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COMPUTER PROGRAM

TO PREDICT SPACECRAFT WINDOW DEFORMATIONS

Tit **AND COMPUTE WINDOW INDUCED** -178

ANGULAR DEVIATIONS OF LIGHT RAYS

By David M. Kelley and Philip A. Diether

Contract Number (Boldface No. 1, 12 Point)



SEPTEMBER 1970

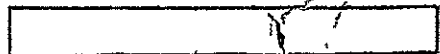
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PHILCO-FORD CORPORATION
WDL DIVISION

For
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
AMES RESEARCH CENTER
MOFFETT FIELD, CALIFORNIA

LOS ANGELES AIR FORCE STATION
LOS ANGELES, CALIFORNIA



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FOREWARD

This report was prepared by Philco-Ford Western Development Laboratory personnel under NASA Contract No. NAS2-5044. Work was administered under the direction of the Manned Systems Research Branch, Ames Research Center, Moffett Field, California. The Technical Monitor for the contract was Mr. Kenneth C. White.

This report covers work conducted between June 1968 and March 1970. The manuscript was released by the authors for publication as a NASA technical report in September 1970.

ABSTRACT

This document describes a computer program (WINDEF) which determines the deviations of light rays passing through deformed windows. Elliptical, rectangular, and trapezoidal window planforms can be analyzed. Rays may enter at any inclination at the points of a specified grid on the undeformed window surface.

Window panes are assumed to be originally flat and of uniform thickness. Ray deviations are computed for windows with elliptical, rectangular, and trapezoidal planforms due to given uniform pressures. Deformations for elliptical and rectangular planforms are calculated in the program. Deformations for trapezoidal planforms must be input from punched cards. Deformations for either clamped or simply supported edge conditions may be considered.

Ray deviations can be developed for windows having one or two panes with any given spacing between panes. Angular and translational deviations are reported for each ray. In addition, mean and root mean square deviations of collinear sets of light rays are listed.

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Section 1

INTRODUCTION

A light ray entering a window system is refracted so that the exiting ray need not be parallel to the entering ray. Thus, corrections must be made to optical measurements performed through the system. The deviations of a set of particular light rays can provide the basis for corrections. These deviations define the difference between the direction of each entering ray and its exiting ray and the changes of coordinates between the point of entry and exit.

The deviations are determined by tracing the path of the ray through the window system. The tracing involves considering ray refractions at the window pane surfaces and the geometrical relationships. Thus, knowing the location and orientation of the entering ray, tracing uses knowledge of pane cross section shape, thickness, and spacing and the indices of refraction of each surface to determine the location and orientation of the exiting ray.

This report describes a computer program which will calculate the shape of thin, originally flat panels of elliptical or rectangular planform, when deformed by uniform pressure, and which will develop ray deviation data for elliptical, rectangular, or trapezoidal planforms.

The technical basis for the calculations is defined. All data needed to prepare input and implement code usage are provided including program details to assist the programmer in diagnosing difficulties and modifying the code.

Section 2

PROGRAM DESCRIPTION

WINDEF is a digital computer program that directs calculation of deformations of window panes of elliptical or rectangular planform. It calculates deviations of light rays passed through deformed elliptical, rectangular or trapezoidal window panes.

The parameters that may be varied are: planform dimensions, pane thickness, number of panes (1 or 2), spacing between panes, pressure load, dimension scaling, ray plane angles, ray inclination angles, and ray location on the window. The spacing, pressure, scaling, plane angles, and inclination angles are each limited to eight values per problem.

Small deflection deformations for the elliptical and rectangular planforms are calculated by exact solutions employing thin plate theory. Approximate solutions are used to calculate large deflections and shear deformations of rectangular plates. Deformations for trapezoidal shapes are found using the Structural Analysis and Matrix Interpretive System (SAMIS) which employs the finite element approach for obtaining solutions. Trapezoidal deformations are read in on punched cards.

The ray trace portion of the program calculates the geometrical changes of rays passing through the window(s). Both coordinate and angular deviations are calculated and presented. In addition, mean and root mean square deviations of collinear sets of light rays are listed. The subroutines used to perform the ray tracing were provided by Ames Research Center.^{(1)*}

*Numbers in brackets correspond to references listed at the end of the report.

DEFORMATION EQUATIONS

This section describes the equations used to calculate deformations of elliptical and rectangular plates. Deflections and slopes (about the x and y axes) are calculated. Equations are developed for elliptical plates for both simply supported and clamped edges. The circle with simply supported edges is included as a special case since a simple closed-form solution exists.

The equations for the small deformations of a clamped ellipse are taken from Timoshenko ⁽²⁾ and are expressed in rectangular coordinates. The equations for the small deformations of a simply supported ellipse are taken from B. G. Galerkin ⁽³⁾ and are expressed in elliptic coordinates. The coordinates for the points at which deformations are calculated are rectangular. These are converted to elliptical coordinates to solve for the deformations. In the conversion process a Newton-Raphson method of successive approximations ⁽⁴⁾ was used to determine the relationships between the two sets of coordinates. When the simply supported ellipse degenerates to a circle, another equation in rectangular coordinates from Timoshenko ⁽²⁾ is used. This alleviates the necessity of iterating to find the elliptical coordinates which is required when using Galerkin's elliptic equations.

The equations for both simply supported and clamped edges for the small deformations of rectangular plates are taken from Timoshenko ⁽²⁾ and Evans ⁽⁵⁾. The solutions are given by infinite series which are truncated after 16 terms. This truncation will insure the one second of arc accuracy required. ⁽⁶⁾ The large deflection of rectangular plates is solved by

combining small plate deflection theory and membrane theory and requiring that the deformations by the two methods be equal at the center of the plate when subjected to the same loads⁽²⁾. The small deflections of the plate are predicted as described above. The membrane deflections are predicted exactly by generalizing Timoshenko's results for a square membrane. By combining the equations for the loads to produce the center deflection, w_0 , by small deflection theory and the center deflection, w_0 , produced by membrane analysis, a cubic equation in w_0 results which can be solved to find the large deflection solution. The large deflection solution for points between the center of the plate and the edge is obtained by averaging the deflection for the small deflection plate theory and the membrane theory at each point.

Shear deformations are calculated using a modification of an equation for the deflections of rectangular sandwich plates⁽⁷⁾. The shear deflection is obtained by multiplying the small deflection theory result by a constant of the form $\xi = 1 + \alpha$ where α is a function of the lengths of the sides and thickness of the plate.

Details of the development of the above described equations are given in Appendix A. Other miscellaneous equations used in the program are developed and described in Appendix B. These are the trapezoidal boundary, mean and standard deviations, and maximum-minimum slope equations.

INTERPOLATION PROCEDURE

Deformations generated by the above equations or those read in from punched cards are defined only for certain points on a regular grid network. Since the light rays intersecting the window surfaces will generally not fall on points of this regular grid, a method of interpolating between the deformations at the grid points is necessary.

The procedure used for the interpolation is to fit, in a least squares sense, a reduced eight-order polynomial to the deformations of a 6 x 6 grid network (36 points).⁽¹⁹⁾ The form of this polynomial is:

$$\begin{aligned}
 w = & A_1 x^4 y^4 + A_2 x^4 y^3 + A_3 x^3 y^2 + A_4 x^4 y + A_5 x^3 y^4 + A_6 x^3 y^3 \\
 & + A_7 x^3 y^2 + A_8 x^3 y + A_9 x^2 y^4 + A_{10} x^2 y^3 + A_{11} x^2 y^2 + A_{12} x^2 y \\
 & + A_{13} x y^4 + A_{14} x y^3 + A_{15} x y^2 + A_{16} x y + A_{17} y^4 + A_{18} y^3 \\
 & + A_{19} y^2 + A_{20} y + A_{21} x^4 + A_{22} x^3 + A_{23} x^2 + A_{24} x + A_{25} \quad (1)
 \end{aligned}$$

Where the A_i are constants and x and y are coordinates of a rectangular cartesian system. This function is fitted to each of the 36 points of a six by six square array of the grid. The equations expressing deformation can be written in matrix form as:

$$\{w\} = [B] \{A\} \quad (2)$$

Where $\{w\}$ and $\{A\}$ are column vectors and $[B]$ is a 36 x 25 rectangular matrix. To define the deformations at any point, the A_i components must be determined. This is accomplished by first premultiplying the above equation by the transpose of $[B]$ to obtain:

$$[B]^T \{w\} = [B]^T [B] \{A\} \quad (3)$$

Then, the A_i can be found by solving this set of linear homogeneous equations. The solution can be formally expressed by:

$$\{A\} = ([B]^T [B])^{-1} [B]^T \{w\} \quad (4)$$

Knowing $\{A\}$, Equation (1) can be used to evaluate deformations at any point on the window.

Since the eight-order polynomial used is not complete, it is sensitive to where the origin of coordinates is chosen. To minimize this sensitivity, the origin of coordinates should be chosen at the point of maximum deflection of the window. For the elliptical and rectangular planforms the computer program automatically selects the proper region. For the trapezoidal

planforms, which are read in on punched cards, the origin of coordinates must be specified by the analyst. In addition, the analyst must specify the center of interpolation (see Figure 1) for the trapezoidal planforms. For the elliptical and rectangular planforms, the center of interpolation is automatically chosen by the computer program.

To obtain adequate accuracy in deformation predictions over the window, it was necessary to use four regions of interpolation as shown in Figure 1. Each region consists of a 6 x 6 grid network as described above. Independent fits are made in each region to determine the interpolation coefficients, A_i . The deformations at any point on the window ^{are} then determined by considering within which of the four regions the point lies and using the interpolation coefficients for that region along with Equation (1) to determine the deformations of the point. To avoid discontinuities in the fit, the interpolation coefficients are linearly interpolated among fits when the point of interest lies between the centers of the four interpolation regions. For example, in Figure 1, if point P is the point of interest the deformations for P would be predicted using the interpolation coefficients for regions 1 and 2 in proportion to the distance of P from the centers of the regions.

The accuracy of the interpolation is limited by the accuracy of the equation solution process which evaluates the $\{A\}$. This difficulty is eliminated by solving Equation (3) with double precision arithmetic. This results in obtaining at least seven digit accuracy in the equation solving process.

Performing the curve fitting with all points in each of four regions and using double precision arithmetic results in a maximum error in the interpolation of less than one second of arc.

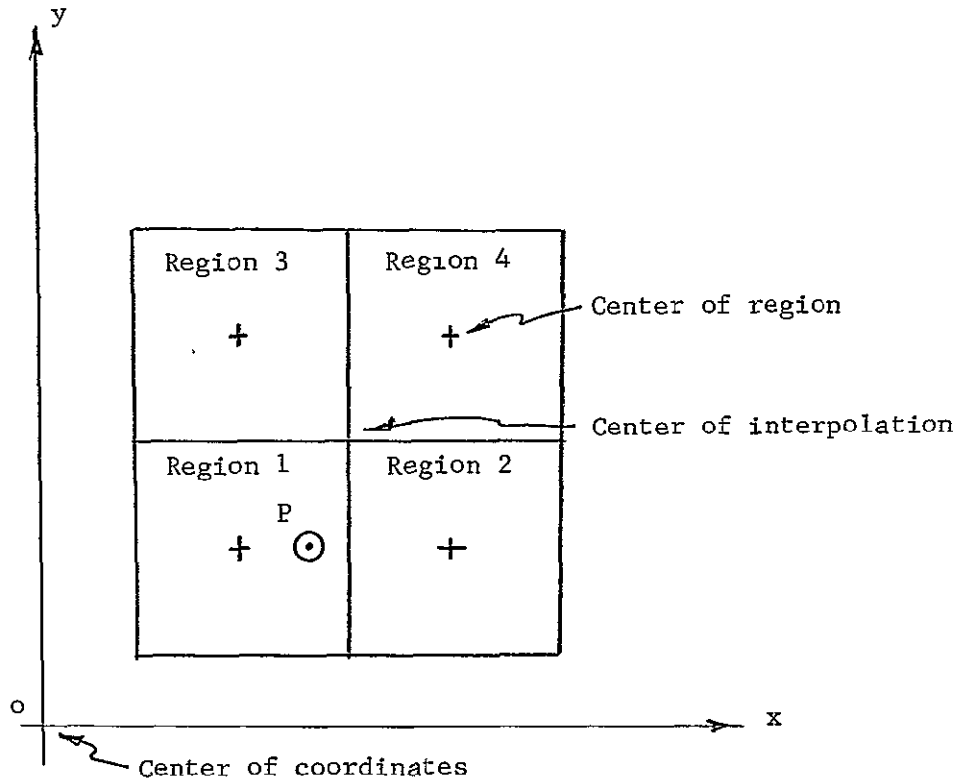


Figure 1. Interpolation Regions

RAY TRACE PROCESS

"Ray tracing" consists of determining the paths of an observed ray as seen from the interior of the spacecraft. Since the mathematical description of the optical phenomenon is reversible, the ray can be considered as emerging from the observer's eye, extending to the window surface, refracting through the window, and then continuing on to the object under observation. This path is shown schematically in Figure 2.

The process by which the ray is traced is to first assume the direction of a ray from the eye of the observer toward the window. The point of intersection of the ray with the deformed window surface is determined by successive improvement of estimates. (This process is used because the deformed surface is defined by tabular data rather than by formulas). At the intersection point the normal to the surface is determined. The refraction of the ray in the medium is determined from the optical incidence rule using the measured value of the index of refraction. In passing through air, the index of refraction is calculated as a function of the air pressure.

The ray is traced through each medium and its refraction calculated at each interface. The position and orientation of the exiting ray is then compared with the position and orientation of the assumed ray at the same distance, measured normal to the undeformed window (reference) surface, if the window system did not exist. (See Figure 2.) The differences in position and angle define the deviation of the light ray being refracted through the set of windows and are a measure of the optical performance of the window system.

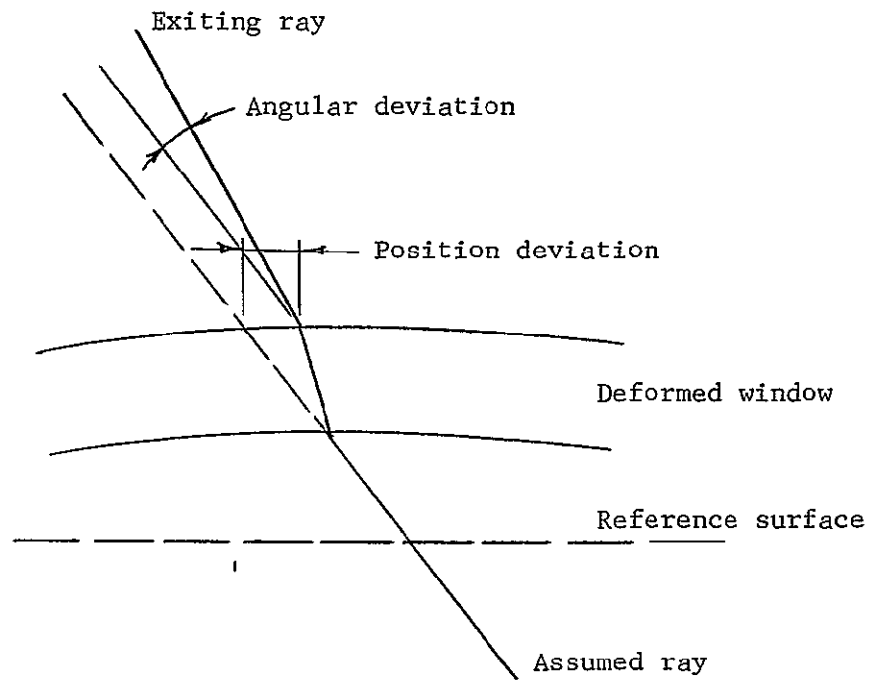


Figure 2. Light Ray Deviations

The equations necessary to determine the path of the refracted light ray are functions of the geometry of the systems and the indices of refraction of the components of the system. Details of these equations are given by White and Gadeberg^(8,9).

SUBROUTINE DESCRIPTIONS

Table 1 gives descriptions of the subroutines that make up the total program. Also included is the function of each subroutine, the method of solution where pertinent, input and output, and calling statements. All input and output is with the common block in the program unless specified or indicated in the calling statement as otherwise.

Included in Table 2 is a list of constants and variables in the common array and the subroutines of the program in which they appear. The subroutines are referred to by the code values that appear in parenthesis after each subroutine in Table 1.

Table 3 gives a listing of the correspondence between the ray trace results and their variable names and storage locations as used on the ray trace subroutine of the program.

Table 4 provides information concerning the sign convention as used in the development of the equations for the computer code.

FLOW CHARTS

This section contains two flow charts. Figure 3 shows the interrelation between the subroutines of the program. Figure 4 shows the sequence in which subroutines are selected by the driver.

Listings of the routines of the program are given in Appendix D.

Table 1

Subroutine Descriptions

WINDEF (D0)

Apollo window deformation and line-of-sight driver

Controls solution of problems

Input: Physical parameters, program control switches, via cards

Output: Error comments

ELIPSE (D1)

Elliptical plate deformation generator

Solutions by small deflection theory (closed form)

Input: Plate dimensions, physical properties

Output: Plate deflection and slopes about x and y axes

Calling statement: CALL ELIPSE

ELIPIT (D2)

Elliptic coordinate generator

Elliptic coordinates are generated by the Newton-Raphson method of successive approximations

Calling statement:

CALL ELIPIT (C, X, Y, XI, ET, FXP, FEP, GXP, GEP, DET)

C = focal distance

X = x coordinate rectangular coordinates

Y = y coordinate rectangular coordinates

XI = elliptic elliptical coordinate

ET = hyperbolic elliptical coordinate

FXP = $-C \sinh (XI) \cos (ET)$

FEP = $C \cosh (XI) \sin (ET)$

GXP = $-C \cosh (XI) \sin (ET)$

GEP = $-C \sinh (XI) \cos (ET)$

DET = determinant (FXP GEP - FEP GXP)

RECTNG (D3)

Rectangular plate deformation generator

Solution by small deflection theory (infinite series of 16 terms)

Input: Plate dimensions, physical properties

Output: Plate deflection and slopes about x and y axes

Calling statement: CALL RECTNG

SEQS (D4)

Matrix inversion and linear equation solution

Calling statement:

CALL SEQS (A, B, C, N, M)

A = matrix of moments

B = matrix of right hand side

C = solution matrix - returned

N = size of square matrix A

M = number of right hand sides

Table 1 (cont'd)

TRPZOD (D5)

Reads in trapezoidal data from cards generated by SAMIS
Eliminates unnecessary data. Re-formats codes for ray trace routines
Input: Load number desired; number of cards, scale factor via cards
Output: Deflections and slopes about x and y axes
Calling statement: CALL TRPZOD

LRGDEF (D6)

Large deflection generator for rectangles
Solved by energy method described in Timoshenko
Input: Plate dimensions, physical properties, deflections and slopes
by small deflection theory (from RECTNG)
Output: Large deflections and slopes about x and y axes
Calling statement. CALL LRGDEF

DEFRES (D7)

Prints plate deformation data on system output tape or tape 7
Input: Problem parameters, physical properties, deflections and slopes
Output: Same as Input
Calling statement:
CALL DEFRES (IDT, NØPRT)
IDT = deformation data retrieval sequence number
NØPRT = output tape selection switch

RAYTRA (D8)

Driver for ray trace procedure
Output: Entering and exiting ray coordinates and angles and vector
difference between entering and exiting rays
Calling statement:
CALL RAYTRA (XS, YS, ZS, ALPHAI, DELTAN)
XS = x coordinate of entering ray
YS = y coordinate of entering ray
ZS = 0.0
ALPHAI = plane angle
DELTAN = ray angle

ITERAT (D9)

Iterates to find location of ray on next surface
Stops iteration when error is less than 1.0E-6
Calling statement:
CALL ITERATE (XP, YP, K, DELTAP, CI, DELZ, OWX, OWY)
XP = x coordinate of ray
YP = y coordinate of ray
K = index of surface
DELTAP = 1.0
CI = direction cosines
DELZ = deflection of plate at point ray enters or leaves plate
OWX = slope about x axis
OWY = slope about y axis

Table 1 (cont'd)

INCOTB (E0)

Determines deformation of plate at intersection with ray
Solution uses an osculating interpolation function

Calling statement:

CALL INCOTB (XP, YP, OWF, OWX, OWY, IPG)
XP = x coordinate of ray
YP = y coordinate of ray
OWF = deflection of plate at point ray enters or leaves plate
OWX = slope about x axis
OWY = slope about y axis
IPG = switch associated with MAX=MIN routine

NORMAL (E1)

Calculates normal to plate at ray intersection point

Calling statement:

CALL NORMAL (OWX, OWY, K, DELTAP, CN)
OWX = slope about x axis
OWY = slope about y axis
K = index of surface
DELTAP = 1.0
CN = direction cosines

REFRI (E2)

Calculates new direction of ray upon entering new medium

Calling statement:

CALL REFRI (CI, CN, QRI, CR, ISØ)
CI = direction cosines, entering
CN = direction cosines, entering
QRI = ratio of refractive indexes of two mediums at boundary
CR = direction cosines, leaving
ISØ = number of system output tape

RESPRT (E3)

Prints ray trace and mean-rms data on system output tape or tapes 7, 8 & 9

Input Problem parameters, physical properties, ray trace output data

Output. Same as input

Calling statement:

CALL RESPRT (IRT, NOPRT)
IRT = retrieval index
NOPRT = output tape selection switch

MENRMS (E4)

Stores data for mean and rms calculations and calculates same

Input Vector error between entering and exiting ray for all grid points

Output: Mean and rms of vector error for all plane angles

Calling statement:

CALL MENRMS

Table 1 (cont'd)

MAXMIN (E5)

Calculates maximum and minimum slopes at each grid point
Calculates slope by means of a small differential
Input: x and y coordinates of point
Output: Problem parameters, physical properties, maximum/minimum output
Calling statement:
CALL MAXMIN

RTVLST (E6)

Prints out the retrieval index list
Input: Problem parameters, physical properties, retrieval data
Output: Same as input
Calling statement:
CALL RTVLST (IRT, LIN, IPV)
IRT = retrieval index
LIN = line number
IPV = page number of retrieval index list

BONDRY (E7)

Tests to see if the location of a ray is outside the plan form boundary
Calling statement:
CALL BONDRY (XP, YP, IBY)
XP = x coordinate of ray
YP = y coordinate of ray
IBY = bypass switch

PACWRD (E8)

Index word packing-unpacking routine
Packs a two word integer into one word or vice versa
Calling statement.
CALL PACWRD (K1, K2, K3)
Packing:
K1 = integer one entering; resulting integer leaving
K2 = integer two entering
K3 = 1, pack integers; = 2 unpack word
Unpacking:
K1 = packed integer entering; integer one leaving
K2 = integer two leaving
K3 = same as above

PAGE (E9)

Prints page number at top of each page
Calling statement:
CALL PAGE (IPN, LINE, ISN, INX)
IPN = page number
LINE = line number
ISN = tape number
INX = retrieval index

Table 15.1 (cont'd)

SHRDEF (F0)

Calculates shear deflection of a rectangular plate

Calling statement:

CALL SHRDEF

Table 2

Constants and Variables in Common Array

| | <u>Subroutine Designation in Which Used</u> | | | | | | | | | |
|-------------------|---|----|----|----|----|----|----|----|----|----------|
| AMN | DO | | | | | | | | E4 | |
| AVH | DO | | | | | | | | E4 | |
| AVS | DO | | | | | | | | E4 | |
| CHAP | DO | | | | D7 | | | E3 | E4 | E5 E6 E7 |
| CPRSS | DO | | | | | D8 | | | | |
| DEL | DO | | | | | | E0 | | | E5 |
| DIMA | DO | D1 | D3 | | D6 | D7 | | E3 | E4 | E5 E6 E7 |
| DIMB | DO | D1 | D3 | | D6 | D7 | | E3 | E4 | E5 E6 E7 |
| DIMC | DO | | | | | D7 | | E3 | E4 | E6 E7 |
| DWX | DO | D1 | D3 | D5 | D6 | D7 | E0 | | | |
| DWY | DO | D1 | D3 | D5 | D6 | D7 | E0 | | | |
| FR | DO | D1 | D3 | | | | | | | |
| GNU | DO | D1 | | | | | | | | |
| IBC | DO | D1 | D3 | | | D7 | | | | E5 |
| ILRG | DO | | | | | D7 | | | | |
| IPB | DO | | | | | | | E3 | | |
| PID | DO | | | | | D7 | | | | E5 |
| IPR | DO | | | | | | | E3 | | |
| IREL | DO | | | | | | | | E4 | |
| IRM | DO | | | | | | | E3 | | |
| ISCR1 | DO | | | | | D7 | | | | |
| ISCR2 | DO | | | | | | | E3 | | |
| ISEC | DO | | | | | | | E3 | E4 | |
| ISI | DO | | | D5 | | | | | | |
| ISO | DO | | | | | D7 | | E3 | | E5 E6 |
| JPN | DO | D1 | D3 | D5 | D6 | D7 | | | | E5 |
| LOCP | DO | | | | | | | E3 | | |
| LP5 | DO | | | | | | | | | E6 |
| LP7 | DO | | | | | | D8 | | | |
| MIPB | DO | | | | | | | E0 | | |
| NGP | DO | D1 | D3 | D5 | D6 | D7 | | | | E5 |
| NMP | DO | | | | | | | | E4 | |
| NPAG | DO | | | | | | | E3 | E4 | |
| NPAN | DO | | | | | D7 | D8 | E3 | | E5 E6 |
| PLNAi | DO | | | | | | | E3 | | |
| PRESi | DO | | | | | | | | | |
| PRSS | DO | | | | | D7 | D8 | E0 | E3 | E5 E6 |
| RAYA | DO | | | | | | | | | E6 |
| RES ₁ | DO | | | | | | D8 | E3 | E4 | |
| RI _i | DO | | | | | | D8 | | | |
| RTV | | | | | | | | | | E6 |
| SCAL _i | DO | | | | | | | | | |
| SKAL | DO | | | | | | | | | |
| SPAC _i | DO | | | | | | | | | |
| SPAD | DO | | | | | D7 | D8 | E3 | | E5 E6 |
| STAT _i | DO | | | | | | | E3 | E4 | |
| STD | DO | | | | | | | | E4 | |
| THIC | DO | | | | D6 | D7 | D8 | E3 | | E5 E6 |
| W | DO | D1 | D3 | D5 | D6 | D7 | E0 | | | |
| X | DO | D1 | D3 | D5 | D6 | D7 | E0 | | | E5 |
| Y | DO | D1 | D3 | D5 | D6 | D7 | E0 | | | E5 |
| YONG | DO | | | | D6 | | | | | |

Table 3

Alternate Names For Printed Ray Trace Itmes

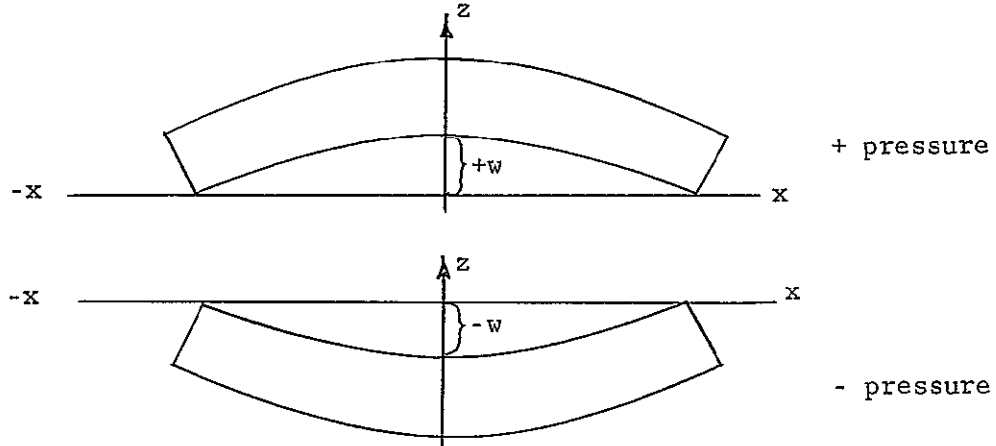
| <u>Name in Printouts</u> | <u>Verbal Name</u> | <u>Storage Name and Location</u> | <u>Name in RAYTRA</u> |
|--------------------------|--|----------------------------------|-----------------------|
| X | Incident ray x coordinate | RES (1-8) | XS |
| Y | Incident ray y coordinate | (11-18) | YS |
| D1 | Ray angle entering | (21-28) | DELTAI |
| A1 | Plane angle entering | (31-38) | ALPHAI |
| Pane Z | Pane deflection | (41-48) | ZP |
| Pane GX | Slope about x axis | (51-58) | ØWX |
| Pane GY | Slope about y axis | (61-68) | ØWY |
| X ØUT | <u>Exiting</u> ray x coordinate | (71-78) | XP |
| Y ØUT | <u>Exiting</u> ray y coordinate | (81-88) | YP |
| Z ØUT | <u>Exiting</u> z coordinate | (91-98) | ZP |
| AZ | Plane angle out | (101-108) | ALPHAR |
| DZ | Ray angle out | (111-118) | DELTAR |
| (A1-A2) | Plane angle deviation | (121-128) | DELALP |
| (D1-D2) | Ray angle deviation | (131-138) | DELDEL |
| THETA | Incident- <u>exiting</u> ray deviation | (141-148) | DELINC |
| I(AxB) | i component of cross product | (151-158) | CRPI |
| J(AxB) | j component of cross product | (161-168) | CRPJ |
| K(AxB) | k component of cross product | (171-178) | CRPK |

Table 42

Sign Convention in Subroutines

Rectangle and Ellipse generate positive deflections in the direction of positive pressure (q).

