,X1B,IS1I2)
GO TO 2
1 XSS=0.
2 CONTINUE
FAR=DSS-XSS
RETURN
END

```

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**

7.0 REFERENCES

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