The pressure (q) is positive in direction of the positive Z-axis. Deflections are always generated for a positive unit pressure (q).



DWX = Slope in x direction (about y axis) is always negative for positive w.

DWY = Slope in \hat{y} direction (about x axis) is always negative for positive w.

DEFRES changes sign of deflection and both slopes for negative pressure

RAYTRA changes sign of deflection for negative pressures of point under consideration

INCOTB changes sign of deflection and both slopes for negative pressure at 4 corner points

INCOTB returns deflection and slopes with correct signs for any quadrant

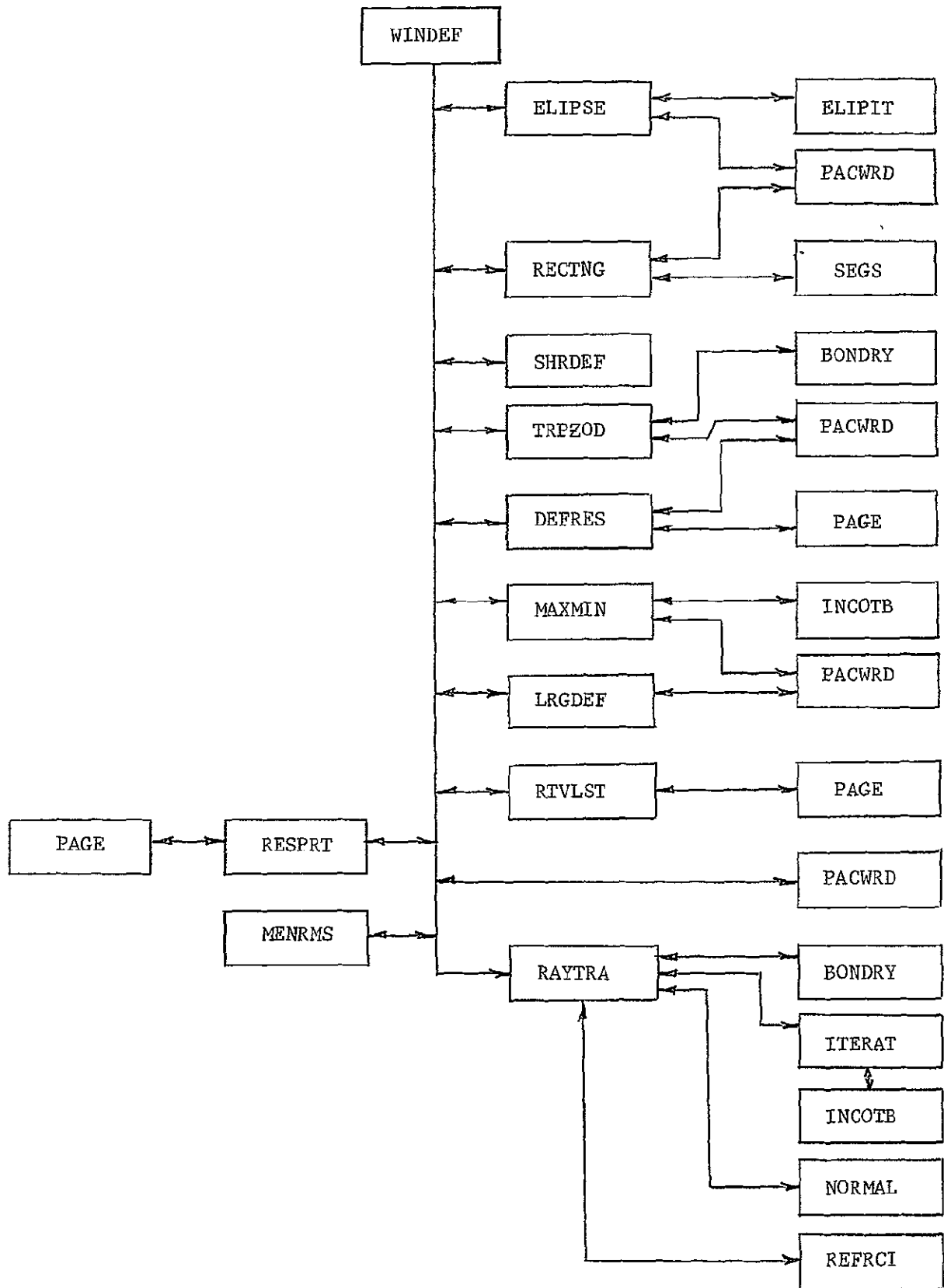


Figure 3. Program Flow Between Subroutines

DRIVER

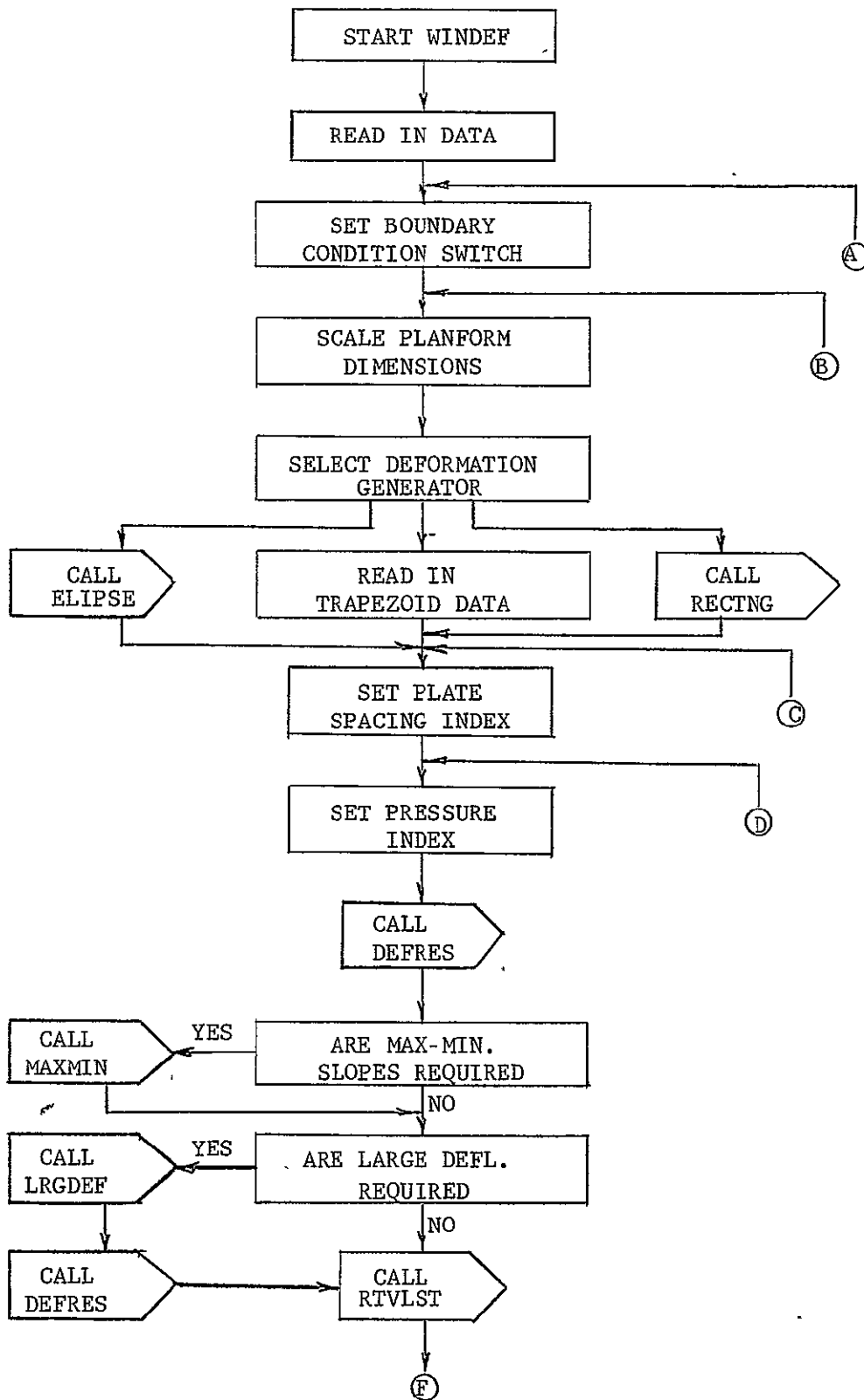


Figure 4a. Driver Flow Chart

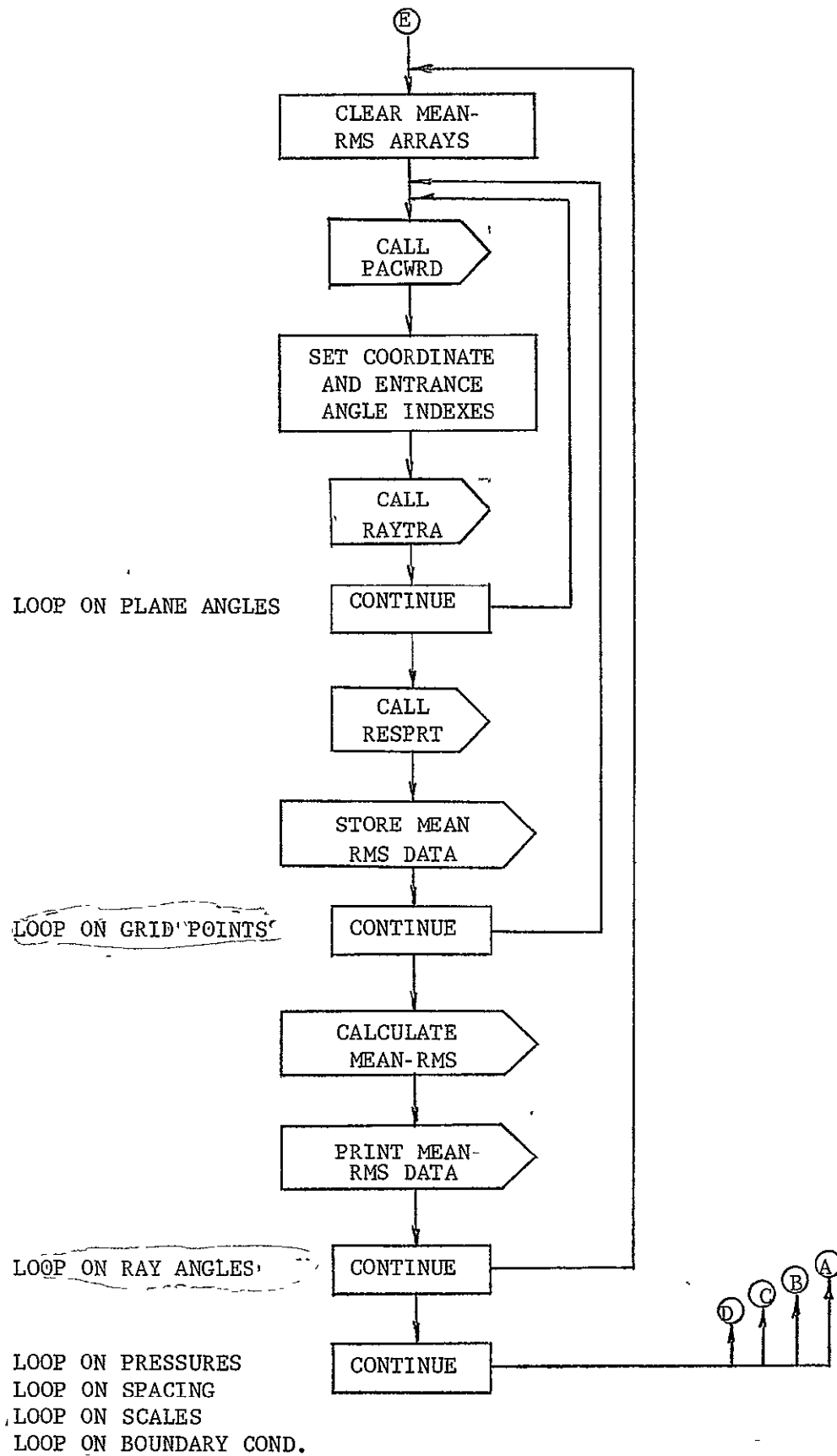


Figure 45 Driver Flow Chart (cont'd)

Section 3

PROGRAM USAGE

This section presents information to assemble and submit a program deck, prepare a data deck, and interpret the output. The program deck is composed of system control cards, the computer code, and the data deck. The data deck consists of cards containing the information necessary to model the particular windows to be analyzed.

WINDEF is a FORTRAN IV program. It was checked out on the IBM 7094 DCS under version 13 of the IBJOB processor. Elliptical and rectangular parameters are introduced on punched cards. Trapezoidal parameters and deformation data are also read in on punched cards. Deformation output is on tape 7 (IS7) and the ray trace results are output on tapes 8 (IS8) and 9 (IS9). Mean and rms summation data and maximum-minimum slope data is output on the system output tape. The data on IS8 is for off-line printing. The data on IS9 is in binary format and can be read by the data retrieval program.

The following paragraphs provide a general description of the input requirements.

PROGRAM DECK MAKEUP

Figure 5 illustrates the order of the cards which make up the program deck when all the data is to be output on the system output tape (Mode 1).

The format for the control cards in the above deck is:

| | | |
|----------|---------|--------------|
| Columns: | 1-7 | 8-80 |
| | \$JOB | (See Manual) |
| | \$IBJOB | blank |
| | \$DATA | blank |

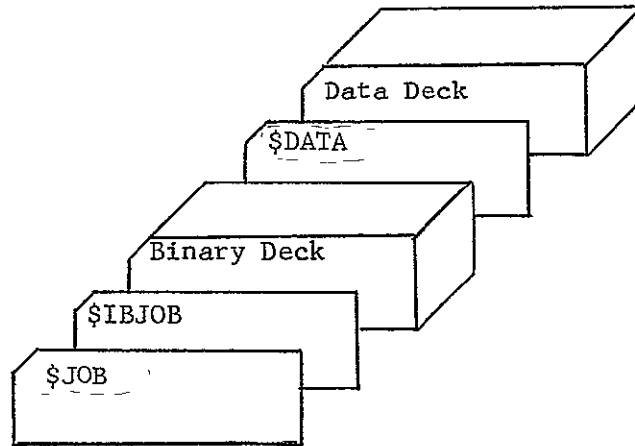


Figure 5. Program Deck-Mode 1

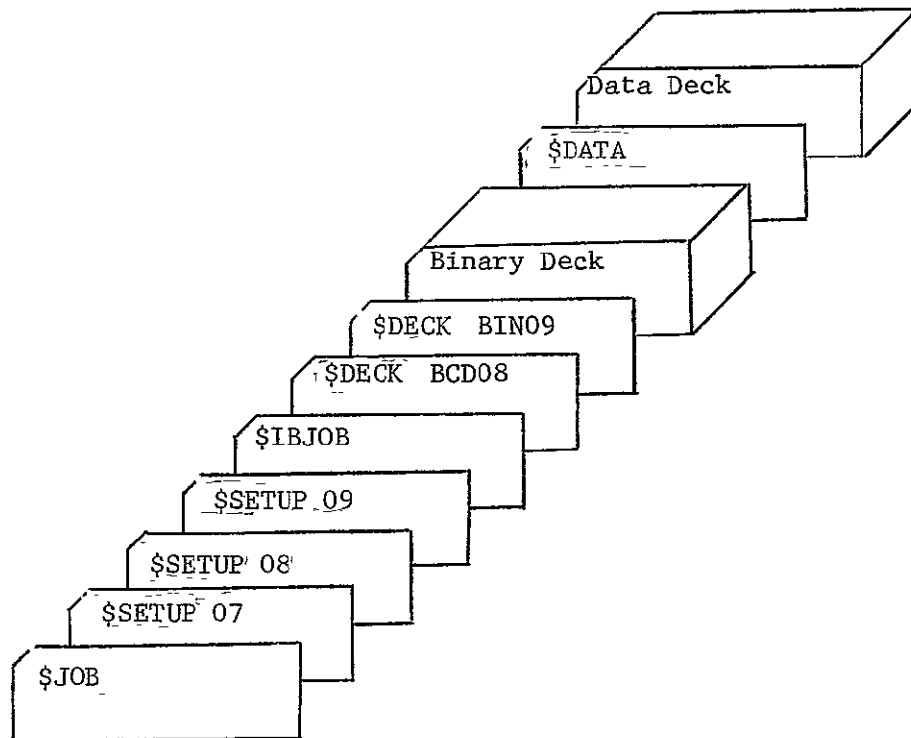


Figure 6. Program Deck-Mode 2

Figure 6 illustrates the order of the cards which make up the program deck when deformation data is output on tape 7, printed ray trace data is output on tape 8 for microfilming, and binary coded ray trace data is stored on tape 9 for later retrieval (Mode 2).

The format for the control cards in the above deck is:

| | | |
|----------|------------|-----------------|
| Columns: | 1-8 | 16-80 |
| | \$JOB | (See Manual) |
| | \$SETUP 07 | ASSIGN |
| | \$SETUP 08 | DISK, ASSIGN, 1 |
| | \$SETUP 09 | ASSIGN |
| | \$IBJOB | blank |
| | \$DECK | BCD08 |
| | \$DECK | BIN09 |
| | \$DATA | blank |

The Ames 7094 Operational Manual should be consulted for other items required on the \$JOB cards.

DATA DECK MAKEUP

Figure 7 illustrates the arrangement of the data deck for multiple problems. This deck may include as many problems as desired, stacked one behind the other. The last problem is followed by two (2) blank or zero cards, i.e., column one to eighty are either all blank or filled with zeros.

Figures 8 and 9 illustrate the arrangement of the data cards within a single problem for the Single Ray Trace and Two Ray Trace data decks. The detailed format for each of the sets of cards in Figures 8 and 9 is explained in Tables 5 and 6. The numbers on the cards shown in the Figures 8 and 9 correspond to the numbers of the entries in Tables 5 and 6 respectively.

Note that the figures show the deck arrangement when trapezoidal deformation data are used. If elliptical or rectangular planforms are being analyzed, cards 13 and 14 are not used.

Several problems may be run using the same data by making multiple entries on cards 4 through 8 and entering the corresponding count on card 2. This compacted input format makes it very convenient to run combinations of problems with a minimum of input.

In the tables, three types of formats are indicated. They are:

- 1) Alphanumeric - Any combination of characters acceptable to the computer, (e.g., 26 letters, numerals 0 to 9, and special characters).
- 2) Integers - (e.g., 3, 14, -8).
- 3) Floating Point Numbers - (e.g., 21.7 + 2, 23.5 and 106-1, which are read as 21.7×10^2 , 23.5, and 106×10^{-1} respectively).

In all instances, the input data must be right justified with respect to their assigned column locations on a card. If a number is to be placed in columns m-n, the rightmost digit (viewer's right) of the number must be in column n. Any consistent set of units for the physical quantities is permissible.

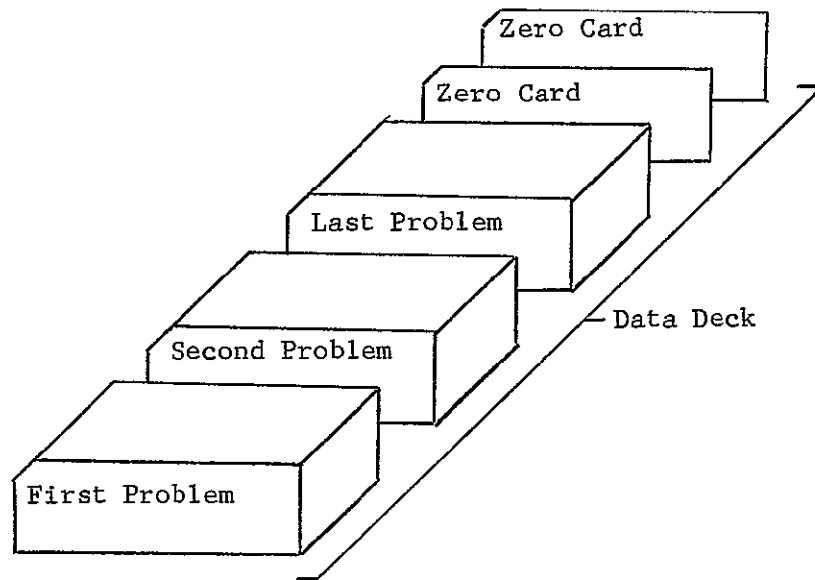


Figure 7. Data Deck . . .

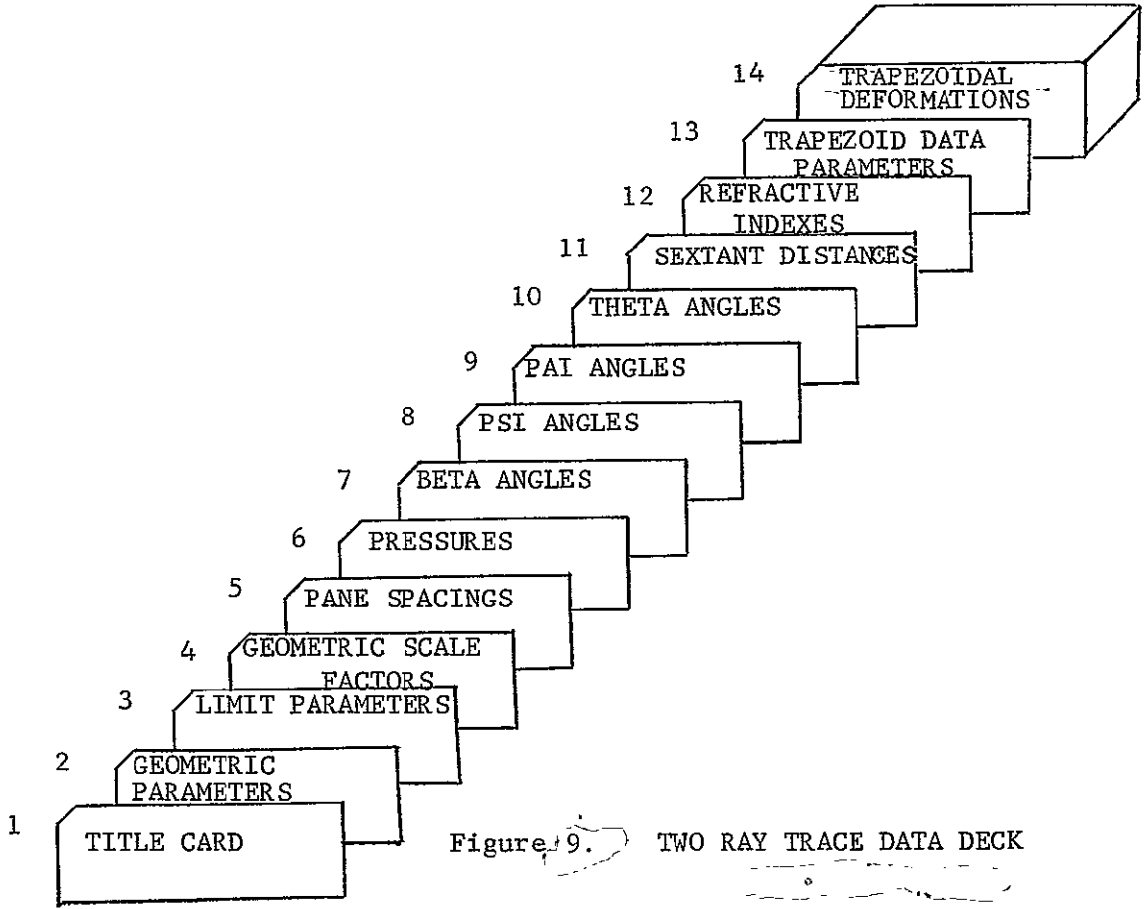
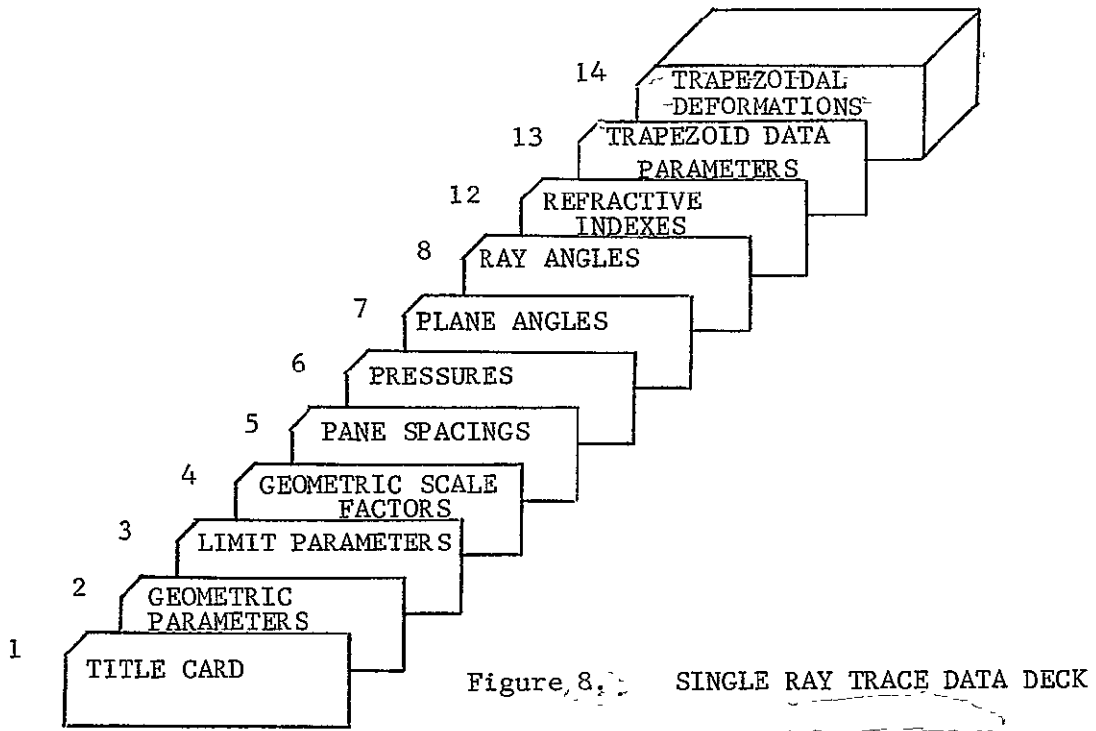


Table 5

Single Ray Trace Input Data

1. Title Card

| <u>Columns</u> | <u>Symbol</u> | <u>Information</u> | <u>Format</u> |
|----------------|---------------|----------------------------------|---------------|
| 1-5 | IRT | Initial retrieval number minus 1 | Integer |
| 6-80 | WORD(I) | Problem title | Alphanumeric |

2. Geometric Parameters

| <u>Columns</u> | <u>Symbol</u> | <u>Information</u> | <u>Format</u> |
|----------------|---------------|--|---------------|
| 1 | - | Leave blank | |
| 2-5 | SHAP | Planform shape ^a Enter: ELIP for ellipses ^b RECT for rectangles ^b TRAP for trapezoids ^c | Alphanumeric |
| 6 | - | Leave blank | |
| 7-10 | BONC | Boundary condition Enter: HING for hinged CLMP for clamped BOTH if both hinged and clamped conditions are to be evaluated | Alphanumeric |
| 11-20 | AA | Ellipse: x axis length Rectangle: long side length Trapezoid: base length (longest) | Floating |
| 21-30 | BB | Ellipse: y axis length Rectangle: short side length Trapezoid: height | Floating |
| 31-40 | CC | Trapezoid: base length (shortest) | Floating |
| 41-50 | THIC | Glass thickness | Floating |
| 51-60 | YONG | Young's modulus | Floating |
| 61-70 | GNU | Poisson's ratio | Floating |
| 71-80 | DEL | Coordinate point increment | Floating |

a See Figure 10.

b A circle is an ellipse with A=B; a square is a rectangle with A=B.

c Trapezoids must be regular trapezoids.

Table 5 (cont'd)

3. Limit Parameters

| <u>Columns</u> | <u>Symbol</u> | <u>Information</u> | <u>Format</u> |
|----------------|---------------|---|---------------|
| 1-5 | NPAN | Number of panes (max.=2) | Integer |
| 6-10 | NSCL | Number of scale values (max.=8) | " |
| 11-15 | NSPC | Number of pane spacing values (max.=8) | " |
| 16-20 | NPRS | Number of pressure differences (max.=8) | " |
| 21-25 | NPAG | Number of plane angles (max.=8) | " |
| 26-30 | NRAG | Number of ray angles (max.=8) | " |
| 31-35 | IMAN | Set=1 to perform maximum/minimum calculations | " |
| 36-40 | ILGD | Set=1 to perform large deflection calculation (rectangles only) | " |
| 41-45 | IREL | Set=1 if trapezoidal x-axis boundary is an axis of symmetry | " |
| 46-50 | NOPT | Set=0 to get displacements on tape 7, ray trace data on tapes 8 and 9. Set=1 to get all data on system output tape, ray trace data on tape 9 Set=2 to get rms and deformation data only | " |
| 51-60 | CPRSS | Cabin pressure for 2 pane cases | Floating |
| 61-65 | ISHR | Set=1 if rectangular shear deformation desired | Integer |

4. Geometric Scale Values

| <u>Columns</u> | <u>Symbol</u> | <u>Information</u> | <u>Format</u> |
|----------------|---------------|--------------------|---------------|
| 1-10 | SCAL(I) | Scale value | Floating |
| 11-20 | | | " |
| . | | | . |
| . | | | . |
| 71-80 | | | " |

Table 5 (cont'd)

5. Pane Spacing Values

| <u>Columns</u> | <u>Symbol</u> | <u>Information</u> | <u>Format</u> |
|----------------|---------------|--|---------------|
| 1-10 | SPAC(I) | Spacing between panes of double pane windows | Floating |
| 11-20 | | | " |
| . | | | . |
| . | | | . |
| 71-80 | | | " |

6. Pressure Values

| <u>Columns</u> | <u>Symbol</u> | <u>Information</u> | <u>Format</u> |
|----------------|---------------|---|---------------|
| 1-10 | PRES(I) | Absolute (not gage) interstitial pressure | Floating |
| 11-20 | | | " |
| . | | | . |
| . | | | . |
| 71-80 | | | " |

7. Plane Angles (see Figure 11)

| <u>Columns</u> | <u>Symbol</u> | <u>Information</u> | <u>Format</u> |
|----------------|---------------|---|---------------|
| 1-10 | PLNA(I) | Plane angle measured from positive x-axis | Floating |
| 11-20 | | | " |
| . | | | . |
| . | | | . |
| 71-80 | | | " |

8. Ray Angles (see Figure 11)

| <u>Columns</u> | <u>Symbol</u> | <u>Information</u> | <u>Format</u> |
|----------------|---------------|--------------------|---------------|
| 1-10 | RAYA(I) | Incidence angle | Floating |
| 11-20 | | | " |
| . | | | . |
| . | | | . |
| 71-80 | | | " |

Table 5 (cont'd)

12. Refractive Indices (There will be 2 (NPAN) + 1 refractive indices)

| <u>Columns</u> | <u>Symbol</u> | <u>Information</u> | <u>Format</u> |
|----------------|---------------|--------------------|---------------|
| 1-10 | RI(I) | Refractive index | Floating |
| 11-20 | | | " |
| . | | | . |
| . | | | . |
| 41-50 | | | " |

13. Trapezoid Data Parameters

| <u>Columns</u> | <u>Symbol</u> | <u>Information</u> | <u>Format</u> |
|----------------|-------------------|---|---------------|
| 1-5 | JLD ^a | Load no. of data to be accepted by program. JLD is the column code value output by SAMIS to identify different loadings | Integer |
| 6-10 | NCRD ^b | No. of cards of data to be read in | " |
| 11-20 | SCLFAC | Scaling factor | Floating |
| 21-30 | X1 | X-coordinate of origin of coordinates | Floating |
| 31-40 | Y1 | Y-coordinate of origin of coordinates | Floating |
| 41-45 | NTX | No. of intervals along x-axis to center of interpolation | Integer |
| 46-50 | NTY | No. of intervals along y-axis to center of interpolation | Integer |

14. Trapezoidal Data

| <u>Columns</u> | <u>Symbol</u> | <u>Information</u> | <u>Format</u> |
|----------------|---------------|-----------------------------------|---------------|
| 1-6 | LOC(J) | Row/col. code ($J_{\max.} = 3$) | Integer |
| 7-12 | ILD(J) | Load number ($J_{\max.} = 3$) | " |

^aIf JLD is negative, data is not to be scaled for pressure.

^bIf NCRD is negative, data for one pane is input and is used for both panes.

Table 5 (cont'd)

14. Trapezoidal Data (continued)

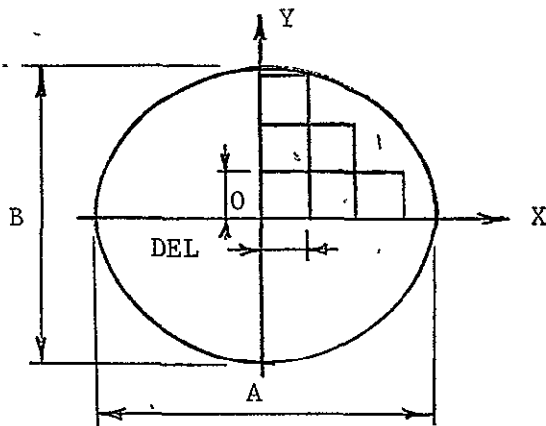
| <u>Columns</u> | <u>Symbol</u> | <u>Information</u> | <u>Format</u> |
|----------------|---------------|---------------------------------------|---------------|
| 13-24 | ELM(J) | Deformation value ($J_{\max.} = 3$) | Octal |
| 25-48 | | Same format as 1-24 | |
| 49-72 | | Same format as 1-24 | |

The rightmost digit in LOC(J) indicates which deformation is stored at ELM(J). The digit-deformation correspondences are:

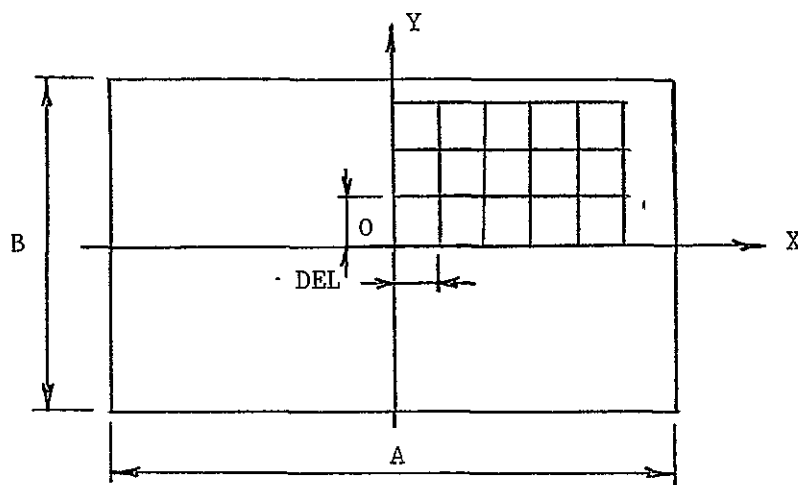
3 = deflection

4 = slope about x-axis

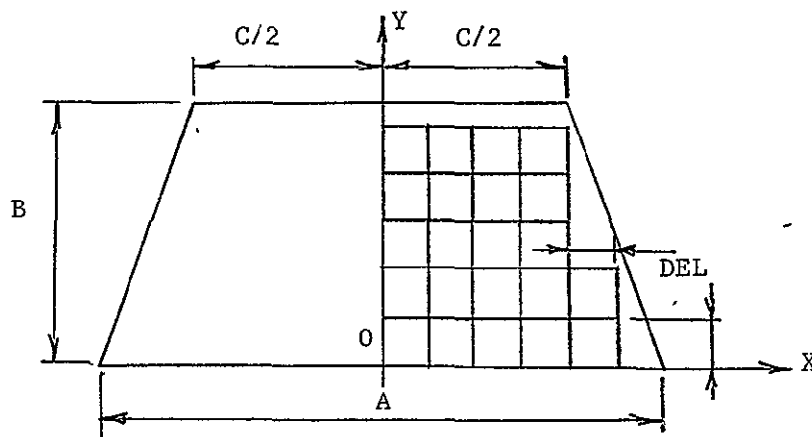
5 = slope about y-axis



(a) Ellipse



(b) Rectangle



(c) Trapezoid

Figure 10. Planform Shapes

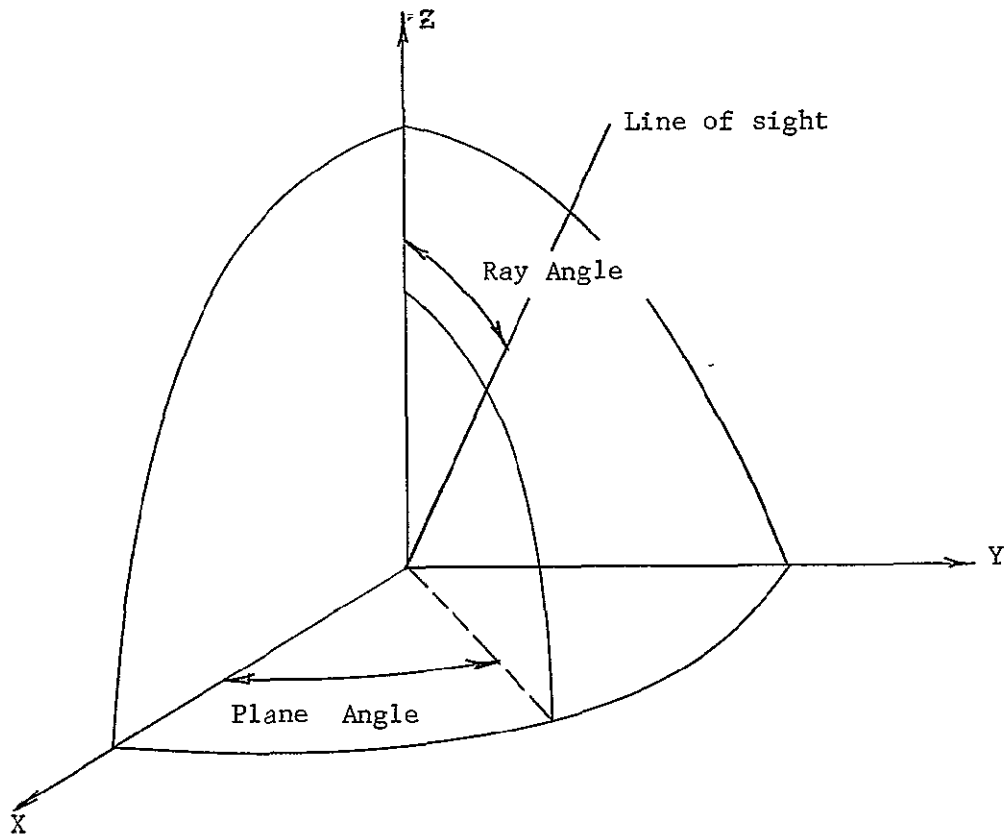


Figure 11 Single Ray Trace Angles

Table 6

Two Ray Trace Input Data

1. Title Card

| <u>Columns</u> | <u>Symbol</u> | <u>Information</u> | <u>Format</u> |
|----------------|---------------|---|---------------|
| 1-5 | IRT | Initial <u>retrieval</u> number minus 1 | Integer |
| 6-80 | WORD(I) | Problem <u>title</u> | Alphanumeric |

2. Geometric Parameters

| <u>Columns</u> | <u>Symbol</u> | <u>Information</u> | <u>Format</u> |
|----------------|---------------|---|---------------|
| 1 | - | Leave <u>blank</u> | |
| 2-5 | SHAP | Planform shape ^a Enter. ELIP for ellipses ^b RECT for rectangles ^b TRAP for trapezoids ^c | Alphanumeric |
| 6 | - | Leave <u>blank</u> | |
| 7-10 | BONC | Boundary <u>condition</u> Enter: HING for hinged CLMP for clamped BOTH if both hinged and clamped conditions are to be evaluated | Alphanumeric |
| 11-20 | AA | Ellipse: x axis length Rectangle: long side length Trapezoid: base length (longest) | Floating |
| 21-30 | BB | Ellipse: y axis length Rectangle: <u>short</u> side length Trapezoid: <u>height</u> | Floating |
| 31-40 | CC | Trapezoid: base length (shortest) | Floating |
| 41-50 | THIC | Glass thickness | Floating |
| 51-60 | YONG | Young's modulus | Floating |
| 61-70 | GNU | Poisson's ratio | Floating |
| 71-80 | DEL | Coordinate point increment | Floating |

a See Figure 10.

b A circle is an ellipse with A=B; a square is a rectangle with A=B.

c Trapezoids must be regular trapezoids.

Table 6 (cont'd)

3. Limit Parameters

| <u>Columns</u> | <u>Symbol</u> | <u>Information</u> | <u>Format</u> |
|----------------|---------------|---|---------------|
| 1-5 | NPAN | Number of panes (max.=2) | Integer |
| 6-10 | NSCL | Number of scale values (max.=8) | " |
| 11-15 | NSPC | Number of pane spacing values (max.=8) | " |
| 16-20 | NPRS | Number of pressure differences (max.=8) | " |
| 21-30 | NOPRT | See Table 1 for NOPRT flags | " |
| 31-35 | IMAN | Set=1 to perform maximum/minimum calculations | " |
| 36-40 | ILGD | Set=1 to perform large deflection calculations (rectangles only) | " |
| 41-45 | IREL | Set=1 if trapezoidal x-axis boundary is an axis of symmetry | " |
| 46-50 | NBET | Number of Beta angles (max.=8) | " |
| 51-55 | NPSI | Number of PSI angles (max.=8) | " |
| 56-60 | NPAI | Number of PAI angles (max.=8) | " |
| 61-65 | NTHE | Number of THETA angles (max.=8) | " |
| 66-70 | NSEX | Number of sextant distances (max.=8) | " |
| 71-80 | CPRSS | Cabin pressure for 2 panes cases | Floating |

4. Geometric Scale Values

| <u>Columns</u> | <u>Symbol</u> | <u>Information</u> | <u>Format</u> |
|----------------|---------------|--------------------|---------------|
| 1-10 | SCAL(I) | Scale value | Floating |
| 11-20 | | | |
| . | | | |
| . | | | |
| 71-81 | | | |

Table 6 (cont'd)

5. Pane Spacing Values

| <u>Columns</u> | <u>Symbol</u> | <u>Information</u> | <u>Format</u> |
|----------------|---------------|---|---------------|
| 1-10 | SPAC(I) | Spacing between panes of double pane windows | Floating |
| 11-20 | | | " |
| . | | | . |
| . | | | . |
| 71-80 | | | " |

6. Pressure Values

| <u>Columns</u> | <u>Symbol</u> | <u>Information</u> | <u>Format</u> |
|----------------|---------------|--|---------------|
| 1-10 | PRES(I) | Absolute (not gage) interstitial pressure | Floating |
| 11-20 | | | " |
| . | | | . |
| . | | | . |
| 71-80 | | | " |

7. Beta Angles (see Figure 12)

| <u>Columns</u> | <u>Symbol</u> | <u>Information</u> | <u>Format</u> |
|----------------|---------------|--|---------------|
| 1-10 | BETA(I) | Plane angle measured from positive x-axis | Floating |
| 11-20 | | | " |
| . | | | . |
| . | | | . |
| 71-80 | | | " |

8. PSI Angle (see Figure 12)

| <u>Columns</u> | <u>Symbol</u> | <u>Information</u> | <u>Format</u> |
|----------------|---------------|---------------------------|---------------|
| 1-10 | PSIA(I) | Z-plane inclination angle | Floating |
| 11-20 | | | " |
| . | | | . |
| . | | | . |
| 71-80 | | | " |

Table 6 (cont'd)

9. PAI Angle (see Figure 12)

| <u>Columns</u> | <u>Symbol</u> | <u>Information</u> | <u>Format</u> |
|----------------|---------------|-----------------------------|---------------|
| 1-10 | PAIA(I) | Primary line-of-sight angle | Floating |
| 11-20 | | | " |
| . | | | . |
| .. | | | . |
| . | | | . |
| 71-80 | | | " |

10. Theata Angle (see Figure 12)

| <u>Columns</u> | <u>Symbol</u> | <u>Information</u> | <u>Format</u> |
|----------------|---------------|-------------------------------------|---------------|
| 1-10 | THEA(I) | Sextant angle (must be positive) | Floating |
| 11-20 | | | " |
| . | | | . |
| . | | | . |
| . | | | . |
| 71-80 | | | " |

11. Sextant Distances

| <u>Columns</u> | <u>Symbol</u> | <u>Information</u> | <u>Format</u> |
|----------------|---------------|------------------------------------|---------------|
| 1-10 | ZSEXT(I) | Distance of sextant from window | Floating |
| 11-20 | | | " |
| . | | | . |
| . | | | . |
| . | | | . |
| 71-80 | | | " |

12. Refractive Indices (There will be 2(NPAN) +1 refractive indices)

| <u>Columns</u> | <u>Symbol</u> | <u>Information</u> | <u>Format</u> |
|----------------|---------------|--------------------|---------------|
| 1-10 | RI(I) | Refractive index | Floating |
| 11-20 | | | " |
| . | | | . |
| . | | | . |
| . | | | . |
| 71-80 | | | " |

Table 6 (cont'd)

13. Trapezoid Data Parameters

| <u>Columns</u> | <u>Symbol</u> | <u>Information</u> | <u>Format</u> |
|----------------|-------------------|--|---------------|
| 1-5 | JLD ^a | Load no. of data to be accepted by program. JLD is the column code value output by SAMIS to identify different loadings. | Integer |
| 6-10 | NCRD ^b | No. of cards of data to be read in | " |
| 11-20 | SCLFAC | Scaling factor | Floating |
| 21-30 | X1 | X-coordinate of origin of coordinates | Floating |
| 31-40 | Y1 | Y-coordinate of origin of coordinates | Floating |
| 41-45 | NTX | No. of intervals along x-axis to center of interpolation | Integer |
| 46-50 | NTY | No. of intervals along y-axis to center of interpolation | Integer |

14. Trapezoidal Data

| <u>Columns</u> | <u>Symbol</u> | <u>Information</u> | <u>Format</u> |
|----------------|---------------|---------------------------------------|---------------|
| 1-6 | LOC(J) | Row/col. code ($J_{\max.} = 3$) | Integer |
| 7-12 | ILD(J) | Load number ($J_{\max.} = 3$) | " |
| 13-24 | ELM(J) | Deformation value ($J_{\max.} = 3$) | Octal |
| 25-48 | | Same format as 1-24 | |
| 49-72 | | Same format as 1-24 | |

^aIf JLD is negative, data is not to be scaled for pressure.

^bIf NCRD is negative, data for one pane is input and is used for both panes.

Table 6 (cont'd)

The rightmost digit in LOC(J) indicates which deformation is stored at ELM(J). The digit-deformation correspondences are:

3 = deflection

4 = slope about x-axis

5 = slope about y-axis

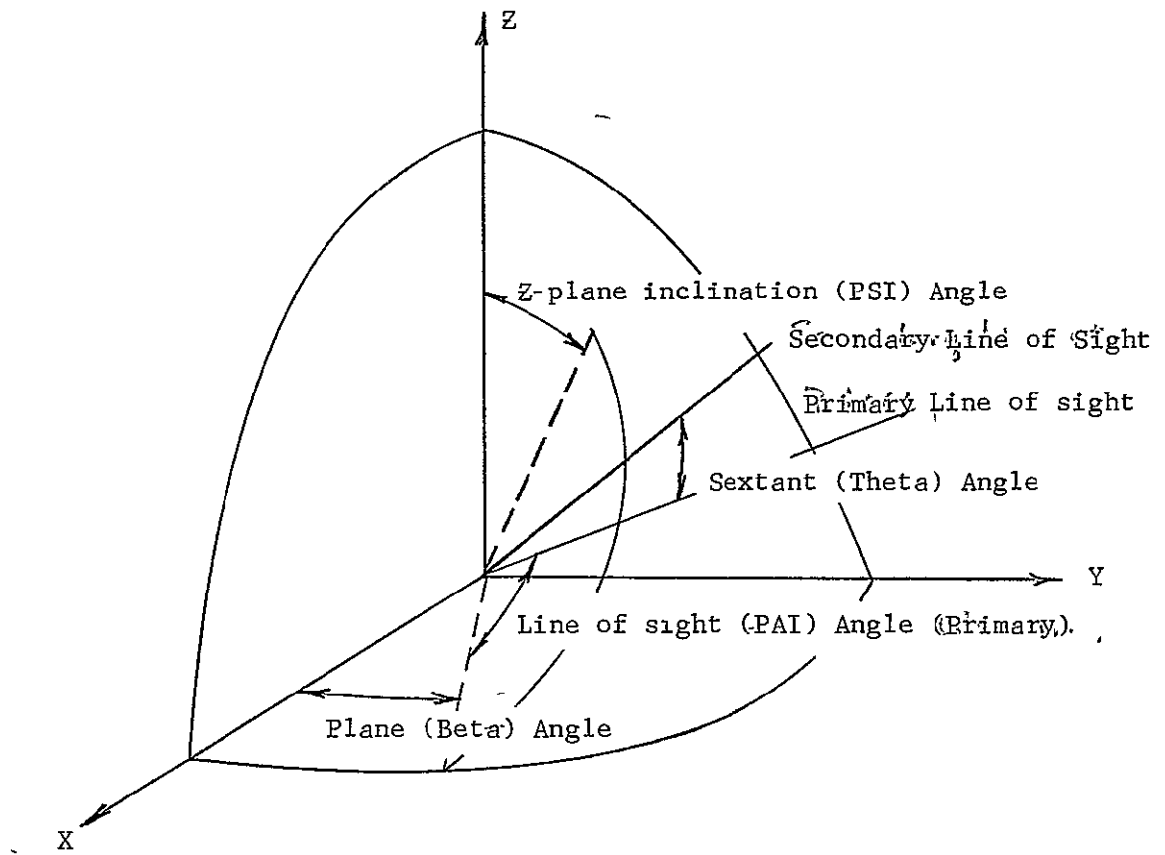


Figure (12) Two Ray Trace Angles

OUTPUT FORMAT

The output for the window deformation data is shown in Figure 13. This output is put on tape 7 (IS7) in a form for printing. The retrieval number is assigned by the analyst to enable retrieval of the data from tape 9. The first line of printout after the title describes the physical parameters of the window being analyzed. The first word denotes the planform shape. A, B, and C are the dimensions of the window. SCALE is the factor by which the dimensions have been multiplied (to study windows of the same shape with different dimensions). The thickness, number of panes, and pane spacing are given. PRESSURE is the interstitial pressure if there are two panes or the cabin pressure if there is only one pane. The edge fixity is given by the last word on the line. The rest of the output consists of a tabulation of the point coordinates (in inches) and the associated deflections for the inner (pane 1) and outer (pane 2) panes. If there is only one pane the deflections of pane 2 are given as zeroes. The deflections are measured in inches.

The output for the ray trace (line of sight) data is shown in Figure 14. This output is put on tape 8 (IS8) in a form for printing and on tape 9 (IS9) in binary format. If the line of sight data is to be retrieved, tape IS9 should be mounted and called by the data retrieval program. The details of the data retrieval program are given in Appendix C. The first line following the title gives the physical parameters of the window being analyzed. The next line gives the coordinates of the point at which the incidence angle strikes the reference surface (see Figure 2). The angle $D1$ is the incidence angle measured in degrees. The remainder of the output is a tabulation of the ray trace data for each plane angle ($A1$) requested by the analyst.

RETRIEVAL NUMBER = 1

WINDOW DEFORMATION DATA

RECTANGLE A= 9.30 B= 9.30 SCALE=0.75 THICKNESS= 0.30 PANES=2 SPACING=1.0 PRESSURE= 7.5 HINGED

| COORDINATES | | | | DEFORMATIONS | | | | COORDINATES | | | | DEFORMATIONS | | | |
|-------------|------|---------------|--------------|--------------|------|---------------|--------------|-------------|------|---------------|--------------|--------------|------|---------------|--------------|
| X | Y | DEFL. PANE 1 | DEFL. PANE 2 | X | Y | DEFL. PANE 1 | DEFL. PANE 2 | X | Y | DEFL. PANE 1 | DEFL. PANE 2 | X | Y | DEFL. PANE 1 | DEFL. PANE 2 |
| 0.00 | 0.00 | -0.288272E-02 | 0.940018E-02 | 0.50 | 0.00 | -0.284498E-02 | 0.927711E-02 | 0.50 | 0.00 | -0.284498E-02 | 0.927711E-02 | 0.50 | 0.00 | -0.284498E-02 | 0.927711E-02 |
| 1.00 | 0.00 | -0.273222E-02 | 0.890941E-02 | 1.50 | 0.00 | -0.254587E-02 | 0.830175E-02 | 1.50 | 0.00 | -0.254587E-02 | 0.830175E-02 | 1.50 | 0.00 | -0.254587E-02 | 0.830175E-02 |
| 2.00 | 0.00 | -0.228851E-02 | 0.746254E-02 | 2.50 | 0.00 | -0.196417E-02 | 0.640489E-02 | 2.50 | 0.00 | -0.196417E-02 | 0.640489E-02 | 2.50 | 0.00 | -0.196417E-02 | 0.640489E-02 |
| 3.00 | 0.00 | -0.157870E-02 | 0.514792E-02 | 3.50 | 0.00 | -0.114036E-02 | 0.371857E-02 | 3.50 | 0.00 | -0.114036E-02 | 0.371857E-02 | 3.50 | 0.00 | -0.114036E-02 | 0.371857E-02 |
| 4.00 | 0.00 | -0.660475E-03 | 0.215372E-02 | 4.50 | 0.00 | -0.154197E-03 | 0.502817E-03 | 4.50 | 0.00 | -0.154197E-03 | 0.502817E-03 | 4.50 | 0.00 | -0.154197E-03 | 0.502817E-03 |
| 0.00 | 0.50 | -0.284498E-02 | 0.927711E-02 | 0.50 | 0.50 | -0.280776E-02 | 0.915572E-02 | 0.50 | 0.50 | -0.280776E-02 | 0.915572E-02 | 0.50 | 0.50 | -0.280776E-02 | 0.915572E-02 |
| 1.00 | 0.50 | -0.269653E-02 | 0.879303E-02 | 1.50 | 0.50 | -0.251270E-02 | 0.819360E-02 | 1.50 | 0.50 | -0.251270E-02 | 0.819360E-02 | 1.50 | 0.50 | -0.251270E-02 | 0.819360E-02 |
| 2.00 | 0.50 | -0.225881E-02 | 0.736570E-02 | 2.50 | 0.50 | -0.193880E-02 | 0.632216E-02 | 2.50 | 0.50 | -0.193880E-02 | 0.632216E-02 | 2.50 | 0.50 | -0.193880E-02 | 0.632216E-02 |
| 3.00 | 0.50 | -0.155841E-02 | 0.508179E-02 | 3.50 | 0.50 | -0.112579E-02 | 0.367106E-02 | 3.50 | 0.50 | -0.112579E-02 | 0.367106E-02 | 3.50 | 0.50 | -0.112579E-02 | 0.367106E-02 |
| 4.00 | 0.50 | -0.652079E-03 | 0.212634E-02 | 4.50 | 0.50 | -0.152242E-03 | 0.496443E-03 | 4.50 | 0.50 | -0.152242E-03 | 0.496443E-03 | 4.50 | 0.50 | -0.152242E-03 | 0.496443E-03 |
| 0.00 | 1.00 | -0.273222E-02 | 0.890941E-02 | 0.50 | 1.00 | -0.269653E-02 | 0.879303E-02 | 0.50 | 1.00 | -0.269653E-02 | 0.879303E-02 | 0.50 | 1.00 | -0.269653E-02 | 0.879303E-02 |
| 1.00 | 1.00 | -0.258988E-02 | 0.844525E-02 | 1.50 | 1.00 | -0.241359E-02 | 0.787039E-02 | 1.50 | 1.00 | -0.241359E-02 | 0.787039E-02 | 1.50 | 1.00 | -0.241359E-02 | 0.787039E-02 |
| 2.00 | 1.00 | -0.217004E-02 | 0.707621E-02 | 2.50 | 1.00 | -0.186294E-02 | 0.607482E-02 | 2.50 | 1.00 | -0.186294E-02 | 0.607482E-02 | 2.50 | 1.00 | -0.186294E-02 | 0.607482E-02 |
| 3.00 | 1.00 | -0.149776E-02 | 0.488401E-02 | 3.50 | 1.00 | -0.108222E-02 | 0.352896E-02 | 3.50 | 1.00 | -0.108222E-02 | 0.352896E-02 | 3.50 | 1.00 | -0.108222E-02 | 0.352896E-02 |
| 4.00 | 1.00 | -0.626961E-03 | 0.204444E-02 | 4.50 | 1.00 | -0.146395E-03 | 0.477375E-03 | 4.50 | 1.00 | -0.146395E-03 | 0.477375E-03 | 4.50 | 1.00 | -0.146395E-03 | 0.477375E-03 |
| 0.00 | 1.50 | -0.254587E-02 | 0.830175E-02 | 0.50 | 1.50 | -0.251270E-02 | 0.819360E-02 | 0.50 | 1.50 | -0.251270E-02 | 0.819360E-02 | 0.50 | 1.50 | -0.251270E-02 | 0.819360E-02 |
| 1.00 | 1.50 | -0.241359E-02 | 0.787039E-02 | 1.50 | 1.50 | -0.224970E-02 | 0.733599E-02 | 1.50 | 1.50 | -0.224970E-02 | 0.733599E-02 | 1.50 | 1.50 | -0.224970E-02 | 0.733599E-02 |
| 2.00 | 1.50 | -0.202320E-02 | 0.659738E-02 | 2.50 | 1.50 | -0.173743E-02 | 0.566553E-02 | 2.50 | 1.50 | -0.173743E-02 | 0.566553E-02 | 2.50 | 1.50 | -0.173743E-02 | 0.566553E-02 |
| 3.00 | 1.50 | -0.139736E-02 | 0.455660E-02 | 3.50 | 1.50 | -0.101005E-02 | 0.329364E-02 | 3.50 | 1.50 | -0.101005E-02 | 0.329364E-02 | 3.50 | 1.50 | -0.101005E-02 | 0.329364E-02 |
| 4.00 | 1.50 | -0.585351E-03 | 0.190875E-02 | 4.50 | 1.50 | -0.136707E-03 | 0.445784E-03 | 4.50 | 1.50 | -0.136707E-03 | 0.445784E-03 | 4.50 | 1.50 | -0.136707E-03 | 0.445784E-03 |
| 0.00 | 2.00 | -0.228851E-02 | 0.746254E-02 | 0.50 | 2.00 | -0.225881E-02 | 0.736570E-02 | 0.50 | 2.00 | -0.225881E-02 | 0.736570E-02 | 0.50 | 2.00 | -0.225881E-02 | 0.736570E-02 |
| 1.00 | 2.00 | -0.217004E-02 | 0.707621E-02 | 1.50 | 2.00 | -0.202320E-02 | 0.659738E-02 | 1.50 | 2.00 | -0.202320E-02 | 0.659738E-02 | 1.50 | 2.00 | -0.202320E-02 | 0.659738E-02 |
| 2.00 | 2.00 | -0.182013E-02 | 0.593522E-02 | 2.50 | 2.00 | -0.156374E-02 | 0.509916E-02 | 2.50 | 2.00 | -0.156374E-02 | 0.509916E-02 | 2.50 | 2.00 | -0.156374E-02 | 0.509916E-02 |
| 3.00 | 2.00 | -0.125832E-02 | 0.410321E-02 | 3.50 | 2.00 | -0.910050E-03 | 0.296755E-02 | 3.50 | 2.00 | -0.910050E-03 | 0.296755E-02 | 3.50 | 2.00 | -0.910050E-03 | 0.296755E-02 |
| 4.00 | 2.00 | -0.527665E-03 | 0.172065E-02 | 4.50 | 2.00 | -0.123273E-03 | 0.401977E-03 | 4.50 | 2.00 | -0.123273E-03 | 0.401977E-03 | 4.50 | 2.00 | -0.123273E-03 | 0.401977E-03 |
| 0.00 | 2.50 | -0.196417E-02 | 0.640489E-02 | 0.50 | 2.50 | -0.193880E-02 | 0.632216E-02 | 0.50 | 2.50 | -0.193880E-02 | 0.632216E-02 | 0.50 | 2.50 | -0.193880E-02 | 0.632216E-02 |
| 1.00 | 2.50 | -0.186294E-02 | 0.607482E-02 | 1.50 | 2.50 | -0.173743E-02 | 0.566553E-02 | 1.50 | 2.50 | -0.173743E-02 | 0.566553E-02 | 1.50 | 2.50 | -0.173743E-02 | 0.566553E-02 |
| 2.00 | 2.50 | -0.156374E-02 | 0.509916E-02 | 2.50 | 2.50 | -0.134423E-02 | 0.438337E-02 | 2.50 | 2.50 | -0.134423E-02 | 0.438337E-02 | 2.50 | 2.50 | -0.134423E-02 | 0.438337E-02 |
| 3.00 | 2.50 | -0.108242E-02 | 0.352963E-02 | 3.50 | 2.50 | -0.783420E-03 | 0.255463E-02 | 3.50 | 2.50 | -0.783420E-03 | 0.255463E-02 | 3.50 | 2.50 | -0.783420E-03 | 0.255463E-02 |
| 4.00 | 2.50 | -0.454562E-03 | 0.148227E-02 | 4.50 | 2.50 | -0.106242E-03 | 0.346441E-03 | 4.50 | 2.50 | -0.106242E-03 | 0.346441E-03 | 4.50 | 2.50 | -0.106242E-03 | 0.346441E-03 |
| 0.00 | 3.00 | -0.157870E-02 | 0.514792E-02 | 0.50 | 3.00 | -0.155841E-02 | 0.508178E-02 | 0.50 | 3.00 | -0.155841E-02 | 0.508178E-02 | 0.50 | 3.00 | -0.155841E-02 | 0.508178E-02 |
| 1.00 | 3.00 | -0.149776E-02 | 0.488401E-02 | 1.50 | 3.00 | -0.139736E-02 | 0.455660E-02 | 1.50 | 3.00 | -0.139736E-02 | 0.455660E-02 | 1.50 | 3.00 | -0.139736E-02 | 0.455660E-02 |
| 2.00 | 3.00 | -0.125832E-02 | 0.410321E-02 | 2.50 | 3.00 | -0.108242E-02 | 0.352963E-02 | 2.50 | 3.00 | -0.108242E-02 | 0.352963E-02 | 2.50 | 3.00 | -0.108242E-02 | 0.352963E-02 |

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Figure 13. Output - Window Deformation Data

| | | | | | | | | | |
|--|---------|-------------|------------|-----------------|-------------|-------------|---------------|-------------|-------------|
| RETRIEVAL NUMBER = 1 | | | | | | | | | |
| RAY TRACE DATA | | | | | | | | | |
| ELLIPSE | A=17.20 | B=11.40 | SCALE=1.00 | THICKNESS= 0.30 | PANES=2 | SPACING=0.5 | PRESSURE= 5.0 | HINGED | |
| X = 0.00 Y = 0.00 DI = 45.00 | | | | | | | | | |
| A1 | DEG. | 0.000000 | 45.000000 | 90.000000 | 135.000000 | 180.000000 | 225.000000 | 270.000000 | 315.000000 |
| XOUT | IN. | 0.859547 | 0.607689 | 0.000000 | -0.607689 | -0.859547 | -0.607689 | -0.000000 | 0.607689 |
| YOUT | IN. | -0.000000 | 0.607753 | 0.859348 | 0.607753 | 0.000000 | -0.607753 | -0.859348 | -0.607753 |
| ZOUT | IN. | 1.126596 | 1.126410 | 1.126224 | 1.126410 | 1.126596 | 1.126410 | 1.126224 | 1.126410 |
| A2CUT | DEG. | 0.000000 | 44.996014 | 89.999999 | 135.003983 | 179.999996 | 224.995998 | 269.999981 | 315.003967 |
| D2OUT | DEG. | 44.997862 | 44.993917 | 44.990003 | 44.993918 | 44.997862 | 44.993917 | 44.990003 | 44.993919 |
| A1-A2 | SEC. | -0.3660E-04 | 0.1435E 02 | 0.0000E-38 | -0.1434E 02 | 0.6147E-02 | 0.1440E 02 | 0.4918E-01 | -0.1430E 02 |
| D1-D2 | SEC. | 0.7695E 01 | 0.2189E 02 | 0.3599E 02 | 0.2189E 02 | 0.7695E 01 | 0.2189E 02 | 0.3599E 02 | 0.2189E 02 |
| THETA | SEC. | 0.7668E 01 | 0.2411E 02 | 0.3597E 02 | 0.2411E 02 | 0.7663E 01 | 0.2411E 02 | 0.3596E 02 | 0.2410E 02 |
| ITHE | SEC. | 0.000126 | 20.538464 | 35.968629 | 20.536927 | 0.001099 | -20.534622 | -35.964019 | -20.533854 |
| JTHE | SEC. | -7.667826 | -10.393328 | -0.000673 | 10.390254 | 7.663216 | 10.391791 | 0.001394 | -10.391023 |
| KTHE | SEC. | -0.000126 | -7.173748 | 0.000672 | 7.174516 | 0.001099 | -7.172211 | 0.001392 | 7.171827 |
| X = 1.00 Y = 0.00 DI = 45.00 | | | | | | | | | |
| A1 | DEG. | 0.000000 | 45.000000 | 90.000000 | 135.000000 | 180.000000 | 225.000000 | 270.000000 | 315.000000 |
| XOUT | IN. | 1.858490 | 1.607128 | 1.000133 | 0.392429 | 0.140355 | 0.392429 | 1.000133 | 1.607128 |
| YOUT | IN. | -0.000000 | 0.607059 | 0.858867 | 0.607768 | 0.000000 | -0.607768 | -0.858867 | -0.607059 |
| ZOUT | IN. | 1.125296 | 1.125351 | 1.125745 | 1.126514 | 1.126944 | 1.126514 | 1.125745 | 1.125351 |
| A2CUT | DEG. | -0.000000 | 44.995956 | 89.999860 | 135.003986 | 179.999996 | 224.995995 | 270.000118 | 315.004021 |
| D2OUT | DEG. | 44.998249 | 44.994278 | 44.990097 | 44.993809 | 44.997787 | 44.993809 | 44.990097 | 44.994277 |
| A1-A2 | SEC. | 0.8726E-04 | 0.1456E 02 | 0.5010E 00 | -0.1436E 02 | 0.6147E-02 | 0.1441E 02 | -0.4426E 00 | -0.1450E 02 |
| D1-D2 | SEC. | 0.6301E 01 | 0.2060E 02 | 0.3565E 02 | 0.2229E 02 | 0.7964E 01 | 0.2229E 02 | 0.3565E 02 | 0.2060E 02 |
| THETA | SEC. | 0.6277E 01 | 0.2301E 02 | 0.3563E 02 | 0.2447E 02 | 0.7938E 01 | 0.2446E 02 | 0.3563E 02 | 0.2301E 02 |
| ITHE | SEC. | 0.000188 | 19.695533 | 35.632072 | 20.820465 | 0.001261 | -20.815855 | -35.626693 | -19.694765 |
| JTHE | SEC. | -6.277029 | -9.403634 | 0.250530 | 10.659961 | 7.938302 | 10.662267 | 0.252614 | -9.405170 |
| KTHE | SEC. | -0.000188 | -7.277481 | -0.250530 | 7.183737 | 0.001261 | -7.179895 | 0.252612 | 7.275560 |

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Figure 14. Output - Ray Trace Data

When maximum-minimum slopes are required, the deflection and maximum and minimum slopes are printed on the system output tape. The output for this data is shown in Figure 15. The first line following the title gives the physical parameters of the window being analyzed. The remainder of the output consists of a tabulation of the coordinates of the point under investigation along with the deflections at that point and the maximum and minimum slopes (in radians) and orientation angles. The orientation angles are measured relative to the positive x-axis.

The mean and rms summation data for sets of collinear rays also appear on the system output tape. The output for this data is shown in Figure 16. The first line following the title gives the incidence angle. The rest of the output consists of a tabulation of the plane angles and their respective mean and rms values. The "no. points" indicates the total number of points on the window which were used in the calculation of the mean and rms values.

A retrieval list also appears on the system output tape. The list contains the retrieval index number and the parameters associated with each problem for one run on the computer. The output for the retrieval list is shown in Figure 17.

The output for the two ray trace data is shown in Figure 18. This output appears on the system output tape. The first line following the title gives the physical parameters of the window being analyzed. The next lines give the values of other parameters affecting the ray tracing. "ZSEXT" is the distance of the sextant from the window reference surface. "BETA" is the plane angle, "PSI" is the z-plane inclination angle, "THETA" is the sextant angle,

WINDOW DEFORMATIONS - DEFLECTION, MAXIMUM AND MINIMUM SLOPE

ELLIPSE A=10.00 B=10.00 SCALE=1.00 THICKNESS= 0.30 PANES=1 SPACING=*** PRESSURE= 10.0 HINGED

(ANGLE IS IN DEGREES MEASURED WITH RESPECT TO THE POSITIVE X-AXIS)

| COORDINATES | | DEFLECTION | MAXIMUM SLOPE | | MINIMUM SLOPE | |
|-------------|------|-------------|---------------|-------|---------------|-------|
| X | Y | | SLOPE | ANGLE | SLOPE | ANGLE |
| 0.50 | 0.50 | 0.16436E-01 | 0.12014E-02 | 48. | -0.20955E-04 | 136. |
| 1.50 | 0.50 | 0.14785E-01 | 0.32701E-02 | 90. | -0.25611E-04 | 180. |
| 2.50 | 0.50 | 0.11647E-01 | 0.54028E-02 | 98. | 0.31432E-04 | 8. |
| 3.50 | 0.50 | 0.73346E-02 | 0.69797E-02 | 100. | -0.10070E-03 | 10. |
| 4.50 | 0.50 | 0.20648E-02 | 0.83423E-02 | 98. | -0.61700E-04 | 8. |
| 5.50 | 0.50 | 0.20648E-02 | 0.83423E-02 | 98. | -0.61700E-04 | 8. |
| 0.50 | 1.50 | 0.14785E-01 | -0.32713E-02 | 180. | 0.24447E-04 | 90. |
| 1.50 | 1.50 | 0.13173E-01 | 0.33842E-02 | 46. | -0.59372E-04 | 136. |
| 2.50 | 1.50 | 0.10126E-01 | 0.46962E-02 | 72. | -0.66357E-04 | 162. |
| 3.50 | 1.50 | 0.59584E-02 | 0.59942E-02 | 84. | -0.90222E-04 | 174. |
| 4.50 | 1.50 | 0.16139E-02 | 0.50818E-02 | 86. | -0.61118E-05 | 176. |
| 0.50 | 2.50 | 0.11647E-01 | -0.53970E-02 | 174. | 0.30268E-04 | 82. |
| 1.50 | 2.50 | 0.10126E-01 | 0.46962E-02 | 20. | 0.67521E-04 | 108. |
| 2.50 | 2.50 | 0.72757E-02 | 0.48988E-02 | 44. | 0.84401E-04 | 134. |
| 3.50 | 2.50 | 0.29470E-02 | 0.70658E-02 | 60. | -0.82073E-04 | 150. |
| 4.50 | 2.50 | 0.29470E-02 | 0.70658E-02 | 60. | -0.82073E-04 | 150. |
| 0.50 | 3.50 | 0.73346E-02 | -0.69803E-02 | 170. | -0.10012E-03 | 80. |
| 1.50 | 3.50 | 0.59584E-02 | 0.59948E-02 | 6. | 0.89640E-04 | 96. |
| 2.50 | 3.50 | 0.34088E-02 | 0.54843E-02 | 28. | 0.86147E-04 | 116. |
| 3.50 | 3.50 | 0.47326E-03 | 0.29512E-02 | 40. | 0.24265E-04 | 130. |
| 0.50 | 4.50 | 0.20648E-02 | -0.83423E-02 | 172. | -0.61700E-04 | 82. |
| 1.50 | 4.50 | 0.20648E-02 | -0.83423E-02 | 172. | -0.61700E-04 | 82. |
| 2.50 | 4.50 | 0.20648E-02 | -0.83423E-02 | 172. | -0.61700E-04 | 82. |
| 3.50 | 4.50 | 0.20648E-02 | -0.83423E-02 | 172. | -0.61700E-04 | 82. |
| 0.50 | 5.50 | 0.20648E-02 | -0.83423E-02 | 172. | -0.61700E-04 | 82. |

Figure 15. Output - Maximum and Minimum Slopes

RAY TRACE DATA

MEAN AND RMS SUMMATION

ELLIPSE A=17.20 E=11.40 SCALE=1.00 THICKNESS= 0.30 PANES=2 SPACING=0.5 PRESSURE= 5.0 HINGED

RAY ANGLE (DI) = 45.00 DEG.

| PLANE ANGLE | MEAN | RMS | NO. POINTS |
|-------------|------------|------------|------------|
| 0.0 | 0.7301E 01 | 0.4958E 01 | 31 |
| 45.0 | 0.1345E 02 | 0.5904E 01 | 28 |
| 90.0 | 0.2329E 02 | 0.7910E 01 | 28 |
| 135.0 | 0.1659E 02 | 0.5921E 01 | 33 |
| 180.0 | 0.6496E 01 | 0.3641E 01 | 36 |
| 225.0 | 0.1644E 02 | 0.5705E 01 | 36 |
| 270.0 | 0.2699E 02 | 0.6800E 01 | 36 |
| 315.0 | 0.1807E 02 | 0.3853E 01 | 33 |

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Figure 16. Output - Mean and RMS Summation

| RETRIEVAL NUMBER | SHAPE | A IN. | B IN. | C IN. | THICKNESS IN. | PANES | SPACING ^a IN. | PRESSURE LB. | FIXITY |
|------------------|-----------|-------|-------|-------|---------------|-------|--------------------------|--------------|---------|
| 1 | ELLIPSE | 3.60 | 3.60 | 0.00 | 0.30 | 1 | ***** | 5.0 | HINGED |
| 2 | ELLIPSE | 3.60 | 3.60 | 0.00 | 0.30 | 1 | ***** | 7.5 | HINGED |
| 3 | ELLIPSE | 3.60 | 3.60 | 0.00 | 0.30 | 1 | ***** | 10.0 | HINGED |
| 4 | ELLIPSE | 3.60 | 3.60 | 0.00 | 0.30 | 1 | ***** | 15.0 | HINGED |
| 5 | ELLIPSE | 3.24 | 3.24 | 0.00 | 0.30 | 1 | ***** | 5.0 | HINGED |
| 6 | ELLIPSE | 3.24 | 3.24 | 0.00 | 0.30 | 1 | ***** | 7.5 | HINGED |
| 7 | ELLIPSE | 3.24 | 3.24 | 0.00 | 0.30 | 1 | ***** | 10.0 | HINGED |
| 8 | ELLIPSE | 3.24 | 3.24 | 0.00 | 0.30 | 1 | ***** | 15.0 | HINGED |
| 9 | ELLIPSE | 4.32 | 4.32 | 0.00 | 0.30 | 1 | ***** | 5.0 | HINGED |
| 10 | ELLIPSE | 4.32 | 4.32 | 0.00 | 0.30 | 1 | ***** | 7.5 | HINGED |
| 11 | ELLIPSE | 4.32 | 4.32 | 0.00 | 0.30 | 1 | ***** | 10.0 | HINGED |
| 12 | ELLIPSE | 4.32 | 4.32 | 0.00 | 0.30 | 1 | ***** | 15.0 | HINGED |
| 13 | ELLIPSE | 4.68 | 4.68 | 0.00 | 0.30 | 1 | ***** | 5.0 | HINGED |
| 14 | ELLIPSE | 4.68 | 4.68 | 0.00 | 0.30 | 1 | ***** | 7.5 | HINGED |
| 15 | ELLIPSE | 4.68 | 4.68 | 0.00 | 0.30 | 1 | ***** | 10.0 | HINGED |
| 16 | ELLIPSE | 4.68 | 4.68 | 0.00 | 0.30 | 1 | ***** | 15.0 | HINGED |
| 17 | ELLIPSE | 3.60 | 3.60 | 0.00 | 0.30 | 1 | ***** | 5.0 | CLAMPED |
| 18 | ELLIPSE | 3.60 | 3.60 | 0.00 | 0.30 | 1 | ***** | 7.5 | CLAMPED |
| 19 | ELLIPSE | 3.60 | 3.60 | 0.00 | 0.30 | 1 | ***** | 10.0 | CLAMPED |
| 20 | ELLIPSE | 3.60 | 3.60 | 0.00 | 0.30 | 1 | ***** | 15.0 | CLAMPED |
| 21 | ELLIPSE | 3.24 | 3.24 | 0.00 | 0.30 | 1 | ***** | 5.0 | CLAMPED |
| 22 | ELLIPSE | 3.24 | 3.24 | 0.00 | 0.30 | 1 | ***** | 7.5 | CLAMPED |
| 23 | ELLIPSE | 3.24 | 3.24 | 0.00 | 0.30 | 1 | ***** | 10.0 | CLAMPED |
| 24 | ELLIPSE | 3.24 | 3.24 | 0.00 | 0.30 | 1 | ***** | 15.0 | CLAMPED |
| 25 | ELLIPSE | 4.32 | 4.32 | 0.00 | 0.30 | 1 | ***** | 5.0 | CLAMPED |
| 26 | ELLIPSE | 4.32 | 4.32 | 0.00 | 0.30 | 1 | ***** | 7.5 | CLAMPED |
| 27 | ELLIPSE | 4.32 | 4.32 | 0.00 | 0.30 | 1 | ***** | 10.0 | CLAMPED |
| 28 | ELLIPSE | 4.32 | 4.32 | 0.00 | 0.30 | 1 | ***** | 15.0 | CLAMPED |
| 29 | ELLIPSE | 4.68 | 4.68 | 0.00 | 0.30 | 1 | ***** | 5.0 | CLAMPED |
| 30 | ELLIPSE | 4.68 | 4.68 | 0.00 | 0.30 | 1 | ***** | 7.5 | CLAMPED |
| 31 | ELLIPSE | 4.68 | 4.68 | 0.00 | 0.30 | 1 | ***** | 10.0 | CLAMPED |
| 32 | ELLIPSE | 4.68 | 4.68 | 0.00 | 0.30 | 1 | ***** | 15.0 | CLAMPED |
| 33 | RECTANGLE | 3.00 | 3.00 | 0.00 | 0.30 | 1 | ***** | 5.0 | HINGED |
| 34 | RECTANGLE | 3.00 | 3.00 | 0.00 | 0.30 | 1 | ***** | 7.5 | HINGED |
| 35 | RECTANGLE | 3.00 | 3.00 | 0.00 | 0.30 | 1 | ***** | 10.0 | HINGED |
| 36 | RECTANGLE | 3.00 | 3.00 | 0.00 | 0.30 | 1 | ***** | 15.0 | HINGED |
| 37 | RECTANGLE | 2.70 | 2.70 | 0.00 | 0.30 | 1 | ***** | 5.0 | HINGED |
| 38 | RECTANGLE | 2.70 | 2.70 | 0.00 | 0.30 | 1 | ***** | 7.5 | HINGED |
| 39 | RECTANGLE | 2.70 | 2.70 | 0.00 | 0.30 | 1 | ***** | 10.0 | HINGED |
| 40 | RECTANGLE | 2.70 | 2.70 | 0.00 | 0.30 | 1 | ***** | 15.0 | HINGED |

a. Pane Spacing Values are not applicable when only one pane is considered and are indicated as "*****."

Figure 17. Output - Retrieval List

RETRIEVAL NUMBER = 1

T W C R A Y T R A C E D A T A

ELLIPSE A=14.00 B=14.00 SCALE=1.00 THICKNESS= 0.30 PANES=2 SPACING=0.3 PRESSURE= 10.0 RINGED

ZSEXT= 4.000 IN. BETA= 135.00 DEG. PSI= 0.00 DEG. THETA= 0.00 DEG. PAI= 90.00 DEG. SAI= 90.00 DEG.

| XP IN | YP IN | XP OUT | YP OUT | XS IN | YS IN | XS OUT | YS OUT | ERRCR (SEC) |
|--------|--------|---------|--------|--------|---------|--------|---------|-------------|
| 0.0000 | 0.0000 | -0.0000 | 0.0000 | 2.4486 | -2.4486 | 2.4490 | -2.4490 | 1.04848 |
| 1.0000 | 0.0000 | 1.0002 | 0.0000 | 3.4486 | -2.4486 | 3.4491 | -2.4490 | 0.86319 |
| 2.0000 | 0.0000 | 2.0003 | 0.0000 | 4.4486 | -2.4486 | 4.4492 | -2.4489 | 0.67565 |
| 3.0000 | 0.0000 | 3.0005 | 0.0000 | 5.4486 | -2.4486 | 5.4493 | -2.4489 | 0.47786 |
| 4.0000 | 0.0000 | 4.0006 | 0.0000 | 6.4486 | -2.4486 | 6.4493 | -2.4489 | 0.40405 |
| 5.0000 | 0.0000 | 5.0007 | 0.0000 | 7.4486 | -2.4486 | 7.4492 | -2.4488 | 0.51238 |
| 6.0000 | 0.0000 | 6.0007 | 0.0000 | 8.4486 | -2.4486 | 8.4492 | -2.4488 | 0.67047 |
| 7.0000 | 0.0000 | 7.0007 | 0.0000 | 9.4486 | -2.4486 | 9.4490 | -2.4487 | 0.75766 |
| 0.0000 | 1.0000 | -0.0000 | 1.0002 | 2.4486 | -1.4486 | 2.4490 | -1.4488 | 1.14827 |
| 1.0000 | 1.0000 | 1.0002 | 1.0002 | 3.4486 | -1.4486 | 3.4491 | -1.4488 | 1.01673 |
| 2.0000 | 1.0000 | 2.0003 | 1.0002 | 4.4486 | -1.4486 | 4.4492 | -1.4488 | 0.83633 |
| 3.0000 | 1.0000 | 3.0005 | 1.0002 | 5.4486 | -1.4486 | 5.4493 | -1.4488 | 0.64515 |
| 4.0000 | 1.0000 | 4.0006 | 1.0001 | 6.4486 | -1.4486 | 6.4493 | -1.4488 | 0.51475 |
| 5.0000 | 1.0000 | 5.0007 | 1.0001 | 7.4486 | -1.4486 | 7.4493 | -1.4487 | 0.52127 |
| 6.0000 | 1.0000 | 6.0007 | 1.0001 | 8.4486 | -1.4486 | 8.4492 | -1.4487 | 0.62114 |
| 0.0000 | 2.0000 | -0.0000 | 2.0003 | 2.4486 | -0.4486 | 2.4490 | -0.4487 | 1.17312 |
| 1.0000 | 2.0000 | 1.0002 | 2.0003 | 3.4486 | -0.4486 | 3.4491 | -0.4487 | 1.07661 |
| 2.0000 | 2.0000 | 2.0003 | 2.0003 | 4.4486 | -0.4486 | 4.4492 | -0.4487 | 0.92533 |
| 3.0000 | 2.0000 | 3.0004 | 2.0003 | 5.4486 | -0.4486 | 5.4493 | -0.4487 | 0.74955 |
| 4.0000 | 2.0000 | 4.0006 | 2.0003 | 6.4486 | -0.4486 | 6.4493 | -0.4487 | 0.60059 |
| 5.0000 | 2.0000 | 5.0006 | 2.0003 | 7.4486 | -0.4486 | 7.4493 | -0.4487 | 0.54315 |
| 6.0000 | 2.0000 | 6.0007 | 2.0002 | 8.4486 | -0.4486 | 8.4492 | -0.4486 | 0.58206 |
| 0.0000 | 3.0000 | -0.0000 | 3.0005 | 2.4486 | 0.5514 | 2.4490 | 0.5515 | 1.12325 |
| 1.0000 | 3.0000 | 1.0002 | 3.0005 | 3.4486 | 0.5514 | 3.4491 | 0.5515 | 1.06157 |
| 2.0000 | 3.0000 | 2.0003 | 3.0004 | 4.4486 | 0.5514 | 4.4492 | 0.5515 | 0.94077 |
| 3.0000 | 3.0000 | 3.0004 | 3.0004 | 5.4486 | 0.5514 | 5.4493 | 0.5515 | 0.78530 |
| 4.0000 | 3.0000 | 4.0005 | 3.0004 | 6.4486 | 0.5514 | 6.4493 | 0.5514 | 0.63573 |
| 5.0000 | 3.0000 | 5.0006 | 3.0004 | 7.4486 | 0.5514 | 7.4493 | 0.5514 | 0.54513 |
| 6.0000 | 3.0000 | 6.0006 | 3.0003 | 8.4486 | 0.5514 | 8.4492 | 0.5514 | 0.53690 |
| 0.0000 | 4.0000 | -0.0000 | 4.0006 | 2.4486 | 1.5514 | 2.4490 | 1.5516 | 1.00862 |
| 1.0000 | 4.0000 | 1.0001 | 4.0006 | 3.4486 | 1.5514 | 3.4491 | 1.5516 | 0.97538 |
| 2.0000 | 4.0000 | 2.0003 | 4.0006 | 4.4486 | 1.5514 | 4.4492 | 1.5516 | 0.88820 |
| 3.0000 | 4.0000 | 3.0004 | 4.0005 | 5.4486 | 1.5514 | 5.4493 | 1.5516 | 0.75559 |
| 4.0000 | 4.0000 | 4.0005 | 4.0005 | 6.4486 | 1.5514 | 6.4493 | 1.5516 | 0.61468 |
| 5.0000 | 4.0000 | 5.0006 | 4.0004 | 7.4486 | 1.5514 | 7.4493 | 1.5515 | 0.51033 |

Figure 18. Output - Two Ray Trace Data

"PAI" is the primary line of sight angle, and "SAI" is the secondary line of sight angle. The remainder of the data consists of a tabulation of the coordinates of the entering (XP IN and YP IN) and exiting (XP OUT and YP OUT) primary lines of sight and the entering (XS IN and YS IN) and exiting (XS OUT and YS OUT) secondary lines of sight and the error in the sextant angle (ERROR). If any of the coordinates fall outside the window planform, the error is indicated as "*****".

ERRORS

There are three program generated errors. These are:

1. The boundary condition word used as XXXX which is not acceptable.
2. The plan form word used was XXXX which is not acceptable.
3. ERROR. There is not a complete grid from which an interpolation can be made.

The first two comments indicate the input data on the parameter card are incorrect. Comment three indicates there are insufficient grid points to form a single grid.

Section 4

CONCLUDING REMARKS

A FORTRAN IV computer program has been described which will generate the deformed shape of elliptical and rectangular windows with single or double panes under pressure loadings. The program also permits tracing of light rays (lines of sight) through the deformed windows. The program computes the angular deviations of the rays passing through the window. The program will also compute the change in the angle between two specified light rays as they pass through the windows. Approximately 2.5 to 4.0 seconds are required to trace a ray through a double pane window.

Extensive use has been made of the computer program to perform ray trace analyses on the Apollo Scientific Side Window and also on generalized windows of various sizes and shapes. This use has resulted in validation of the program for a wide variety of input and output conditions and for extensive run times.

References

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Appendix A

Development of Deformation Equations

This appendix contains the details of the development of the deformation equations for the ~~elliptic~~ ^{elliptic circular}, circular, and rectangular plates with both simply supported and clamped edges using small deflection theory. In addition, the formulation of the equations for the large deflection and shear deformation of rectangular plates are presented.

Timoshenko⁽²⁾ gives Equation (1) below as the expression for the deflection, w_0 , at the center of a clamped ellipse as a function of the semiaxis dimensions "a" and "b" as shown in Figure A-1. Equation (2) gives the deflection, w , at any point on the ellipse in terms of w_0 . Equation 2, when differentiated with respect to x and y, yields the slopes about the x and y axes. Equation (3) and (4) are the resulting expressions.

ELLIPSE

CLAMPED EDGES

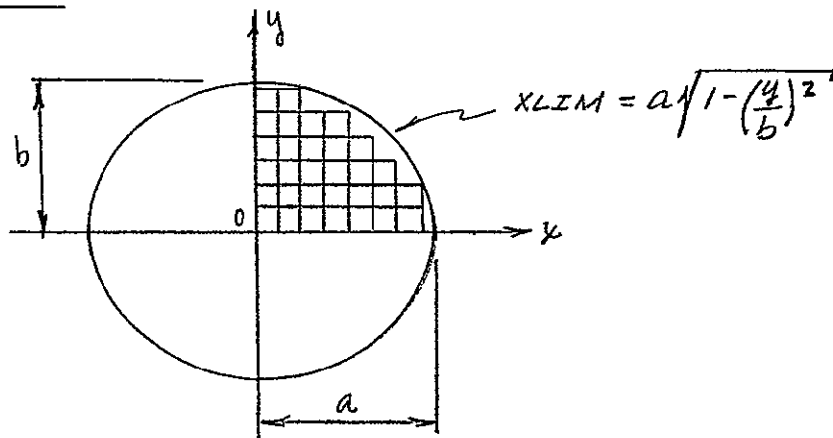


FIGURE A-1

$$w_0 = \frac{8}{D \left(\frac{24}{a^4} + \frac{24}{b^4} + \frac{16}{a^2 b^2} \right)} \quad (1)$$

= DEFLECTION AT CENTER OF PLATE

$$w = w_0 \left\{ 1 - \frac{x^2}{a^2} - \frac{y^2}{b^2} \right\}^2 \quad \text{pos. in direction of load} \quad (2)$$

$$\frac{\partial w}{\partial x} = - \frac{4 w_0 x}{a^2} \left\{ 1 - \frac{x^2}{a^2} - \frac{y^2}{b^2} \right\} \quad (3)$$

$$\frac{\partial w}{\partial y} = - \frac{4 w_0 y}{b^2} \left\{ 1 - \frac{x^2}{a^2} - \frac{y^2}{b^2} \right\} \quad (4)$$

$w =$ DEFLECTION AT ANY POINT

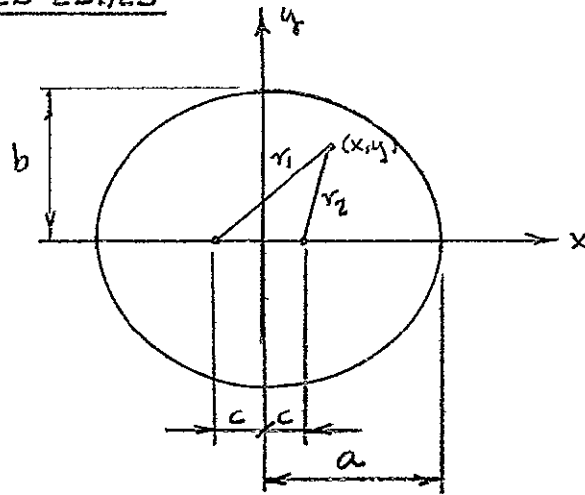
$\partial w / \partial x =$ SLOPE ABOUT X AXIS

$\partial w / \partial y =$ SLOPE ABOUT Y AXIS

The deflection, w , for any point on a simply supported ellipse is given by Galerkin⁽³⁾ in terms of the center deflection w_0 , and the trigonometric and hyperbolic functions of α , ξ and η , where α is a constant and ξ and η are the elliptical coordinates of the ellipse. Equations (5), (6), (7), (8), and (9) give these expressions. The x and y slopes are found by differentiating Equation (4a) with respect to x and y the parameters ξ and η . These differentiations are given in Equations (10) and (11). The resulting differentials of w , ξ , and η are found by differentiating Equation (5) and finding the solution to the two arbitrary functions $F = f(x, \xi, \eta) = 0$ and $G = g(y, \xi, \eta) = 0$. The resulting expressions are given in Equations (12), (13), (14), and (15). These equations are differentiated with respect to x and y (Equations 16 and 17), combined into the matrix equation given as Equation (18), and solved for derivatives of ξ and η as Equation (20). For given values of x and y the values of ξ and η are found using a Newton-Raphson method of successive approximations⁽⁴⁾ which are in terms of the functions F , G , and their derivatives. These expressions are given as Equation (22). The value of ξ and η are substituted into Equations (4a), (10), and (11) to obtain the deflections and slopes.

ELLIPSE

SIMPLY SUPPORTED EDGES



$$\xi = \frac{r_1 + r_2}{2c}$$

$$\eta = \frac{r_1 - r_2}{2c}$$

FIGURE A-2

$$w = f(\xi, \eta) \quad (4a)$$

$$= w_0 \left[\left(3 \cosh 2\alpha \cosh 4\alpha - 4 \cosh 4\alpha \cosh 2\alpha \right) + \cosh 2\alpha \cosh 4\alpha \right] \times$$

$$\left(3 \cosh 2\alpha \cosh 4\alpha - 4 \cosh 4\alpha \cosh 2\alpha + \cosh 2\alpha \cosh 4\alpha \right)$$

$$- w_1 \left(\cosh 2\alpha - \cosh 2\eta \right) \times \left(\cosh 2\alpha - \cosh 2\eta \right) \quad (5)$$

$$\text{WHERE: } w_0 = \frac{8 C^3}{12 \times 128 \times \cosh^2 2\alpha \cosh 4\alpha \times D} \quad (6)$$

$$\frac{1}{D} = \frac{12(1-\nu^2)}{E H^3} \quad (7)$$

$$w_1 = \frac{8(1-\nu) \times (3 \cosh^2 2\alpha - 2) \times \sinh^4 2\alpha}{2 \cosh^2 2\alpha - (1-\nu) \sinh^2 2\alpha} \quad (8)$$

$$x = c \cosh \xi \cos \eta$$

$$a = c \cosh \alpha$$

$$y = c \sinh \xi \sin \eta$$

$$b = c \sinh \alpha$$

$$\alpha = \text{TANH}^{-1}(b/a)$$

$$c^2 = a^2 - b^2$$

(9)

ELLIPSE - SIMPLY SUPPORTED EDGES

DIFFERENTIATE EQ.N. 4a TO OBTAIN SLOPES

$$w'_x = \frac{\partial w}{\partial \xi} \frac{\partial \xi}{\partial x} + \frac{\partial w}{\partial \eta} \frac{\partial \eta}{\partial x} \quad (10)$$

$$w'_y = \frac{\partial w}{\partial \xi} \frac{\partial \xi}{\partial y} + \frac{\partial w}{\partial \eta} \frac{\partial \eta}{\partial y} \quad (11)$$

DIFFERENTIATE EQ.N. 5 TO OBTAIN $\frac{\partial w}{\partial \xi} = w'_\xi$
AND $\frac{\partial w}{\partial \eta} = w'_\eta$

$$w'_\xi = w_0 \left[(3 \cosh 2\alpha \cosh 4\alpha - 4 \cosh 4\alpha \cos 2\eta + \cosh 2\alpha \cos 4\eta) \times \right. \\ \left. (-8 \cosh 4\alpha \sinh 2\xi + 4 \cosh 2\alpha \sinh 4\xi) \right. \\ \left. - w_1 (\cosh 2\alpha - \cos 2\eta)(2 \sinh 2\xi) \right] \quad (12)$$

$$w'_\eta = w_0 \left[(3 \cosh 2\alpha \cosh 4\alpha - 4 \cosh 4\alpha \cosh 2\xi + \cosh 2\alpha \cosh 4\xi) \times \right. \\ \left. (8 \cosh 4\alpha \sin 2\eta - 4 \cosh 2\alpha \sin 4\eta) \right. \\ \left. - w_1 (\cosh 2\xi - \cosh 2\alpha)(2 \sin 2\eta) \right] \quad (13)$$

TO FIND $\frac{\partial \xi}{\partial x}, \frac{\partial \eta}{\partial x}, \frac{\partial \xi}{\partial y}, \frac{\partial \eta}{\partial y}$ LET

$$F = x - c \cosh \xi \cos \eta = 0 \quad \& \quad G = y - c \sinh \xi \sin \eta = 0$$

$$F = f(x, \xi, \eta) \quad (14)$$

$$G = f(y, \xi, \eta) \quad (15)$$

DIFFERENTIATE WITH RESPECT TO x, y, ξ, η AND
SOLVE FOR THE DERIVATIVES.

ELLIPSE - SIMPLY SUPPORTED EDGES

$$\frac{\partial F}{\partial X} = \frac{\partial F}{\partial X} \frac{\partial X}{\partial \xi} + \frac{\partial F}{\partial \xi} \frac{\partial \xi}{\partial X} + \frac{\partial F}{\partial \eta} \frac{\partial \eta}{\partial X} = 0$$

$$\frac{\partial G}{\partial X} = \frac{\partial G}{\partial \eta} \frac{\partial \eta}{\partial X} + \frac{\partial G}{\partial \xi} \frac{\partial \xi}{\partial X} + \frac{\partial G}{\partial \eta} \frac{\partial \eta}{\partial X} = 0$$

$$1 + f'_\xi \xi'_x + f'_\eta \eta'_x = 0 \quad (16) \quad 0 + g'_\xi \xi'_x + g'_\eta \eta'_x = 0$$

$$\frac{\partial F}{\partial y} = \frac{\partial F}{\partial X} \frac{\partial X}{\partial y} + \frac{\partial F}{\partial \xi} \frac{\partial \xi}{\partial y} + \frac{\partial F}{\partial \eta} \frac{\partial \eta}{\partial y} = 0$$

$$\frac{\partial G}{\partial y} = \frac{\partial G}{\partial y} \frac{\partial y}{\partial y} + \frac{\partial G}{\partial \xi} \frac{\partial \xi}{\partial y} + \frac{\partial G}{\partial \eta} \frac{\partial \eta}{\partial y} = 0$$

$$0 + f'_\xi \xi'_y + f'_\eta \eta'_y = 0 \quad (17) \quad 1 + g'_\xi \xi'_y + g'_\eta \eta'_y = 0$$

EQUATIONS 16 & 17 CAN BE PUT IN MATRIX FORM AS FOLLOWS.

$$\begin{bmatrix} f'_\xi & f'_\eta \\ g'_\xi & g'_\eta \end{bmatrix} \begin{bmatrix} \xi'_x & \xi'_y \\ \eta'_x & \eta'_y \end{bmatrix} = \begin{bmatrix} -1 & 0 \\ 0 & 1 \end{bmatrix} \quad (18)$$

$$\begin{bmatrix} \xi'_x & \xi'_y \\ \eta'_x & \eta'_y \end{bmatrix} = \frac{1}{\Delta} \begin{bmatrix} -g'_\eta & f'_\eta \\ g'_\xi & -f'_\xi \end{bmatrix} \quad \text{WHERE:} \quad \begin{vmatrix} -g'_\eta & f'_\eta \\ g'_\xi & -f'_\xi \end{vmatrix} = \Delta \quad (19)$$

THE SOLUTIONS ARE:

$$\begin{aligned} \xi'_x &= g'_\eta / \Delta & g'_\eta &= -c \sinh \xi \cos \eta \\ \eta'_x &= g'_\xi / \Delta & g'_\xi &= -c \cosh \xi \sin \eta \\ \xi'_y &= f'_\eta / \Delta & f'_\eta &= c \cosh \xi \sin \eta \\ \eta'_y &= f'_\xi / \Delta & f'_\xi &= -c \sinh \xi \cos \eta \end{aligned} \quad (20) \quad \text{WHERE:} \quad (21)$$

FOR GIVEN VALUES OF x & y , ξ & η ARE FOUND USING A
NEWTON-RHAPSON METHOD OF SUCCESSIVE APPROXIMATIONS.

IN GENERAL ξ & η ARE FOUND BY:

$$\xi_{i+1} = \xi_i - \frac{1}{\Delta} (J'_\eta f_{\xi,\eta} - f'_\eta J_{\xi,\eta}) \quad (22)$$

$$\eta_{i+1} = \eta_i - \frac{1}{\Delta} (J'_\xi f_{\xi,\eta} - f'_\xi J_{\xi,\eta})$$

SEVERAL SPECIAL CASES EXIST IN THE ITERATIONS.

THEY ARE:

FOR: $y = 0$ & $0 \leq x \leq c$ ($x = c \cosh \xi \cos \eta$)

$\xi = 0$ $\therefore x = c \cos \eta$ or $\eta = \arccos(x/c)$

$y = 0$ & $x > c$

$\eta = 0$ $\therefore x = c \cosh \xi$ or $\cosh \xi = x/c$

$x = 0$ & $0 \leq y$ ($y = c \sinh \xi \sin \eta$)

$\eta = 0$ $\therefore y = c \sinh \xi$ or $\sinh \xi = y/c$

" ξ " IS FOUND BY:

$$\xi_{i+1} = \xi_i - \frac{f(\xi)}{f'(\xi)} \quad \left(f(\xi) = x - c \cosh \xi \cos \eta \right)$$

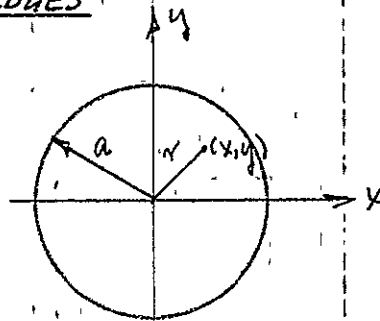
$$\left(\text{or } y - c \sinh \xi \sin \eta \right)$$

When the ellipse degenerates into a circle another equation given by Timoshenko⁽²⁾ is used in which the deflection at any point of the circle is given as Equation (23) in terms of the radius and the x and y coordinates of the point. Equation (23) is differentiated with respect to x and y to obtain the slopes about the x and y axes which are given in Equations (24) and (25).

CIRCLE

(SPECIAL CASE OF ELLIPSE)

SIMPLY SUPPORTED EDGES



$$r^2 = x^2 + y^2$$

FIGURE A-3

THE DEFLECTION IS:

$$W = \frac{q}{64D} [a^2 - r^2] \left[\frac{5+\nu}{1+\nu} a^2 - r^2 \right]$$

$$\text{LET } C\phi = \frac{5+\nu}{1+\nu} a^2$$

$$r^2 = x^2 + y^2$$

$$W = \frac{q}{64D} (a^2 - x^2 - y^2)(C\phi - x^2 - y^2) \quad (23)$$

DIFFERENTIATE "W" TO FIND THE SLOPES ABOUT THE X & Y AXES.

$$\frac{\partial W}{\partial X} = -2X \left(\frac{q}{64D} \right) \left[(a^2 - x^2 - y^2) + (C\phi - x^2 - y^2) \right] \quad (24)$$

$$\frac{\partial W}{\partial Y} = -2Y \left(\frac{q}{64D} \right) \left[(a^2 - x^2 - y^2) + (C\phi - x^2 - y^2) \right] \quad (25)$$

Equation (26) is the expression for the deflection of any point on a simply supported rectangular plate given by Timoshenko⁽²⁾. The derivative of Equation (26) with respect to x and y gives the slopes in the x and y directions. These appear in Equations (27) and (28).

RECTANGLE

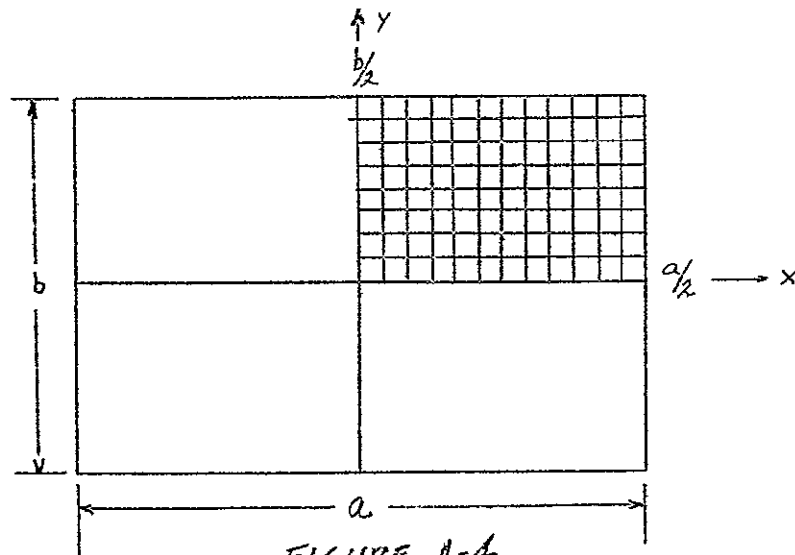


FIGURE A-4

SIMPLY SUPPORTED (1, 2)

$$w = \frac{48a^4}{\pi^5 D} \sum \frac{(-1)^{\frac{m-1}{2}}}{m^5} \left[1 - \left(\frac{2 + \alpha_m \text{TANH } \alpha_m}{2 \text{COSH } \alpha_m} \right) \text{COSH } \frac{m\pi y}{a} + \frac{m\pi y}{a} \left(\frac{\text{SINH } \frac{m\pi y}{a}}{2 \text{COSH } \alpha_m} \right) \right] \text{COS } \frac{m\pi x}{a} \quad (26)$$

$$w'_x = -\frac{48a^3}{\pi^4 D} \sum \frac{(-1)^{\frac{m-1}{2}}}{m^4} \left[1 - \left(\frac{2 + \alpha_m \text{TANH } \alpha_m}{2 \text{COSH } \alpha_m} \right) \text{COSH } \frac{m\pi y}{a} + \frac{m\pi y}{a} \left(\frac{\text{SINH } \frac{m\pi y}{a}}{2 \text{COSH } \alpha_m} \right) \right] \text{SIN } \frac{m\pi x}{a} \quad (27)$$

$$w'_y = \frac{48a^3}{\pi^4 D} \sum \frac{(-1)^{\frac{m-1}{2}}}{m^4} \left[-\left(\frac{2 + \alpha_m \text{TANH } \alpha_m}{2 \text{COSH } \alpha_m} \right) \text{SINH } \frac{m\pi y}{a} + \frac{m\pi y}{a} \left(\frac{\text{COSH } \frac{m\pi y}{a}}{2 \text{COSH } \alpha_m} \right) + \frac{\text{SINH } \frac{m\pi y}{a}}{2 \text{COSH } \alpha_m} \right] \text{COS } \frac{m\pi x}{a}$$

$$\alpha_m = \frac{m\pi b}{2a} \quad \beta_m = \frac{m\pi a}{2b} \quad (28)$$

WHERE

w = DEFLECTION

w'_x = SLOPE IN X-DIRECTION

w'_y = SLOPE IN Y-DIRECTION

G. KELLEY, D.M., "APOLLO WINDOW DEFORMATION AND RAY TRACE ANALYSES,"
PHILCO-FORD CORPORATION, PALO ALTO, CALIFORNIA, AUGUST, 1970.

For clamped rectangular plates the deformations resulting from the moments applied to the boundaries and given in Equations (29) and (32) are added to the simply supported deformations. The resulting Equations (36a) give the deflection and slopes for the clamped plate.

RECTANGLE

CLAMPED EDGES (5,6) $\alpha_m = \frac{m\pi b}{a}$ $\beta_m = \frac{m\pi a}{b}$

$$w_1' = -\frac{a^2}{2\pi^2 D} \left[\sum \frac{(-1)^{\frac{m-1}{2}}}{m^2} E_m \left(\frac{m\pi y}{a} \frac{\sinh \frac{m\pi y}{a}}{\cosh \alpha_m} - \frac{\alpha_m \tanh \alpha_m}{\cosh \alpha_m} \cosh \frac{m\pi y}{a} \right) \cos \frac{m\pi x}{a} \right] \quad (29)$$

$$w_{1x}' = \frac{a}{2\pi^2 D} \left[\sum \frac{(-1)^{\frac{m-1}{2}}}{m} E_m \left(\frac{m\pi y}{a} \frac{\sinh \frac{m\pi y}{a}}{\cosh \alpha_m} - \frac{\alpha_m \tanh \alpha_m}{\cosh \alpha_m} \cosh \frac{m\pi y}{a} \right) \sin \frac{m\pi x}{a} \right] \quad (30)$$

$$w_{1y}' = -\frac{a}{2\pi^2 D} \left[\sum \frac{(-1)^{\frac{m-1}{2}}}{m} E_m \left(\frac{m\pi y}{a} \frac{\cosh \frac{m\pi y}{a}}{\cosh \alpha_m} + \frac{\sinh \frac{m\pi y}{a}}{\cosh \alpha_m} - \frac{\alpha_m \tanh \alpha_m}{\cosh \alpha_m} \sinh \frac{m\pi y}{a} \right) \cos \frac{m\pi x}{a} \right] \quad (31)$$

$$w_2 = -\frac{b^2}{2\pi^2 D} \left[\sum \frac{(-1)^{\frac{m-1}{2}}}{m^2} F_m \left(\frac{m\pi x}{b} \frac{\sinh \frac{m\pi x}{b}}{\cosh \beta_m} - \frac{\beta_m \tanh \beta_m}{\cosh \beta_m} \cosh \frac{m\pi x}{b} \right) \cos \frac{m\pi y}{b} \right] \quad (32)$$

$$w'_{1x} = -\frac{b}{2\pi D} \left[\sum \frac{(-1)^{\frac{m-1}{2}}}{m} F_m \left(\frac{m\pi x}{b} \frac{\cosh \frac{m\pi z}{b}}{\cosh \beta_m} + \frac{\sinh \frac{m\pi x}{b}}{\cosh \beta_m} - \frac{\beta_m \tanh \beta_m}{\cosh \beta_m} \sinh \frac{m\pi x}{b} \right) \cos \frac{m\pi y}{b} \right] \quad (33)$$

$$w'_{2y} = \frac{b}{2\pi D} \left[\sum \frac{(-1)^{\frac{m-1}{2}}}{m} F_m \left(\frac{m\pi x}{b} \frac{\sinh \frac{m\pi z}{b}}{\cosh \beta_m} - \frac{\beta_m \tanh \beta_m}{\cosh \beta_m} \cosh \frac{m\pi x}{b} \right) \sin \frac{m\pi y}{b} \right] \quad (34)$$

WHERE E_m & F_m ARE DEFINED BY:

$$\begin{aligned} \frac{E_n}{\eta} \left[\tanh \alpha_n + \frac{\alpha_n}{\cosh^2 \alpha_n} \right] + \frac{8na}{\pi b} \sum \frac{F_m}{m^3 \left(\frac{n^2}{m^2} + \frac{a^2}{b^2} \right)^2} \\ = \frac{48a^2}{\pi^3 \eta^4} \left[\frac{\alpha_n}{\cosh^2 \alpha_n} - \tanh \alpha_n \right] \end{aligned} \quad (35)$$

$$\begin{aligned} \frac{F_n}{\eta} \left[\tanh \beta_n + \frac{\beta_n}{\cosh^2 \beta_n} \right] + \frac{8nb}{\pi a} \sum \frac{E_m}{m^3 \left(\frac{n^2}{m^2} + \frac{b^2}{a^2} \right)^2} \\ = \frac{48b^2}{\pi^3 \eta^4} \left[\frac{\beta_n}{\cosh^2 \beta_n} - \tanh \beta_n \right] \end{aligned} \quad (36)$$

THE DEFLECTION AND SLOPES FOR CLAMPED EDGES ARE:

$$w_c = w_s + w_1 + w_2$$

$$w'_{cx} = w'_{sx} + w'_{1x} + w'_{2x}$$

$$w'_{cy} = w'_{sy} + w'_{1y} + w'_{2y}$$

WHERE: w_s = SIMPLY SUPPORTED DEFLECTION

w_1 = DEFLECTION FOR MOMENT APPLIED TO X BOUNDARY

w_2 = DEFLECTION FOR MOMENT APPLIED TO Y BOUNDARY

The first step in developing a solution for large deflections of a rectangular plate is to generalize Timoshenko's equations for the deformation of a square membrane⁽²⁾. Into Equation (37), the general equation for the strain energy in a membrane, are substituted the differentials of the equations for the displacements in a rectangular plate given as Equation (37a). This yields Equation (38) which when simplified by letting $\nu = 0.25$ gives Equation (39). Timoshenko⁽²⁾ gives two equations resulting from the principle of virtual displacements which can be solved for the constant "c" and the deflection w_0 . These are Equations (40) and (41).

LARGE DEFLECTION - RECTANGULAR PLATE

FIRST. SOLVE FOR ν IN THE GENERAL CASE $a \neq b$

$$\begin{aligned}
 V = & \frac{Eh}{2(1-\nu^2)} \iint \left\{ \left(\frac{\partial u}{\partial x} \right)^2 + \frac{\partial u}{\partial x} \left(\frac{\partial w}{\partial x} \right)^2 + \left(\frac{\partial v}{\partial y} \right)^2 + \frac{\partial v}{\partial y} \left(\frac{\partial w}{\partial y} \right)^2 \right. \\
 & + \frac{1}{4} \left[\left(\frac{\partial w}{\partial x} \right)^2 + \left(\frac{\partial w}{\partial y} \right)^2 \right]^2 + 2\nu \left[\frac{\partial u}{\partial x} \frac{\partial v}{\partial y} + \frac{1}{2} \frac{\partial v}{\partial y} \left(\frac{\partial w}{\partial x} \right)^2 + \frac{1}{2} \frac{\partial u}{\partial x} \left(\frac{\partial w}{\partial y} \right)^2 \right] \\
 & \left. + \frac{1-\nu}{2} \left[\left(\frac{\partial u}{\partial y} \right)^2 + \frac{\partial u}{\partial y} \frac{\partial v}{\partial x} + \left(\frac{\partial v}{\partial x} \right)^2 + 2 \frac{\partial u}{\partial y} \frac{\partial w}{\partial x} \frac{\partial w}{\partial y} + 2 \frac{\partial v}{\partial x} \frac{\partial w}{\partial x} \frac{\partial w}{\partial y} \right] \right\} dx dy \quad (37)
 \end{aligned}$$

$$\begin{aligned}
 \text{WITH: } w &= w_0 \cos \frac{\pi x}{2a} \cos \frac{\pi y}{2b} \\
 u &= c \sin \frac{\pi x}{a} \cos \frac{\pi y}{2b} \\
 v &= c \sin \frac{\pi y}{b} \cos \frac{\pi x}{2a}
 \end{aligned} \quad (37a)$$

AND:

$$\begin{aligned}
 \frac{\partial w}{\partial x} &= -\frac{w_0 \pi}{2a} \sin \frac{\pi x}{2a} \cos \frac{\pi y}{2b} \\
 \frac{\partial w}{\partial y} &= -\frac{w_0 \pi}{2b} \cos \frac{\pi x}{2a} \sin \frac{\pi y}{2b} \\
 \frac{\partial u}{\partial x} &= \frac{c \pi}{a} \cos \frac{\pi x}{a} \cos \frac{\pi y}{2b}
 \end{aligned} \quad (37b)$$

$$\frac{\delta u}{\delta y} = -\frac{C\pi}{2b} \sin \frac{\pi x}{a} \sin \frac{\pi y}{2b}$$

$$\frac{\delta v}{\delta x} = -\frac{C\pi}{2a} \sin \frac{\pi y}{b} \sin \frac{\pi x}{2a}$$

(37c)

$$\frac{\delta v}{\delta y} = \frac{C\pi}{b} \cos \frac{\pi y}{b} \cos \frac{\pi x}{2a}$$

V IS THE STRAIN ENERGY OF A MEMBRANE

SUBSTITUTE, INTEGRATE, AND SIMPLIFY

$$V = \frac{Eh}{2(1-\nu^2)} \int_{-a}^{+a} \int_{-b}^{+b} \left\{ \left(\frac{C^2 \pi^2}{a^2} \cos^2 \frac{\pi x}{a} \cos^2 \frac{\pi y}{2b} \right) \right.$$

$$+ \left(\frac{Cw_0^2 \pi^3}{4a^3} \cos \frac{\pi x}{a} \sin^2 \frac{\pi x}{2a} \cos^3 \frac{\pi y}{2b} \right)$$

$$+ \left(\frac{C^2 \pi^2}{b^2} \cos^2 \frac{\pi x}{2a} \cos^2 \frac{\pi y}{b} \right)$$

$$+ \left(\frac{Cw_0^2 \pi^3}{4b^3} \cos^3 \frac{\pi x}{2a} \cos \frac{\pi y}{b} \sin^2 \frac{\pi y}{2b} \right)$$

$$+ \frac{1}{4} \left[\frac{w_0^4 \pi^4}{16a^4} \sin^4 \frac{\pi x}{2a} \cos^4 \frac{\pi y}{2b} \right)$$

$$+ 2 \left(\frac{w_0^4 \pi^4}{16a^2 b^2} \sin^2 \frac{\pi x}{2a} \cos^2 \frac{\pi x}{2a} \cos^2 \frac{\pi y}{2b} \sin^2 \frac{\pi y}{2b} \right)$$

$$+ \left(\frac{w_0^4 \pi^4}{16b^4} \cos^4 \frac{\pi x}{2a} \sin^4 \frac{\pi y}{2b} \right) \left. \right]$$

$$+ 2\nu \left[\left(\frac{C^2 \pi^2}{ab} \cos \frac{\pi x}{a} \cos \frac{\pi x}{2a} \cos \frac{\pi y}{2b} \cos \frac{\pi y}{b} \right) \right]$$

$$\begin{aligned}
& + \frac{1}{2} \left(\frac{C \omega_0^2 \pi^3}{4a^2 b} \cos \frac{\pi X}{2a} \sin^2 \frac{\pi Y}{2a} \cos \frac{\pi Y}{b} \cos^2 \frac{\pi Y}{2b} \right) \\
& + \frac{1}{2} \left(\frac{C \omega_0^2 \pi^3}{4ab^2} \cos \frac{\pi Y}{a} \cos^2 \frac{\pi X}{2a} \cos \frac{\pi Y}{2b} \sin^2 \frac{\pi Y}{2b} \right) \Bigg] \\
& + \frac{1-\nu}{2} \left[\left(\frac{C^2 \pi^2}{4b^2} \sin^2 \frac{\pi X}{a} \sin^2 \frac{\pi Y}{2b} \right) \right. \\
& \quad + \left(\frac{C^2 \pi^2}{4ab} \sin \frac{\pi X}{a} \sin \frac{\pi X}{2a} \sin \frac{\pi Y}{2b} \sin \frac{\pi Y}{b} \right) \\
& \quad + \left. \left(\frac{C^2 \pi^2}{4a^2} \sin^2 \frac{\pi X}{2a} \sin^2 \frac{\pi Y}{b} \right) \right. \\
& - 2 \left(\frac{C \omega_0^2 \pi^3}{8ab^2} \sin \frac{\pi X}{a} \sin \frac{\pi X}{2a} \cos \frac{\pi X}{2a} \sin^2 \frac{\pi Y}{2b} \cos \frac{\pi Y}{2b} \right) \\
& - 2 \left. \left(\frac{C \omega_0^2 \pi^3}{8a^2 b} \sin^2 \frac{\pi X}{2a} \cos \frac{\pi X}{2a} \sin \frac{\pi Y}{b} \sin \frac{\pi Y}{2b} \cos \frac{\pi Y}{2b} \right) \right] \Bigg\} dy dx \\
V & = \frac{Eh}{2(1-\nu^2)} \left\{ \left(\frac{C^2 \pi^2 b}{a} \right) - \left(\frac{C \omega_0^2 \pi^2 b}{3a^2} \right) + \left(\frac{C^2 \pi^2 a}{b} \right) - \left(\frac{C \omega_0^2 \pi^2 a}{3b^2} \right) \right. \\
& + \frac{1}{4} \left[\frac{9 \omega_0^4 \pi^4 b}{256 a^3} + \frac{\omega_0^4 \pi^4}{128 ab} + \frac{9 \omega_0^4 \pi^4 a}{256 b^3} \right] \\
& + 2\nu \left[\frac{16C^2}{9} + \frac{C \omega_0^2 \pi^2}{12a} + \frac{C \omega_0^2 \pi^2}{12b} \right] \\
& + \frac{(1-\nu)}{2} \left[\frac{C^2 \pi^2 a}{4b} + \frac{32C^2}{9} + \frac{C^2 \pi^2 b}{4a} - \frac{C \omega_0^2 \pi^2}{6b} - \frac{C \omega_0^2 \pi^2}{6a} \right] \Bigg\} \\
& \hspace{20em} (38)
\end{aligned}$$

THIS IS THE STRAIN ENERGY OF A RECTANGULAR
MEMBRANE WITH $a \neq b$

CHECK EQUATION BY SETTING $b = a$ AND

CHECK AGAINST TIMOSHENKO SOLUTION, P. 420

$$\begin{aligned}
 V &= \frac{Eh}{2(1-\nu^2)} \left\{ \left(\frac{C^2 \pi^2 a}{a} \right) - \left(\frac{C W_0^2 \pi^2 a}{3a^2} \right) + \left(\frac{C^2 \pi^2 a}{a} \right) - \left(\frac{C W_0^2 \pi^2 a}{3a^2} \right) \right. \\
 &+ \frac{1}{4} \left[\frac{9 W_0^4 \pi^4 a}{256 a^3} + \frac{W_0^4 \pi^4}{128 a^2} + \frac{9 W_0^4 \pi^4 a}{256 a^3} \right] \\
 &+ 2\nu \left[\frac{16 C^2}{9} + \frac{C W_0^2 \pi^2}{12a} + \frac{C W_0^2 \pi^2}{12a} \right] \\
 &+ \frac{(1-\nu)}{2} \left[\frac{C^2 \pi^2 a}{4a} + \frac{32 C^2}{9} + \frac{C^2 \pi^2 a}{4a} - \frac{C W_0^2 \pi^2}{6a} - \frac{C W_0^2 \pi^2}{6a} \right]
 \end{aligned}$$

Set $\nu = 0.25$

$$\begin{aligned}
 V &= \frac{Eh}{1.875} \left\{ \frac{5 \pi^4 W_0^4}{256 a^2} - \frac{8 C \pi^2 W_0^2}{12a} + \frac{C W_0^2 \pi^2}{12a} - \frac{3 C W_0^2 \pi^2}{24a} \right. \\
 &+ \left. 2 C^2 \pi^2 + \frac{3 C^2 \pi^2}{16} + \frac{8 C^2}{9} + \frac{12 C^2}{9} \right\}
 \end{aligned}$$

$$V = \frac{Eh}{1.875} \left\{ \frac{5 \pi^4 W_0^4}{256 a^2} - \frac{17 C \pi^2 W_0^2}{24a} + C^2 \left[\frac{35 \pi^2}{16} + \frac{80}{36} \right] \right\}$$

$$V = \frac{Eh}{7.5} \left\{ \frac{5 \pi^4 W_0^4}{64 a^2} - \frac{17 \pi^2 C W_0^2}{6 a} + C^2 \left[\frac{35 \pi^2}{4} + \frac{80}{9} \right] \right\}$$

CHECKS

An Equation for w_0 is determined by first obtaining Equations (42) and (43) by differentiating Equation (39) with respect to "c" and w_0 , then integrating the right hand side of Equation (41), and equating the results. This is the deflection of a membrane due to a uniform load "q". By combining the equations for the loads to produce the center plate deflection w_0 and using both small deflection theory and membrane analysis a cubic equation in w_0 can be written as Equation (47). The resulting large deflection solution is obtained for points between the center and edge of the rectangular plate by averaging the deflections produced by small deflection theory and membrane theory. This is done in Equation (48). The x and y derivatives of this equation yield the slopes about the x and y axes.

SIMPLIFY EQN. 38 BY COLLECTING TERMS AND
SETTING $\nu = 0.25$

$$V = \frac{Eh}{2(1-\nu^2)} \left\{ \frac{w_0^4 \pi^4}{4 \times 256} \left(\frac{9b}{a^3} + \frac{2}{ab} + \frac{9a}{b^3} \right) \right. \\ \left. - \frac{C w_0^2 \pi^2}{48} \left(\frac{16b}{a^2} + \frac{4-12\nu}{a} + \frac{4-12\nu}{b} + \frac{16a}{b^2} \right) \right. \\ \left. + \frac{C^2}{2} \left(\frac{\pi^2 b}{4a} (9-\nu) + \frac{\pi^2 a}{4b} (9-\nu) + \frac{32}{9} (1-\nu) \right) \right\}$$

LET $\nu = 0.25$

$$V = \frac{Eh}{30} \left\{ \frac{w_0^4 \pi^4}{64} \left(\frac{9b}{a^3} + \frac{2}{ab} + \frac{9a}{b^3} \right) \right. \\ \left. - \frac{w_0^2 \pi^2 C}{3} \left(\frac{16b}{a^2} + \frac{1}{a} + \frac{1}{b} + \frac{16a}{b^2} \right) \right. \\ \left. + C^2 \left(\frac{35\pi^2 b}{2a} + \frac{35\pi^2 a}{2b} + \frac{320}{9} \right) \right\} \quad (39)$$

TIMOSHENKO GIVES TWO EQUATIONS BASED ON THE PRINCIPAL OF VIRTUAL DISPLACEMENTS FROM WHICH THE CONSTANT C AND DEFLECTION w_0 ARE DETERMINED.

$$\frac{\partial V}{\partial C} = 0 \quad (40)$$

$$\frac{\partial V}{\partial w_0} \delta w_0 = \int_{-a}^a \int_{-b}^b q \delta w_0 \cos \frac{\pi x}{2a} \cos \frac{\pi y}{2b} dx dy \quad (41)$$

DIFFERENTIATING V WITH RESPECT TO w_0 AND C GIVES:

$$\frac{\partial V}{\partial w_0} = \frac{Eh}{30} \left\{ \frac{w_0^3 \pi^4}{16} \left(\frac{9b}{a^3} + \frac{2}{ab} + \frac{9a}{b^3} \right) - \frac{2w_0 \pi^2 C}{3} \left(\frac{16b}{a^2} + \frac{1}{a} + \frac{1}{b} + \frac{16a}{b^2} \right) \right\} \quad (42)$$

$$\frac{\partial V}{\partial C} = \frac{Eh}{30} \left\{ -\frac{w_0^2 \pi^2}{3} \left(\frac{16b}{a^2} + \frac{1}{a} + \frac{1}{b} + \frac{16a}{b^2} \right) + 2C \left(\frac{35\pi^2 b}{2a} + \frac{35\pi^2 a}{2b} + \frac{320}{9} \right) \right\} \quad (43)$$

$$C = \frac{\frac{w_0^2 \pi^2}{3} \left(\frac{16b}{a^2} + \frac{1}{a} + \frac{1}{b} + \frac{16a}{b^2} \right)}{\left(\frac{35\pi^2 b}{a} + \frac{35\pi^2 a}{b} + \frac{640}{9} \right)} \quad (44)$$

LET $a=b$ for CHECK

$$C = \frac{\frac{w_0^2 \pi^2}{3} \left(\frac{16}{a} + \frac{1}{a} + \frac{1}{a} + \frac{16}{a} \right)}{\left(35\pi^2 + 35\pi^2 + \frac{640}{9} \right)} = 0.14679 \frac{w_0^2}{a} \quad \text{CHECKS WITH TIMOSHENKO'S (1) EQUATION \# 250, P. 420}$$

INTEGRATE THE RIGHT HAND SIDE OF EQN. 41

$$\begin{aligned} \frac{\partial V}{\partial w_0} \delta w_0 &= \int_{-a}^a \int_{-b}^b q \delta w_0 \cos \frac{\pi x}{2a} \cos \frac{\pi y}{2b} dx dy \\ &= q \delta w_0 \int_{-a}^a \cos \frac{\pi x}{2a} dx \int_{-b}^b \cos \frac{\pi y}{2b} dy \\ &= \frac{4 \delta w_0 a b}{\pi^2} \left\{ \sin \frac{\pi x}{2a} \right\}_{-a}^a \left\{ \sin \frac{\pi y}{2b} \right\}_{-b}^b \end{aligned}$$

$$\frac{\partial V}{\partial w_0} = \frac{16 q a b}{\pi^2} \quad (45)$$

EQUATE EQUATIONS 42 AND 45, SOLVE FOR w_0

$$\frac{E h \delta w_0}{30} \left\{ w_0^2 \pi^4 \left(\frac{q b}{a^3} + \frac{2}{a b} + \frac{q a}{b^3} \right) - \frac{2 \pi^2 c}{3} \left(\frac{16 b}{a^2} + \frac{1}{a} + \frac{1}{b} + \frac{16 a}{b^2} \right) \right\} = \frac{16 q \delta w_0 a b}{\pi^2}$$

$$\left\{ \frac{w_0^2 \pi^4}{16} \left(\frac{q b}{a^3} + \frac{2}{a b} + \frac{q a}{b^3} \right) - \frac{2 c \pi^2}{3} \left(\frac{16 b}{a^2} + \frac{1}{a} + \frac{1}{b} + \frac{16 a}{b^2} \right) \right\} = \frac{480 q a b}{E h \pi^4}$$

$$w_0^3 = \frac{\frac{480 q a b}{E h \pi^4}}{\frac{\pi^2}{16} \left(\frac{q b}{a^3} + \frac{2}{a b} + \frac{q a}{b^3} \right) - \frac{2}{3} \left\{ \frac{\pi^2 \left(\frac{16 b}{a^2} + \frac{1}{a} + \frac{1}{b} + \frac{16 a}{b^2} \right)^2}{\left(\frac{35 \pi^2 b}{a} + \frac{35 \pi^2 a}{b} + \frac{640}{9} \right)} \right\}}$$

$$w_0^3 / q = \frac{\frac{480 a b}{E h \pi^4}}{\frac{1}{16} \left(\frac{q b}{a^3} + \frac{2}{a b} + \frac{q a}{b^3} \right) - \frac{2}{45} \left\{ \frac{\left(\frac{16 b}{a^2} + \frac{1}{a} + \frac{1}{b} + \frac{16 a}{b^2} \right)^2}{\left(\frac{7 \pi^2 b}{a} + \frac{7 \pi^2 a}{b} + \frac{128}{9} \right)} \right\}} \quad (46)$$

$$w_0^3 = q (\text{CONS}) \quad \text{WHERE CONS} = \text{THE RIGHT HAND SIDE OF EQUATION 44} \quad (47)$$

THE LARGE DEFLECTION SOLUTION IS GIVEN BY SOLVING THE FOLLOWING EQUATION.

$$q_1 + q_2 = \frac{W_0}{\alpha_{00}} + \frac{W_0^3}{\text{CONS}} = q = \text{PRSS} \quad (48)$$

WHERE: q = UNIT AREA LOAD ON PLATE

q_1 = LOAD COMPONENT BALANCED BY SMALL DEFLECTION REACTIONS

q_2 = LOAD COMPONENT BALANCED BY MEMBRANE REACTIONS

$$W_0 = q_1 * \alpha_{00}$$

$$W_0^3 = q_2 * \text{CONS}$$

REWRITING :

$$W_0^3 \left(\frac{1}{\text{CONS}} \right) + W_0 \left(\frac{1}{\alpha_{00}} \right) - \text{PRSS} = 0 \quad (49)$$

THE EQUATION IS NOW IN THE FORM

$$W_0^3 A1 + 3W_0^2 B1 + 3W_0 C1 + D = 0$$

WHERE: $A1 = (1/\text{CONS})$

$B1 = 0$

$C1 = (1/3\alpha_{00})$ α_{00} = Defl. @ Plate Center

$D1 = -\text{PRSS}$

USING THE CUBIC SOLUTION METHOD

$$Q1 = A1 \times C1 \quad R = -0.5A1^2 \times D1$$

$$S1 = \left\{ R + \sqrt{Q^3 + R^2} \right\}^{1/3}$$

$$S2 = \left\{ R - \sqrt{Q^3 + R^2} \right\}^{1/3}$$

$$W_0 = (S1 + S2)/A1$$

$$q1 = W_0/\alpha_{00} \quad q2 = PRSS - q1 \quad \text{OR}$$

$$q2 = W_0^3/CON5$$

THE DEFLECTION AND SLOPES OF EACH POINT CAN NOW BE FOUND

$$W_{ij}^L = \left[W_{ij}^S Q1 + W_0 \cos\left(\frac{\pi X}{2a}\right) \cos\left(\frac{\pi Y}{2b}\right) \right] 0.5 \quad (50)$$

$$\frac{\partial W_{ij}^L}{\partial X} = \left[\frac{\partial W_{ij}^S}{\partial X} Q1 - \frac{W_0 \pi}{2a} \sin\left(\frac{\pi X}{2a}\right) \cos\left(\frac{\pi Y}{2b}\right) \right] 0.5 \quad (51)$$

$$\frac{\partial W_{ij}^L}{\partial Y} = \left[\frac{\partial W_{ij}^S}{\partial Y} Q1 - \frac{W_0 \pi}{2b} \cos\left(\frac{\pi X}{2a}\right) \sin\left(\frac{\pi Y}{2b}\right) \right] 0.5 \quad (52)$$

WHERE:

W^L = LARGE DEFLECTION DISPLACEMENT

W^S = SMALL DEFLECTION DISPLACEMENT

W_0 = $(CON5 \times Q2)^{1/3}$ MEMBRANE CONTRIBUTION

SHEAR DEFORMATION

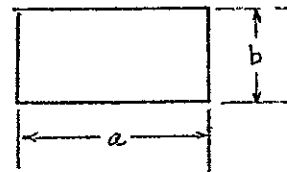
AN APPROXIMATE SOLUTION FOR SHEAR IS GIVEN BY

$$w_s = W \rho$$

$$\rho = 1 + \frac{\pi^2 (1 + \beta^2) t^2}{3a^2 (1 - \nu)} \quad (53)$$

W = Deflection by
Small defl. Theory

$$\beta = a/b$$



ρ HAS BEEN SIMPLIFIED FROM AN EQUATION BY
C.C. CHANG & B.T. FANG⁽⁷⁾ USED FOR SHEAR IN
SANDWICH PLATES

7. CHANG, C.C., AND FANG, B.T., "TRANSIENT AND PERIODIC RESPONSE OF A LOADED SANDWICH PLATE," JOURNAL OF AEROSPACE SCIENCES, Vol. 28, MAY 1961, 382-396.

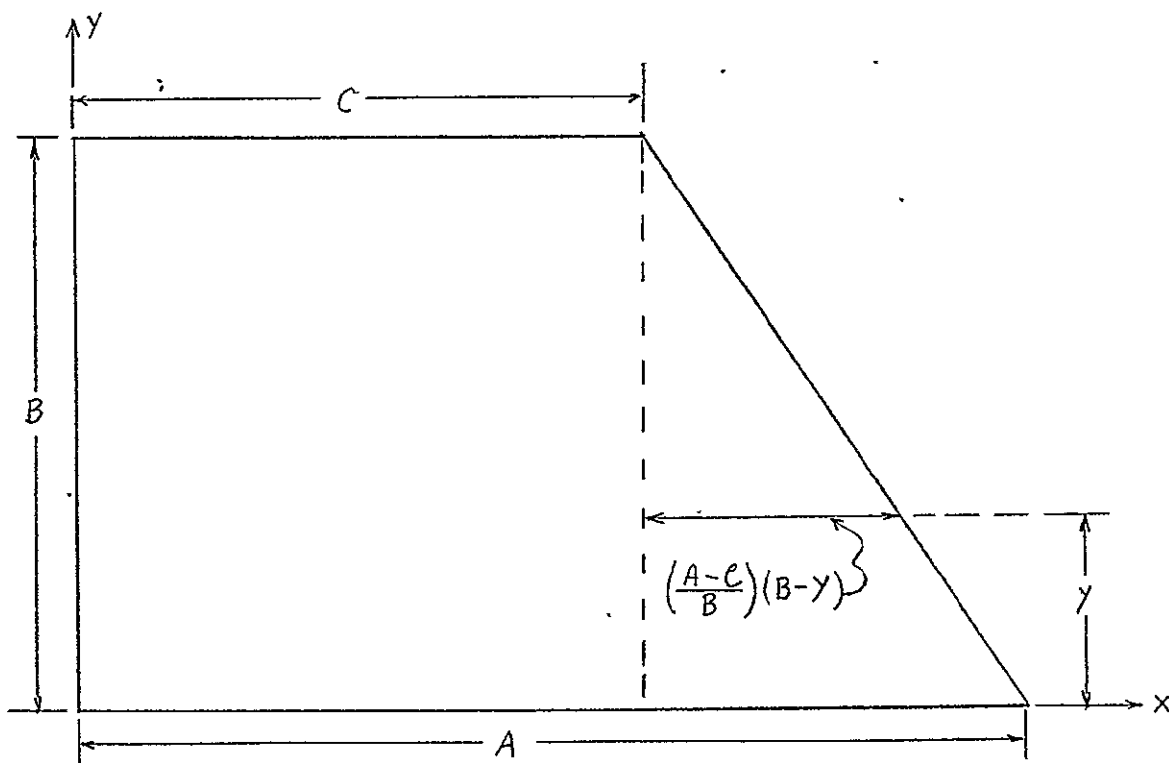
Appendix B

Miscellaneous Equations

This appendix contains equations for defining the boundary of a trapezoid, for finding the mean and rms, and for finding the maximum and minimum slope.

The trapezoid boundary equations are used in the program, BONDY, which tests for the boundary of a planform shape (ellipse, rectangle, trapezoid).

TRAPEZOIDAL BOUNDARY EQUATIONS



$$X_{LIM} = C + \left(\frac{A-C}{B}\right)(B-Y)$$

$$Y_{LIM}_{x=C} = B$$

$$Y_{LIM}_{x=A} = \left(\frac{B}{A-C}\right)(A-X)$$

The equations used for finding the mean and rms are those found in any elementary statistics book..

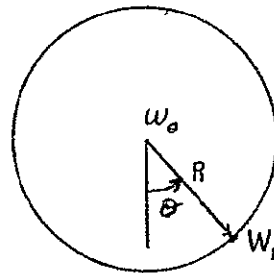
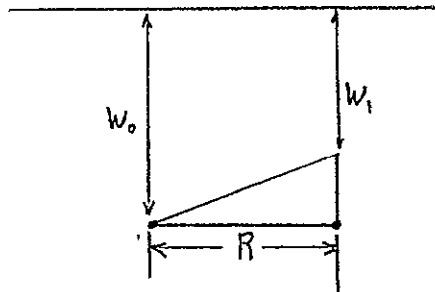
MEAN & STANDARD DEVIATION

$$MEAN = \frac{1}{N} \sum_{i=1}^N x_i = \bar{M}$$

$$\sigma = \frac{1}{\sqrt{N-1}} \sqrt{\sum x_i^2 - \frac{1}{N} \left(\sum x_i\right)^2}$$

The equations for the maximum and minimum slope are based on the premise that the slope at a point is approximately equal to the slope between the point and another point a very small distance away.

MAXIMUM-MINIMUM SLOPE EQUATION



THE MAXIMUM AND MINIMUM SLOPES ARE FOUND USING THE Δ EQUATION $S = (W_0 - W_1)/R$ WHERE S IS CALCULATED EVERY 2 DEGREES, BETWEEN 0° AND 180° . THE LIST OF S VALUES IS THEN SEARCHED FOR THE MAX. & MIN. VALUE.

Appendix C

This appendix gives the details of the data retrieval program. This program will search tape 9 (which has been written in binary format by the WINDEF program) and obtain the set(s) of ray trace data required by the user.

Figure C-1 illustrates the order of cards which make up the program deck. The format for the control cards on the above deck is:

| | | |
|----------|------------|--|
| Columns: | 1-8 | 16-80 |
| | \$JOB | (See Manual) |
| | \$SETUP 09 | (Number of tape on which required data is located) |
| | \$IBJOB | blank |
| | \$DECK | BIN09 |
| | \$DATA | blank |

The AMES 7094 operational manual should be consulted for other items required on the \$JOB cards.

Figure C-2 illustrates the arrangement of the data deck for multiple problems. Each problem requires only one card with the following format:

| <u>Column</u> | <u>Symbol</u> | <u>Information</u> | <u>Format</u> |
|---------------|---------------|--------------------------|---------------|
| 1-5 | IRTV | Retrieval number desired | Integer |

There is no limit on the number of sets of ray trace data which may be retrieved on one run (as long as all the retrieval numbers desired are on the same tape).

A listing of the retrieval program is given in Appendix D.

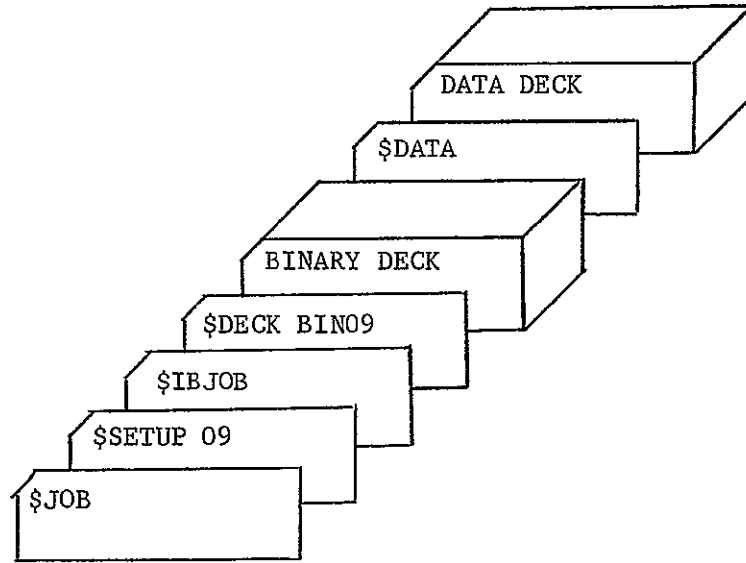


Figure C-1. Program Deck

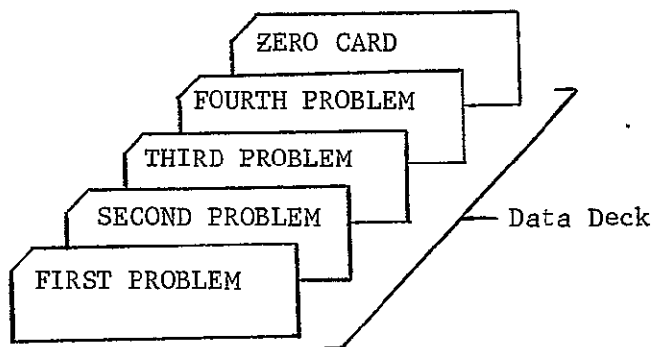


Figure C-2. Data Deck

Appendix D

This appendix contains the listings of the subroutines which comprise the single and two ray trace computer programs and the data retrieval program.

CWINDEF

C

C D0 WINDEF - APOLLO WINDOW DEFORMATION AND LINE OF SIGHT DRIVER

C D1 ELIPSE - ELLIPSE DEFORMATION GENERATOR

C D2 ELIPIT - ELLIPTIC COORDINATE GENERATOR

C D3 RECTNG - RECTANGULAR DEFORMATION GENERATOR

C D4 SEQ5 - MATRIX INVERSION AND LINEAR EQUATION SOLUTION.

C D5 TRPZOD - READS IN TRAPEZOIDAL DEFORMATION DATA FROM SAMIS

C D6 LRGDEF - LARGE DEFLECTION GENERATOR FOR RECTANGLES

C D7 DEFRES - PRINTS PLATE (WINDOW) DEFORMATION DATA

C D8 RAYTRA - DRIVER FOR RAY TRACE PROCEDURE

C D9 ITERAT - ITERATES TO FIND LOCATION OF RAY ON NEXT SURFACE

C E0 INCOTB - DETERMINES DEFORMATION OF PLATE AT INTERSECTION W/RAY

C E1 NORMAL - CALCULATES NORMAL TO PLATE AT RAY INTERSECTION POINT

C E2 REFRCI - CALCULATES NEW DIRECTION OF RAY UPON ENTERING NEW MEDIUM

C E3 RESPRT - PRINTS RAY TRACE AND MEAN-RMS RESULTS

C E4 MENRMS - STORES DATA FOR MEAN AND RMS CALCULATIONS

C E5 MAXMIN - CALCULATES MAX/MIN SLOPES AT GRID POINTS

C E6 RTVLST - RETRIEVAL LIST

C E7 BONDY - TEST TO SEE IF POINT OF RAY IS OUTSIDE PLAN FORM BNDRY

C E8 PACWRD - INDEX WORD PACKING-UNPACKING ROUTINE

C E9 PAGE - PRINTS PAGE NO. AT TOP OF EACH PAGE (AND RETRIEVAL NO.)

C F0 SHRDEF - SHEAR DEFORMATION GENERATOR

C F1 SINH - CALCULATES HYPERBOLIC SINE

C F2 COSH - CALCULATES HYPERBOLIC COSINE

C F3 TANH - CALCULATES HYPERBOLIC TANGENT

C

C AA = X DIMENSION OF SHAPE

C = LENGTH OF ELLIPSE SEMI AXIS

C = LENGTH OF RECTANGLE

C = 1/2 BASE LENGTH OF TRAPEZOID

C AMN = ARRAY FOR STORING MEANS

C AVG = ARRAY FOR STORING MEAN DATA

C AVS = ARRAY FOR STORING RMS DATA

C BB = Y DIMENSION OF SHAPE

C = HEIGHT OF ELLIPSE SEMI AXIS

C = HEIGHT OF RECTANGLE

C = HEIGHT OF TRAPEZOID

C BONC = BOUNDARY CONDITION

C CC = UPPER X DIMENSION OF TRAPEZOID

C CHAP = ICHAP = SHAP = GEOMETRIC SHAPE

C CON = DUMMY ARRAY FOR CONSTANT AND VARIABLE STORAGE

C CPRSS = CABIN PRESSURE

C DEL = GRID SPACING

C DIMA = AA DIMENSION

C DIMB = BB DIMENSION

| | | | |
|---|-------|--|-------|
| C | DIMC | = CC DIMENSION | 00470 |
| C | DON | = CONSTANT IN REFRACTIVE INDEX EQUATION | 00480 |
| C | DWX | = ARRAY OF GRIDPOINT DEFLECTIONS FOR SECOND PANE | 00490 |
| C | EANDF | = ARRAY USED IN RECTNG | 00500 |
| C | FR | = PLATE STIFFNESS (D) | 00510 |
| C | GNU | = POISSONS RATIO | 00520 |
| C | IBC | = 1, INDICATES POINT IS OUTSIDE PLANFORM BOUNDARY | 00530 |
| C | ICHAP | = SEE CHAP | 00540 |
| C | IDT | = DEFORMATION DATA RETRIEVAL SEQUENCE NUMBER | 00550 |
| C | ILGD | = 1, FIND DEFORMATIONS BY LARGE DEFORMATION METHOD | 00560 |
| C | ILRG | = 1, LARGE DEFLECTIONS WERE CALCULATED | 00570 |
| C | IMAN | = 1, FIND MAX./MIN. SLOPES OF DEFORMED POINTS | 00580 |
| C | INDX | = 1, PRINT RETRIEVAL INDEX AT TOP OF PAGE =0,NO PRINT | 00590 |
| C | IPB | = PAGE NUMBER COUNTER IN RESPRT FOR TAPE 9 | 00600 |
| C | IPD | = PAGE NUMBER COUNTER IN DEFRES | 00610 |
| C | IPR | = PAGE NUMBER COUNTER IN RESPRT FOR TAPE 8 | 00620 |
| C | IPV | = RETRIEVAL LIST PAGE NUMBER | 00630 |
| C | IREL | = 1, REAL WINDOW INCLUDE OTHER SIDE OF SYMMETRY AXIS | 00640 |
| C | IRM | = PAGE NUMBER COUNTER IN RESPRT FOR RMS OUTPUT ON TAPE 6 | 00650 |
| C | IRT | = LOS DATA RETRIEVAL SEQUENCE NUMBER | 00660 |
| C | ISCR1 | = SCRATCH TAPE UNIT 7 FOR DEFORMATION DATA | 00670 |
| C | ISCR2 | = SCRATCH TAPE UNIT 8 FOR LINE OF SIGHT (LOS) DATA | 00680 |
| C | ISEC | = 1, PRINT LOS DATA, =2, PRINT RMS DATA | 00690 |
| C | ISI | = INPUT TAPE NUMBER | 00700 |
| C | ISO | = OUTPUT TAPE NUMBER | 00710 |
| C | IS9 | = SCRATCH TAPE UNIT 9 FOR LINE OF SIGHT DATA BINARY CODED | 00720 |
| C | ISHR | = 1, CALCULATE SHEAR DEFORMATIONS | 00730 |
| C | JPN | = ARRAY OF GRIDPOINT COORDINATE INDEXES | 00740 |
| C | LIN | = RETRIEVAL LIST LINE COUNTER | 00750 |
| C | LOCP | = KEYS HEADINGS AT TOP OF LOS PRINTED PAGE LOCP=2,NO HEAD | 00760 |
| C | LP1 | = INDEX ON NO. OF BOUNDARY CONDITIONS | 00770 |
| C | LP2 | = INDEX ON NO. OF SCALES | 00780 |
| C | LP3 | = INDEX ON NO. OF SPACES | 00790 |
| C | LP4 | = INDEX ON NO. OF PRESSURES | 00800 |
| C | LP5 | = INDEX ON NO. OF RAY ANGLES | 00810 |
| C | LP6 | = INDEX ON NO. OF GRID POINTS | 00820 |
| C | LP7 | = INDEX ON NO. OF PLANE ANGLES | 00830 |
| C | MIBP | = 1, BYPASS GENERATION OF INVERSION MATRIX FOR INTERPOLATION | 00840 |
| C | MRT | = BY PASS SWITCH FOR TAPE REWIND STATEMENTS IN WINDEF | 00850 |
| C | NBC | = NO. OF BOUNDARY CONDITIONS | 00860 |
| C | NGP | = NUMBER OF GRID POINTS | 00870 |
| C | NMP | = ARRAY OF NUMBER OF DATA PTS. IN MEAN | 00880 |
| C | NOPRT | = KEYS TAPES ON WHICH OUTPUT DATA APPEARS | 00890 |
| C | | = 0, DEFORMATIONS ON TAPE 7, LOS ON TAPES 8 AND 9 | 00900 |
| C | | = 1, ALL DATA ON SYSTEM OUTPUT TAPE | 00910 |
| C | | = 2, OUTPUT ONLY RMS DATA ON OUTPUT TAPE | 00920 |
| C | NPAG | = NO. OF PLANE ANGLES | 00930 |

| | | | | |
|---|---|-------------------|--------------------|-------|
| C | NPAN = NO. OF PANES | | | 00940 |
| C | NPRS = NO. OF PRESSURES | | | 00950 |
| C | NRAG = NO. OF RAY ANGLES | | | 00960 |
| C | NRFI = NO. OF REFRACTIVE INDEXES TO BE READ IN | | | 00970 |
| C | NSCL = NO. OF SCALES | | | 00980 |
| C | NSPC = NO. OF SPACES | | | 00990 |
| C | OIF = SUPPLEMENTAL ARRAY | | | 01000 |
| C | PLNA = ARRAY OF PLANE ANGLES | | | 01010 |
| C | PRES = ARRAY FOR STORING INTERSTITIAL PRESSURES | | | 01020 |
| C | PRSS = PRES(I) = PRESSURE ON PLATE | | | 01030 |
| C | RAYA = ARRAY OF RAY ANGLES | | | 01040 |
| C | RES = ARRAY FOR STORING LOS OUTPUT | | | 01050 |
| C | RI = ARRAY OF REFRACTIVE INDEXES | | | 01060 |
| C | RIC = REFRACTIVE INDEX COEFFICIENT | | | 01070 |
| C | RHS = ARRAY USED IN RECTNG | | | 01080 |
| C | RTV = ARRAY FOR STORING RETRIEVAL INFORMATION | | | 01090 |
| C | SCAL = ARRAY FOR STORING GEOMETRIC SCALE FACTORS | | | 01100 |
| C | SHAP = SEE CHAP | | | 01110 |
| C | SKAL = SCAL(I) = DIMENSIONAL SCALING FACTOR | | | 01120 |
| C | SPAC = ARRAY FOR STORING SPACE FACTORS | | | 01130 |
| C | SPAD = SPAC(I) = SPACE BETWEEN PLATES | | | 01140 |
| C | STAT = ARRAY FOR STORING MEAN AND RMS DATA | | | 01150 |
| C | STD = ARRAY FOR STORING RMSES | | | 01160 |
| C | THIC = PLATE THICKNESS | | | 01170 |
| C | W = ARRAY OF GRIDPOINT DEFLECTIONS FOR FIRST PANE | | | 01180 |
| C | WORD = ARRAY FOR TITLE | | | 01190 |
| C | X = ARRAY OF X COORDINATES OF GRIDPOINTS IN DEFORMATION TABLE | | | 01200 |
| C | YONG = YOUNG'S MODULUS | | | 01210 |
| C | | | | 01220 |
| C | DOUBLE PRECISION AVG, AVS | | | 01230 |
| C | | | | 01240 |
| C | COMMON DUM | | | 01250 |
| C | | | | 01260 |
| | 0 EQUIVALENCE | (DUM(1), CON), | (DUM(501), X), | 01270 |
| | 1 | (DUM(1501), W), | (DUM(2251), DWX), | 01280 |
| | 2 | (DUM(3001), JPN), | (DUM(3501), RTV) | 01290 |
| C | | | | 01300 |
| | 0 EQUIVALENCE | (CON(1), DIMA), | (CON(2), DIMB), | 01310 |
| | 1 (CON(3), DIMC), | (CON(4), DEL), | (CON(5), GNU), | 01320 |
| | 2 (CON(6), THIC), | (CON(7), SPAD), | (CON(8), PRSS), | 01330 |
| | 3 (CON(9), NPAN), | (CON(10), ISI), | (CON(11), ISO), | 01340 |
| | 4 (CON(12), IBC), | (CON(13), NGP), | (CON(14), LP7), | 01350 |
| | 5 (CON(15), FR), | (CON(16), LOCP), | (CON(17), IPD), | 01360 |
| | 6 (CON(18), IPR), | (CON(19), CHAP), | (CON(20), ISCRI), | 01370 |
| | 7 (CON(21), ISCR2), | (CON(22), SKAL), | (CON(23), ISEC), | 01390 |
| | 8 (CON(24), NPAG), | (CON(25), YONG), | (CON(26), ILRG), | 01400 |
| | 9 (CON(27), IREL), | (CON(28), LP5), | (CON(29), CPRSS) | 01410 |

81

| | | | | |
|---|------|--|--|-------|
| C | | | | 01420 |
| | 0 | EQUIVALENCE | (CON(30), IRM), (CON(31), IPB), | 01430 |
| | 1 | (CON(32), MIBP), | | 01440 |
| | 2 | (CON(53), SCAL), | (CON(61), SPAC), (CON(69), PRES), | 01450 |
| | 3 | (CON(77), PLNA), | (CON(85), RAYA), (CON(93), RI), | 01460 |
| | 4 | (CON(101), RES), | (CON(315), STAT), (CON(371), OIF) | 01470 |
| | 4 | (OIF(1),IDX), (OIF(2),IDY), (OIF(3),X1), (OIF(4),Y1) | | 01480 |
| C | | | | 01490 |
| | 0 | EQUIVALENCE | (RTV(1), JT1), (RTV(41), RT2), | 01500 |
| | 1 | (RTV(81), RT3), | (RTV(121), RT4), (RTV(161), RT5), | 01510 |
| | 2 | (RTV(201), RT6), | (RTV(241), JT7), (RTV(281), RT8), | 01520 |
| | 3 | (RTV(321), RT9), | (RTV(361),JT10), (RTV(401),RT11) | 01530 |
| C | | | | 01540 |
| | 0 | EQUIVALENCE | (STAT(1), NMP), (STAT(9), AVG), | 01550 |
| | 1 | (STAT(25), AVS), | (STAT(41), AMN), (STAT(49), STD) | 01560 |
| C | | | | 01570 |
| | | EQUIVALENCE | (CON(33),ITEST),(OIF(11),N2) | 01580 |
| C | | | | 01590 |
| | 0 | DIMENSION | CON(500), X(21,33), W(21,33), | 01600 |
| | 1 | DWX(21,33),JPN(500),RTV(500) | | 01610 |
| C | | | | 01620 |
| | 0 | DIMENSION | SCAL(8), SPAC(8), PRES(8), PLNA(8), | 01630 |
| | 1 | RAYA(8), RI(7), WORD(15) | | 01640 |
| C | | | | 01650 |
| | | DIMENSION | NMP(8), AVG(8), AVS(8), AMN(8), STD(8), RES(180) | 01660 |
| C | | | | 01670 |
| | | DATA | TRAP/4HTRAP/, ELIP/4HELIP/, RECT/4HRECT/ | 01680 |
| C | | | | 01690 |
| | | DATA | HING/4HHING/, CLMP/4HCLMP/, BOTH/4HBOTH/,STAR/5H*****/ | 01700 |
| C | | | | 01710 |
| | | C===== | THIS SECTION INITIALIZES INDEXES. | 01720 |
| C | | | | 01730 |
| | | CALL | CLOCK (TIME) | 01740 |
| | | WRITE | (6,9070) TIME | 01750 |
| | 9070 | FORMAT | (IHO,25HWINDEF TIME = ,F10.4) | 01760 |
| | | ISI | = 5 | 01770 |
| | | ISO | = 6 | 01780 |
| | | ISCR1 | = 7 | 01790 |
| | | ISCR2 | = 8 | 01800 |
| | | IS9 | = 9 | 01810 |
| | | IDT | = 0 | 01820 |
| | | IRT | = 0 | 01830 |
| | | IRM | = 0 | 01840 |
| | | LIN | = 0 | 01850 |
| | | IPD | = 0 | 01860 |
| | | IPR | = 0 | 01870 |
| | | IPV | = 0 | 01880 |

| | | |
|--------|--|-------|
| | IPB = 0 | 01890 |
| | MRT = 0 | 01900 |
| | DO 90 I=1,500 | 01910 |
| 90 | RTV(I) = 0.0 | 01920 |
| 100 | NGP = 0 | 01930 |
| | X1=0. | 01940 |
| | Y1=0. | 01950 |
| 499 | READ (ISI,499) IRT, (WORD(I),I=1,15) | 01960 |
| | FORMAT (I5,15A5) | 01970 |
| | NBC = 1 | 01980 |
| | IBC = 0 | 01990 |
| | CHAP = 0.0 | 02000 |
| C | | 02010 |
| C===== | READ IN PARAMETER DATA. | 02020 |
| C | | 02030 |
| | READ (ISI,500) SHAP, BONC, AA, BB, CC, THIC, YONG, GNU, DEL | 02040 |
| 500 | FORMAT (1X,A4,1X,A4,7E10.0) | 02050 |
| | IF (AA.EQ. 0.0) GO TO 1000 | 02060 |
| 0 | IF ((THIC .EQ. 0.0) .OR. (YONG .EQ. 0.0) .OR. (DEL .EQ. 0.0)) | 02070 |
| 1 | GO TO 902 | 02080 |
| | IF (BONC .EQ. HING) IBC = 1 | 02090 |
| | IF (BONC .EQ. CLMP) IBC = 2 | 02100 |
| | IF (BONC .EQ. BOTH) IBC = 1 | 02110 |
| | IF (BONC .EQ. BOTH) NBC = 2 | 02120 |
| | IF (IBC .EQ. 0) GO TO 900 | 02130 |
| | IF (SHAP .EQ. ELIP) CHAP = 1.0 | 02140 |
| | IF (SHAP .EQ. RECT) CHAP = 2.0 | 02150 |
| | IF (SHAP .EQ. TRAP) CHAP = 3.0 | 02160 |
| | IF (CHAP .EQ. 0.0) GO TO 901 | 02170 |
| 0 | READ (ISI,501) NPAN, NSCL, NSPC, NPRS, NPAG, NRAG, IMAN, ILGD, | 02180 |
| 1 | IREL, NOPRT, CPRSS, ISHR | 02190 |
| | IF (NPAN.EQ.1) CPRSS=0. | 02200 |
| 501 | FORMAT (10I5,E10.0,I5) | 02210 |
| | READ (ISI,502) (SCAL(I), I=1,NSCL) | 02220 |
| | IF (NPAN .LT. 2) GO TO 101 | 02230 |
| | READ (ISI,502) (SPAC(I), I=1,NSPC) | 02240 |
| 502 | FORMAT (8E10.0) | 02250 |
| 101 | READ (ISI,502) (PRES(I), I=1,NPRS) | 02260 |
| | DO 299 I=1,8 | 02270 |
| 299 | PLNA(I)=0.0 | 02280 |
| | READ (ISI,502) (PLNA(I), I=1,NPAG) | 02290 |
| | READ (ISI,502) (RAYA(I), I=1,NRAG) | 02300 |
| | NRFI = 2*NPAN + 1 | 02310 |
| | READ (ISI,502) (RI(I),I=1,NRFI) | 02320 |
| | FR= (YONG*(THIC**3))/(12.0*(1.0-(GNU**2))) | 02330 |
| | ITEST=0 | 02340 |
| | DO 300 I=1,8 | 02350 |

| | | |
|--|---|-------|
| | EI=I-1 | 02360 |
| | ANGLE=EI*45. | 02370 |
| | IF(PLNA(I).EQ.ANGLE) GO TO 300 | 02380 |
| | ITEST=1 | 02390 |
| | 300 CONTINUE | 02400 |
| | IF (MRT .NE. 0) GO TO 201 | 02410 |
| | IF (NOPRT .EQ. 0) REWIND ISCR1 | 02420 |
| | IF (NOPRT .EQ. 0) REWIND ISCR2 | 02430 |
| | IF (NOPRT .EQ. 0) REWIND IS9 | 02440 |
| | IF (NOPRT .EQ. 0) MRT = 1 | 02450 |
| | C | 02460 |
| | C===== MAIN DO-LOOP ON NUMBER OF BOUNDARY CONDITIONS. | 02470 |
| | C | 02480 |
| | 201 DO 200 LP1=1,NBC | 02490 |
| | IF (LP1 .EQ. 2) IBC=2 | 02500 |
| | DO 200 LP2=1,NSCL | 02510 |
| | MIBP = 0 | 02520 |
| | SKAL = SCAL(LP2) | 02530 |
| | IF (SKAL .EQ. 0.0) GO TO 903 | 02540 |
| | DIMA = AA*SCAL(LP2) | 02550 |
| | DIMB = BB*SCAL(LP2) | 02560 |
| | DIMC = CC*SCAL(LP2) | 02570 |
| | ICHAP = CHAP | 02580 |
| | DO 609 IS=1,33 | 02590 |
| | DO 609 JS=1,21 | 02600 |
| | X(IS,JS)=1.E-6 | 02610 |
| | W(IS,JS) = 0.0 | 02620 |
| | 609 DWX(IS,JS) = 0.0 | 02630 |
| | C | 02640 |
| | C===== SELECT PLANFORM TO BE SOLVED. | 02650 |
| | C | 02660 |
| | GO TO (301,102,103), ICHAP | 02670 |
| | 301 CALL ELIPSE | 02680 |
| | GO TO 104 | 02690 |
| | 102 CALL RECTNG | 02700 |
| | IF (ISHR .EQ. 1) CALL SHRDEF | 02710 |
| | GO TO 104 | 02720 |
| | 103 CALL TRPZOD | 02730 |
| | 104 IF(ICHAP.EQ.3) GO TO 202 | 02740 |
| | IF((DIMA/2.).GT.(32.*DEL)) GO TO 1060 | 02741 |
| | IF((DIMB/2.).GT.(20.*DEL)) GO TO 1065 | 02742 |
| | 202 SPAD = STAR | 02743 |
| | IF (NSPC .EQ. 0) GO TO 105 | 02750 |
| | DO 200 LP3=1,NSPC | 02760 |
| | SPAD = SPAC(LP3) | 02770 |
| | 105 DO 200 LP4 = 1,NPRS | 02780 |
| | ILRG = 0 | 02790 |

| | | |
|--------|--|-------|
| | IRT = IRT + 1 | 02800 |
| | PRSS = PRES(LP4) | 02810 |
| | IF((ICHAP.NE.3).OR.(N2.NE.1)) GO TO 110 | 02820 |
| | DO 799 K=1,21 | 02830 |
| | DO 799 L=1,33 | 02840 |
| | W(K,L)=W(K,L)*(CPRSS-PRSS) | 02850 |
| 799 | DWX(K,L)=DWX(K,L)*PRSS | 02860 |
| C | CALCULATE REFRACTIVE INDEXES FOR PRESSURE USED. | 02870 |
| 110 | DON = ((2.926E-4)/(1.0 + (3.665E-3)*(21.0)))/14.7 | 02880 |
| | RIC = 1.0 + DON*ABS(PRSS) | 02890 |
| | IF (NPAN .EQ. 1) RI(1) = RIC | 02900 |
| | IF (NPAN .EQ. 2) RI(1) = 1.0 + DON*ABS(CPRSS) | 02910 |
| | IF (NPAN .EQ. 2) RI(3) = RIC | 02920 |
| | WRITE (ISO,1050) IPR,IPB | 02930 |
| | WRITE (ISO,123)(PRES(I),I=1,NPRS),CPRSS | 02940 |
| | WRITE (ISO,121)(RI(I),I=1,NRFI) | 02950 |
| 123 | FORMAT (1H , 21HPRESSURE LEVELS ARE 6E15.4) | 02960 |
| 121 | FORMAT (1H , 23HREFRACTIVE INDICES ARE 6E16.8) | 02970 |
| | IDT = IDT + 1 | 02980 |
| | CALL DEFRES (IRT, NOPRT) | 02990 |
| | CALL RTVLST (IRT, LIN, IPV) | 03000 |
| | IF (IMAN .EQ. 0) GO TO 184 | 03010 |
| | CALL MAXMIN(IRT) | 03020 |
| 184 | IF (ILGD .EQ. 0) GO TO 186 | 03030 |
| | CALL LRGDEF | 03040 |
| | ILRG = 1 | 03050 |
| | CALL DEFRES (IRT, NOPRT) | 03060 |
| C | | 03070 |
| C===== | PERFORM RAY TRACE ON DEFLECTED SHAPE FOUND ABOVE. | 03080 |
| C | | 03090 |
| 186 | DO 194 LP5=1,NRAG | 03100 |
| | DO 182 I=1,8 | 03110 |
| | NMP(I) = 0 | 03120 |
| | AVG(I) = 0.0 | 03130 |
| | AVS(I) = 0.0 | 03140 |
| | AMN(I) = 0.0 | 03150 |
| .182 | STD(I) = 0.0 | 03160 |
| | LOCP = 1 | 03170 |
| | RAYAN = RAYA(LP5) | 03180 |
| | DO 192 LP6 = 1,NGP | 03190 |
| | K1 = JPN(LP6) | 03200 |
| | CALL PACWRD (K1,K2, 2) | 03210 |
| C | | 03220 |
| C | THIS SECTION BYPASSES ALL POINTS NOT ON A 1 INCH SQUARE GRID | 03230 |
| C | | 03240 |
| | XQ = X(K1,K2) | 03250 |
| | EJ=K1-1 | 03260 |

| | | |
|-----|---|-------|
| | YQ=DEL*EJ | 03270 |
| | ZQ = 0.0 | 03280 |
| | XQQ=XQ/(2.*DEL) | 03290 |
| | IX=XQQ | 03300 |
| | XU=IX | 03310 |
| | RE=XQQ-XU | 03320 |
| | IF(RE.NE.0.) GO TO 192 | 03330 |
| | YQQ=YQ/(2.*DEL) | 03340 |
| | IY=YQQ | 03350 |
| | YV=IY | 03360 |
| | RE=YQQ-YV | 03370 |
| | IF(RE.NE.0.) GO TO 192 | 03380 |
| | DO 190 LP7 = 1, NPAG | 03390 |
| | PLANA = PLNA(LP7) | 03400 |
| | CALL RAYTRA (XQ, YQ, ZQ, PLANA, RAYAN) | 03410 |
| 190 | CONTINUE | 03420 |
| C | | 03430 |
| C | THIS SECTION PRINTS THE RAY TRACE DATA AND STORES THE COMPONENT | 03440 |
| C | DATA IN MENRES NEEDED TO CALCULATE THE MEAN AND RMS. | 03450 |
| C | | 03460 |
| | ISEC = 1 | 03470 |
| | CALL RESPRT (IRT, NOPRT) | 03480 |
| | CALL MENRMS | 03490 |
| 192 | CONTINUE | 03500 |
| C | | 03510 |
| C | THIS SECTION CALCULATES THE MEAN AND RMS AND THEN PRINTS THEM | 03520 |
| C | | 03530 |
| | ISEC = 2 | 03540 |
| | CALL MENRMS | 03550 |
| | CALL RESPRT (IRT, NOPRT) | 03560 |
| 194 | CONTINUE | 03570 |
| | IF((ICHAP.NE.3).OR.(N2.NE.1)) GO TO 200 | 03580 |
| | DO 199 K=1,21 | 03590 |
| | DO 199 L=1,33 | 03600 |
| | W(K,L)=W(K,L)/(CPRSS-PRSS) | 03610 |
| 199 | DWX(K,L)=DWX(K,L)/PRSS | 03620 |
| 200 | CONTINUE | 03630 |
| | GO TO 100 | 03640 |
| C | | 03650 |
| C | THIS SECTION PRINTS THE ERROR COMMENTS. | 03660 |
| C | | 03670 |
| 900 | WRITE (ISO,950) BONC | 03680 |
| 950 | 0 FORMAT (1H1/1H0,37HTHE BOUNDARY CONDITION WORD USED WAS ,A4, | 03690 |
| | 1 25H WHICH IS NOT ACCEPTABLE.) | 03700 |
| | GO TO 2000 | 03710 |
| 901 | WRITE (ISO,951) SHAP | 03720 |
| 951 | 0 FORMAT (1H1/1H0/1H0,28HTHE PLANEFORM WORD USED WAS ,A4, | 03730 |

| | | |
|--------|--|-------|
| | 1 25H WHICH IS NOT ACCEPTABLE.) | 03740 |
| | GO TO 2000 | 03750 |
| 902 | WRITE (ISO,952) | 03760 |
| 952 0 | FORMAT (1H0,43HTHE THICKNESS, YOUNGS MODULUS, OR THE GRID , | 03770 |
| | 1 19HINCREMENT ARE ZERO.) | 03780 |
| | GO TO 2000 | 03790 |
| 903 | WRITE (ISO,953) LP2 | 03800 |
| 953 | FORMAT (1H0, 6HSCALE(,11,10H) IS ZERO.) | 03810 |
| | GO TO 2000 | 03820 |
| 1000 | LIN = LIN + 100 | 03830 |
| | CALL RTVLST (IRT, LIN, IPV) | 03840 |
| | IF (NOPRT .EQ. 1) GO TO 1010 | 03850 |
| | WRITE (ISO,1050) IPR, IPB | 03860 |
| 1050 0 | FORMAT (1H1/1H0,9HTHERE ARE,15,27H PAGES OF RAY TRACE OUTPUT , | 03870 |
| | 1 30HON THE MICROFILM TAPE (TAPE 8)/ | 03880 |
| | 2 1H0,9HTHERE ARE,15,27H PAGES OF RAY TRACE OUTPUT , | 03890 |
| | 1 30HON THE RETRIEVAL TAPE (TAPE 9)) | 03900 |
| | INX = 999 | 03910 |
| | CALL PAGE (IPB, LIN, IS9, INX) | 03920 |
| | GO TO 1020 | 03930 |
| 1010 | WRITE (ISO,1051) IPR | 03940 |
| 1051 0 | FORMAT (1H1/1H0,9HTHERE ARE,15,27HPAGES OF RAY TRACE OUTPUT , | 03950 |
| | 1 30HON THE SYSOUTPUT TAPE (TAPE 6)) | 03960 |
| 1020 | WRITE (ISO,1052) | 03970 |
| 1052 | FORMAT (1H0/1H0,30X,40H***** THE PROBLEM YOU GAVE ME TO DO WAS , | 03980 |
| | 1 20HDONE CORRECTLY *****) | 03990 |
| | CALL CLOCK (TIME) | 04000 |
| | WRITE (6,9099) TIME | 04010 |
| 9099 | FORMAT (1H0,25HEND WINDEF TIME = , F10.4) | 04020 |
| 1060 | WRITE(6,9098) IRT | 04021 |
| 9098 | FORMAT(1H1,38HTHE PROBLEM DESIGNATED RETRIVAL NUMBER,I4,58H HAS IT | 04022 |
| | 1S AA DIMENSION GREATER THAN THE PROGRAM CAN HANDLE.) | 04023 |
| 1065 | WRITE(6,9097) IRT | 04024 |
| 9097 | FORMAT(1H1,38HTHE PROBLEM DESIGNATED RETRIVAL NUMBER,I4,58H HAS IT | 04025 |
| | 1S BB DIMENSION GREATER THAN THE PROGRAM CAN HANDLE.) | 04026 |
| | GO TO 100 | 04027 |
| 2000 | STOP | 04030 |
| | END | 04040 |
| | \$IRFTC MS23D1 | 04050 |
| | CELIPSE | 04060 |
| | SUBROUTINE ELIPSE | 04070 |
| C | | 04080 |
| C | THIS SUBROUTINE GENERATES THE TABLE OF GRIDPOINT DEFORMATIONS FOR | 04090 |
| C | AN ELLIPSE | 04100 |
| C | | 04110 |
| C | A = ELLIPSE MAJOR SEMI AXIS | 04120 |
| C | B = ELLIPSE MINOR SEMI AXIS | 04130 |

| | | | | | |
|----|------|--|--------------------------------|-------------------|-------|
| C | C | = ELLIPTIC FOCAL DISTANCE | | | 04140 |
| C | DWX | = DEFLECTION AT POINT I,J OF SECOND PANE | | | 04150 |
| C | ET | = ELLIPTIC COORDINATE | | | 04160 |
| C | ETX | = PARTIAL OF ET WRT X | | | 04170 |
| C | ETY | = PARTIAL OF ET WRT Y | | | 04180 |
| C | I | = ROW INDEX | | | 04190 |
| C | J | = COLUM INDEX | | | 04200 |
| C | K | = GRIDPOINT COUNTER | | | 04210 |
| C | NGP | = NUMBER OF GRID POINTS | | | 04220 |
| C | W | = DEFLECTION AT POINT I,J OF FIRST PANE | | | 04230 |
| C | W1 | = CONSTANT IN DEFLECTION EQUATION | | | 04240 |
| C | W0 | = CONSTANT IN DEFLECTION EQUATION | | | 04250 |
| C | WEP | = PARTIAL OF W WRT ET | | | 04260 |
| C | WZP | = PARTIAL OF W WRT ZI | | | 04270 |
| C | X | = X COORDINATE ARRAY | | | 04280 |
| C | XLIM | = X VALUE AT ELLIPTIC BOUNDARY ALONG ANY ABSISSA | | | 04290 |
| C | ZI | = ELLIPTIC COORDINATE | | | 04300 |
| C | ZIX | = PARTIAL OF ZI WRT X | | | 04310 |
| C | ZIY | = PARTIAL OF ZI WRT Y | | | 04320 |
| C | | ALL OTHER LEFT HAND SIDE VALUES ARE TEMPORARIES | | | 04330 |
| C | | | | | 04340 |
| C | | COMMON DUM | | | 04350 |
| C | | | | | 04360 |
| | 0 | EQUIVALENCE | (DUM(1), CON), | (DUM(501), X), | 04370 |
| | 1 | | (DUM(1501), W), | (DUM(2251), DWX), | 04380 |
| | 2 | | (DUM(3001), JPN), | (DUM(3501), RTV) | 04390 |
| 87 | C | | | | 04400 |
| | 0 | EQUIVALENCE | (CON(1), DIMA), | (CON(2), DIMB), | 04410 |
| | 1 | (CON(3), DIMC), | (CON(4), DEL), | (CON(5), GNU), | 04420 |
| | 2 | (CON(6), THIC), | (CON(7), SPAD), | (CON(8), PRSS), | 04430 |
| | 3 | (CON(9), NPAN), | (CON(10), ISI), | (CON(11), ISO), | 04440 |
| | 4 | (CON(12), IBC), | (CON(13), NGP), | (CON(14), LP7), | 04450 |
| | 5 | (CON(15), FR), | (CON(16), LOCP), | (CON(17), IPD), | 04460 |
| | 6 | (CON(18), IPR), | (CON(19), CHAP), | (CON(20), ISCR1), | 04470 |
| | 7 | (CON(21), ISCR2), | (CON(22), SKAL), | (CON(23), ISEC), | 04480 |
| | 8 | (CON(24), NPAG), | (CON(25), YONG), | (CON(26), ILGD), | 04490 |
| | 9 | (CON(27), IREL), | (CON(28), LP5), | (CON(29), CPRSS) | 04500 |
| | C | | | | 04510 |
| | 0 | EQUIVALENCE | (CON(30), IRM), | (CON(31), IPB), | 04520 |
| | 1 | (CON(53), SCAL), | (CON(61), SPAC), | (CON(69), PRES), | 04530 |
| | 2 | (CON(77), PLNA), | (CON(85), RAYA), | (CON(93), RI), | 04540 |
| | 3 | (CON(101), RES), | (CON(315), STAT), | (CON(371), OIF), | 04550 |
| | 4 | (CON(401), EANDF), | (CON(451), RHS) | | 04560 |
| | C | | | | 04570 |
| | C | | | | 04580 |
| | 0 | DIMENSION | CON(500), X(21,33), | W(21,33), | 04590 |
| | 1 | | DWX(21,33), JPN(500), RTV(500) | | 04600 |

```

C
A = DIMA/2.0
B = DIMB/2.0
C
C===== INITIALIZE INDEXES.
C
IF (A .GT. B) GO TO 201
TM = B
B = A
A = TM
201 C = SQRT(A*A - B*B)
XLIM = A
I = 0
J = 0
K = 0
X(1,1) = 0.0
GO TO (100,104), IBC
C
C===== THIS SECTION CALCULATES THE GRIDPOINT DEFORMATIONS FOR AN ELLIPSE
WITH SIMPLY SUPPORTED EDGES.
C
C CALCULATE CONSTANTS
C
100 IF (A .EQ. B) GO TO 102
X(1,1) = A
ZI = 1.0
ET = 1.0
XC = X(1,1)
YC=0.
CALL ELIPIT (C, XC, YC, ZI, ET, FZP, FEP, GZP, GEP, DET)
C
A10 = ZI
A20 = 2.0*ZI
A40 = 4.0*ZI
CA20 = COSH(A20)
CA40 = COSH(A40)
CA2S = (COSH(A20))**2
SA2S = (SINH(A20))**2
SA2Q = (SINH(A20))**4
WO = (C**4)/(12.0*128.0*CA2S*CA40*FR)
OMNU = (1.0 - GNU)
W1 = +(8.0*(OMNU)*(3.0*CA2S-2.0)*SA2Q)/(2.0*CA2S-(OMNU)*SA2S)
X(1,1) = 0.0
C
C CALCULATE GRID POINT DEFORMATIONS.
203 I = I+1
101 J = J+1
K = K+1

```

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04610
04620
04630
04640
04650
04660
04670
04680
04690
04700
04710
04720
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04740
04750
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04800
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04900
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04960
04970
04980
04990
05000
05010
05020
05030
05040
05050
05060
05070

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| | | |
|--|--|-------|
| | K1 = I | 05080 |
| | K2 = J | 05090 |
| | CALL PACWRD (K1,K2,1) | 05100 |
| | JPN(K) = K1 | 05110 |
| | ZI = 1.0 | 05120 |
| | ET = 1.0 | 05130 |
| | XC = X(I,J) | 05140 |
| | EJ=I-1 | 05150 |
| | YC=DEL*EJ | 05160 |
| | CALL ELIPIT (C, XC, YC, ZI, ET, FZP, FEP, GZP, GEP, DET) | 05170 |
| | ZI2 = 2.0*ZI | 05180 |
| | ZI4 = 4.0*ZI | 05190 |
| | ET2 = 2.0*ET | 05200 |
| | ET4 = 4.0*ET | 05210 |
| | TE1 = (3.0*CA20*CA40 - 4.0*CA40*COSH(ZI2) + CA20*COSH(ZI4)) | 05220 |
| | TE2 = (3.0*CA20*CA40 - 4.0*CA40* COS(ET2) + CA20* COS(ET4)) | 05230 |
| | TE3 = (COSH(ZI2) - CA20) | 05240 |
| | TE4 = (CA20 - COS(ET2)) | 05250 |
| | W(I,J) = WO*(TE1*TE2 - W1*TE3*TE4) | 05260 |
| | IF(NPAN.EQ.2) DWX(I,J)=W(I,J) | 05270 |
| | 0 WZP = WO*(TE2*(-8.0*CA40*SINH(ZI2) + 4.0*CA20*SINH(ZI4)) | 05280 |
| | 1 -W1*TE4*(2.0*SINH(ZI2))) | 05290 |
| | 0 WEP = WO*(TE1*(+8.0*CA40* SIN(ET2) - 4.0*CA20* SIN(ET4)) | 05300 |
| | 1 -W1*TE3*(2.0* SIN(ET2))) | 05310 |
| | ZIX =GEP/DET | 05320 |
| | ETX =GZP/DET | 05330 |
| | ZIY =FEP/DET | 05340 |
| | ETY =FZP/DET | 05350 |
| | X(I,J+1) = X(I,J) + DEL | 05360 |
| | IF (X(I,J+1) .LE. XLIM) GO TO 101 | 05370 |
| | X(I,J+1) = 0.0 | 05380 |
| | J = 0 | 05390 |
| | X(I+1,J+1) = 0.0 | 05400 |
| | EJ=I | 05410 |
| | DWY=DEL*EJ | 05420 |
| | IF (DWY .GT. B) GO TO 800 | 05430 |
| | XLIM = A*SQRT (1.0 - (DWY **2/(B*B))) | 05440 |
| | IF (DWY .LE. B) GO TO 203 | 05450 |
| | GO TO 800 | 05460 |
| | C | 05470 |
| | C===== THIS SECTION SOLVES THE SIMPLY SUPPORTED EDGE WHEN A = B (CIRCLE) | 05480 |
| | C | 05490 |
| | 102 TE1 = 1.0/(64.0*FR) | 05500 |
| | TE2 = ((5.0+GNU)/(1.0+GNU))*(A*A) | 05510 |
| | I = 0 | 05520 |
| | J = 0 | 05530 |
| | X(1,1) = 0.0 | 05540 |

06

| | | |
|-----|--|-------|
| | XLIM = A | 05550 |
| 205 | I = I+1 | 05560 |
| 103 | J = J+1 | 05570 |
| | K = K+1 | 05580 |
| | K1 = I | 05590 |
| | K2 = J | 05600 |
| | CALL PACWRD (K1,K2,1) | 05610 |
| | JPN(K) = K1 | 05620 |
| | X2 = X(I,J)*X(I,J) | 05630 |
| | EJ=I-1 | 05640 |
| | Y2=DEL*DEL*EJ*EJ | 05650 |
| | TE3 = (A*A - X2 - Y2) | 05660 |
| | TE4= (TE2 - X2 - Y2) | 05670 |
| | W(I,J) = TE1*TE3*TE4 | 05680 |
| | IF(NPAN.EQ.2) DWX(I,J)=W(I,J) | 05690 |
| | X(I,J+1) = X(I,J) + DEL | 05700 |
| | EJ=I | 05710 |
| | DWY=DEL*EJ | 05720 |
| | IF (X(I,J+1) .LE. XLIM) GO TO 103 | 05730 |
| | X(I,J+1) = 0.0 | 05740 |
| | J = 0 | 05750 |
| | X(I+1,J+1) = 0.0 | 05760 |
| | EJ=I | 05770 |
| | DWY=DEL*EJ | 05780 |
| | IF (DWY .GT. B) GO TO 800 | 05790 |
| | XLIM = A*SQRT (1.0 - (DWY **2/(B*B))) | 05800 |
| | IF (DWY .LE. B) GO TO 205 | 05810 |
| | GO TO 800 | 05820 |
| | C | 05830 |
| | C===== THIS SECTION CALCULATES THE GRIDPOINT DEFORMATIONS FOR AN | 05840 |
| | C ELLIPSE WITH CLAMPED EDGES. | 05850 |
| | C | 05860 |
| 104 | TEM = (24.0/(A**4)) + (24.0/(B**4)) + (16.0/(A*A*B*B)) | 05870 |
| | WO = 1.0/(FR*TEM) | 05880 |
| 207 | I = I+1 | 05890 |
| 105 | J = J+1 | 05900 |
| | K = K+1 | 05910 |
| | K1 = I | 05920 |
| | K2 = J | 05930 |
| | CALL PACWRD (K1,K2,1) | 05940 |
| | JPN(K) = K1 | 05950 |
| | EJ=I-1 | 05960 |
| | DWY=EJ*DEL | 05970 |
| | TEM = (1.0 - (X(I,J)*X(I,J)/(A*A)) - (DWY*DWY / (B*B))) | 05980 |
| | W(I,J) = WO*(TEM**2) | 05990 |
| | IF(NPAN.EQ.2) DWX(I,J)=W(I,J) | 06000 |
| | X(I,J+1) = X(I,J) + DEL | 06010 |

| | | |
|-----|--|-------|
| | IF (X(I,J+1) .LE. XLIM) GO TO 105 | 06020 |
| | X(I,J+1) = 0.0 | 06030 |
| | J = 0 | 06040 |
| | X(I+1,J+1) = 0.0 | 06050 |
| | EJ=I | 06060 |
| | DWY=DEL*EJ | 06070 |
| | IF (DWY .GT. B) GO TO 800 | 06080 |
| | XLIM = A*SQRT (1.0 - (DWY*DWY / (B*B))) | 06090 |
| | IF (DWY .LE. B) GO TO 207 | 06100 |
| 800 | NGP = K | 06110 |
| | RETURN | 06120 |
| | END | 06130 |
| | \$IBFTC MS23D2 | 06140 |
| | CELIPIT | 06150 |
| | SUBROUTINE ELIPIT (C, X, Y, XI, ET, FXP, FEP, GXP, GEP, DET) | 06160 |
| | C | 06170 |
| | C THIS SUBROUTINE DETERMINS THE ELLIPTIC COORDINATES XI AND ET, | 06180 |
| | C CORRESPONDING TO THE CARTESIAN COORDINATES X AND Y. | 06190 |
| | C | 06200 |
| | C ITERATION IS BY THE NEWTON-RHAPSON METHOD OF SUCCESSIVE APPROX. | 06210 |
| | C | 06220 |
| | C C = ELLIPTIC FOCAL DISTANCE | 06230 |
| | C DET = DETERMINENT | 06240 |
| | C ET = ET COORDINATE VALUE IN ELLIPTICAL SYSTEM | 06250 |
| | C FEP = PARTIAL OF FIO WRT ET | 06260 |
| | C FIO = FUNCTION F | 06270 |
| | C FXP = PARTIAL OF FIO WRT XI | 06280 |
| | C GEP = PARTIAL OF GIO WRT ET | 06290 |
| | C GIO = FUNCTION G | 06300 |
| | C GXP = PARTIAL OF GIO WRT XI | 06310 |
| | C IDON = 1 INDICATES ITERATION IS COMPLETE | 06320 |
| | C X = X COORDINATE VALUE IN RETANGULAR SYSTEM | 06330 |
| | C XI = XI COORDINATE VALUE IN ELLIPTICAL SYSTEM | 06340 |
| | C Y = Y COORDINATE VALUE IN RETANGULAR SYSTEM | 06350 |
| | C ALL OTHER LEFT HAND VALUES ARE TEMPORARIES | 06360 |
| | C | 06370 |
| | IDON = 0 | 06380 |
| 100 | IF (Y .NE. 0.0) GO TO 103 | 06390 |
| | IF (X .GT. C) GO TO 101 | 06400 |
| | XI1 = 0.0 | 06410 |
| | ET1 = ACOS(X/C) | 06420 |
| | GO TO 108 | 06430 |
| 101 | XI = 1.0 | 06440 |
| | ET = 0.0 | 06450 |
| 102 | FIO = X - C*COSH(XI)*COS(ET) | 06460 |
| | FXP = - C*SINH(XI)*COS(ET) | 06470 |
| | XI1 = XI - FIO/FXP | 06480 |

| | | |
|-----|--|-------|
| | ET1 = ET | 06490 |
| | IF ((ABS(XI1 - XI)) .LE. 0.0000001) GO TO 108 | 06500 |
| | XI = XI1 | 06510 |
| | GO TO 102 | 06520 |
| 103 | IF (X .NE. 0.0) GO TO 105 | 06530 |
| | ET = 90.0*0.017453292519 | 06540 |
| | XI = 0.0 | 06550 |
| 104 | GIO = Y - C*SINH(XI)*SIN(ET) | 06560 |
| | GXP = - C*COSH(XI)*SIN(ET) | 06570 |
| | XI1 = XI - GIO/GXP | 06580 |
| | ET1 = ET | 06590 |
| | IF ((ABS(XI1 - XI)) .LE. 0.0000001) GO TO 108 | 06600 |
| | XI = XI1 | 06610 |
| | GO TO 104 | 06620 |
| 105 | FIO = X - C*COSH(XI)*COS(ET) | 06630 |
| | GIO = Y - C*SINH(XI)*SIN(ET) | 06640 |
| 106 | FXP = - C*SINH(XI)*COS(ET) | 06650 |
| | FEP = + C*COSH(XI)*SIN(ET) | 06660 |
| | GXP = - C*COSH(XI)*SIN(ET) | 06670 |
| | GEP = - C*SINH(XI)*COS(ET) | 06680 |
| | DET = (FXP*GEP - FEP*GXP) | 06690 |
| | IF (IDON .EQ. 1) GO TO 800 | 06700 |
| | XI1 = XI - (1.0/DET)*(GEP*FIO - FEP*GIO) | 06710 |
| | ET1 = ET + (1.0/DET)*(GXP*FIO - FXP*GIO) | 06720 |
| | IF ((ABS(XI1 - XI)) .LE. 0.0000001) GO TO 107 | 06730 |
| | XI = XI1 | 06740 |
| | ET = ET1 | 06750 |
| | GO TO 105 | 06760 |
| 107 | IF ((ABS(ET1 - ET)) .LE. 0.0000001) GO TO 108 | 06770 |
| | XI = XI1 | 06780 |
| | ET = ET1 | 06790 |
| | GO TO 105 | 06800 |
| 108 | XI = XI1 | 06810 |
| | ET = ET1 | 06820 |
| | IDON = 1 | 06830 |
| | GO TO 105 | 06840 |
| 800 | RETURN | 06850 |
| | END | 06860 |
| | \$IBFTC MS23D3 | 06870 |
| | CRECTAG | 06880 |
| | C | 06890 |
| | SUBROUTINE RECTNG | 06900 |
| | C | 06910 |
| | C THIS SUBROUTINE GENERATES THE TABLE OF GRIDPOINT DEFORMATIONS | 06920 |
| | C FOR A RECTANGULAR PLATE WITH DIMENSIONS A BY B AND RIGIDITY D | 06930 |
| | C | 06940 |
| | C A = PLATE LENGTH | 06950 |

| | | | | |
|---|-----------------------------------|-------------------|---|-------|
| C | ALPHAM | = | DEFLECTION COEFFICIENT | 06960 |
| C | ALPHAN | = | DEFLECTION COEFFICIENT | 06970 |
| C | ASPECT | = | SQUARE OF ASPECT RATIO | 06980 |
| C | B | = | PLATE WIDTH | 06990 |
| C | BETAM | = | MOMENT COEFFICIENT | 07000 |
| C | BETAN | = | MOMENT COEFFICIENT | 07010 |
| C | D | = | PLATE STIFFNESS | 07020 |
| C | DWX | = | DEFLECTION AT POINT I,J OF SECOND PANE | 07030 |
| C | DWXMOE | = | SLOPE IN X DIRECTION FOR MOMENTS APPLIED ALONG ONE EDGE | 07040 |
| C | DWXMOF | = | SLOPE IN X DIRECTION FOR MOMENTS APPLIED ALONG OTHER EDGE | 07050 |
| C | DWXSIM | = | SLOPE IN X DIRECTION FOR SIMPLY SUPPORTED EDGE | 07060 |
| C | DWYMOE | = | SLOPE IN Y DIRECTION FOR MOMENTS APPLIED ALONG ONE EDGE | 07070 |
| C | DWYMOF | = | SLOPE IN Y DIRECTION FOR MOMENTS APPLIED ALONG OTHER EDGE | 07080 |
| C | DWYSIM | = | SLOPE IN Y DIRECTION FOR SIMPLY SUPPORTED EDGE | 07090 |
| C | EM | = | COUNT ON NUMBER OF TERMS | 07100 |
| C | EN | = | COUNT ON NUMBER OF TERMS | 07110 |
| C | I | = | ROW INDEX | 07120 |
| C | IBC | = | BOUNDARY CONDITION SWITCH | 07130 |
| C | ILIM | = | NUMBER OF EQUATIONS USED TO DETERMINE REDUNDANT MOMENTS | 07140 |
| C | J | = | COLUMN INDEX | 07150 |
| C | K | = | GRIDPOINT COUNTER | 07160 |
| C | MN | = | NUMBER OF SIMULTANEOUS EQUATIONS | 07170 |
| C | MOMENT | = | COEFFICIENTS OF LHS OF EQUATIONS | 07180 |
| C | NGP | = | NUMBER OF GRIDPOINTS | 07190 |
| C | NM | = | COLUMNS IN RHS OF EQUATIONS | 07200 |
| C | RHS | = | RHS OF SET OF SIMULTANEOUS EQUATIONS | 07210 |
| C | W | = | DEFLECTION AT POINT I,J OF FIRST PANE | 07220 |
| C | WMOE | = | DEFLECTION FOR MOMENTS APPLIED ALONG ONE EDGE | 07230 |
| C | WMOF | = | DEFLECTION FOR MOMENTS APPLIED ALONG OTHER EDGE | 07240 |
| C | WSIM | = | DEFLECTION FOR SIMPLY SUPPORTED EDGE | 07250 |
| C | X | = | X COORDINATE ARRAY | 07260 |
| C | | | | 07270 |
| C | COMMON DUM | | | 07280 |
| C | | | | 07290 |
| | DOUBLE PRECISION RHS,EANDF,MOMENT | | | 07300 |
| | 0 EQUIVALENCE | (DUM(1), CON), | (DUM(501), X), | 07310 |
| | 1 | (DUM(1501), W), | (DUM(2251), DWX), | 07320 |
| | 2 | (DUM(3001), JPN), | (DUM(3501), RTV), | 07330 |
| | 3 (DUM(4001),MOMENT) | | | 07340 |
| C | | | | 07350 |
| | 0 EQUIVALENCE | (CON(1), DIMA), | (CON(2), DIMB), | 07360 |
| | 1 (CON(3), DIMC), | (CON(4), DEL), | (CON(5), GNU), | 07370 |
| | 2 (CON(6), THIC), | (CON(7), SPAD), | (CON(8), PRSS), | 07380 |
| | 3 (CON(9), NPAN), | (CON(10), ISI), | (CON(11), ISO), | 07390 |
| | 4 (CON(12), IBC), | (CON(13), NGP), | (CON(14), LP7), | 07400 |
| | 5 (CON(15), FR), | (CON(16), LOCP), | (CON(17), IPD), | 07410 |
| | 6 (CON(18), IPR), | (CON(19), CHAP), | (CON(20), ISCR1), | 07420 |

| | | | | | |
|----|----|--|-------------------|-------------------|---------------|
| | 7 | (CON(21), ISCR2), | (CON(22), SKAL), | (CON(23), ISEC), | 07430 |
| | 8 | (CON(24), NPAG), | (CON(25), YONG), | (CON(26), ILGD), | 07440 |
| | 9 | (CON(27), IREL), | (CON(28), LP5), | (CON(29), CPRSS) | 07450 |
| C | | | | | 07460 |
| | 0 | EQUIVALENCE | (CON(30), IRM), | (CON(31), IPB), | 07470 |
| | 1 | (CON(53), SCAL), | (CON(61), SPAC), | (CON(69), PRES), | 07480 |
| | 2 | (CON(77), PLNA), | (CON(85), RAYA), | (CON(93), RI), | 07490 |
| | 3 | (CON(101), RES), | (CON(315), STAT), | (CON(371), OIF), | 07500 |
| | 4 | (CON(401), RHS) | | | 07510 |
| C | | | | | 07520 |
| | 0 | DIMENSION | CON(500), | X(21,33), | W(21,33), |
| | 1 | DWX(21,33), | JPN(500), | RTV(500) | |
| C | | | | | 07530 |
| | | DIMENSION | RHS(32), | EANDF(32), | MOMENT(32,32) |
| | | EQUIVALENCE | (RHS,EANDF) | | |
| C | | | | | 07560 |
| C | | | | | 07570 |
| C | | | | | 07580 |
| C | | | | | 07590 |
| C | | C===== THIS SECTION SETS UP INITIAL CONSTANTS | | | 07600 |
| C | | | | | 07610 |
| | | D = FR | | | 07620 |
| | | A = DIMA | | | 07630 |
| | | B = DIMB | | | 07640 |
| | | ILIM = 28 | | | 07650 |
| | | IULIM = ILIM/2 | | | 07660 |
| | | ILLIM = ILIM/2 + 1 | | | 07670 |
| | | NTERMS = ILIM - 3 | | | 07680 |
| | | TERMS = NTERMS | | | 07690 |
| 46 | 10 | I = 0 | | | 07700 |
| | | J = 0 | | | 07710 |
| | | K = 0 | | | 07720 |
| | | X(1,1) = 0.0 | | | 07730 |
| | | PI = 3.1415926535 | | | 07740 |
| | | CNST1 = 4.0*(A**4)/(D*(PI**5)) | | | 07750 |
| | | CNST2 = 4.0*(A**3)/(D*(PI**4)) | | | 07760 |
| | | CNST3 = A*A/(2.0*D*PI*PI) | | | 07770 |
| | | CNST4 = A/(2.0*D*PI) | | | 07780 |
| | | CNST5 = B*B/(2.0*D*PI*PI) | | | 07790 |
| | | CNST6 = B/(2.0*D*PI) | | | 07800 |
| | | IF (IBC .EQ. 1) GO TO 100 | | | 07810 |
| C | | | | | 07820 |
| C | | C===== THIS SECTION CALCULATES THE MOMENT COEFFICIENTS FOR CLAMPED PLATE | | | 07830 |
| C | | | | | 07840 |
| | 50 | DO 55 JK=1,ILIM | | | 07850 |
| | | DO 55 L=1,IULIM | | | 07860 |
| | 55 | MOMENT(JK,L) = 0.0 | | | 07870 |
| | | EN = -1.0 | | | 07880 |
| | | DO 60 II=1,IULIM | | | 07890 |

| | | |
|----|---|-------|
| | EN = EN + 2.0 | 07900 |
| | ALPHAN = EN*PI*B/(2.0*A) | 07910 |
| | CNST7 = 8.0*EN*A/(PI*B) | 07920 |
| | CNST8 = 4.0*A*A/((EN**4)*(PI**3)) | 07930 |
| | ASPECT = A*A/(B*B) | 07940 |
| | III = II | 07950 |
| | IF (ALPHAN .LT. 88.0) GO TO 57 | 07960 |
| | MOMENT(II,III) = 1.0/EN | 07970 |
| | RHS(II) = -CNST8 | 07980 |
| | GO TO 58 | 07990 |
| 57 | 0 MOMENT(II,III) = (TANH(ALPHAN)+ALPHAN/ | 08000 |
| | 1 COSH(ALPHAN)/COSH(ALPHAN)) /EN | 08010 |
| | RHS(II) = CNST8*(ALPHAN/ COSH(ALPHAN)/COSH(ALPHAN) -TANH(ALPHAN)) | 08020 |
| 58 | EM = -1.0 | 08030 |
| | DO 60 JJ=ILLIM,ILIM | 08040 |
| | EM = EM + 2.0 | 08050 |
| | 0 MOMENT(II,JJ) = CNST7*(1.0/((EM**3)*(EN*EN/(EM*EM)+ASPECT) | 08060 |
| | 1 *(EN*EN/(EM*EM)+ASPECT))) | 08070 |
| | 60 CONTINUE | 08080 |
| 70 | EN = -1.0 | 08090 |
| | DO 80 II=ILLIM,ILIM | 08100 |
| | EN = EN +2.0 | 08110 |
| | BETAN = EN*PI*A/(2.0*B) | 08120 |
| | CNST9 = 8.0*B*EN/(PI*A) | 08130 |
| | CNST10 = 4.0*B*B/((EN**4)*(PI**3)) | 08140 |
| 95 | ASPECT = B*B/(A*A) | 08150 |
| | III = II | 08160 |
| | IF (BETAN .LT. 88.0) GO TO 73 | 08170 |
| | MOMENT (II,III) = 1.0/EN | 08180 |
| | RHS (II) = -CNST10 | 08190 |
| | GO TO 75 | 08200 |
| 73 | 0 MOMENT(II,III) = (TANH(BETAN)*BETAN/ | 08210 |
| | 1 COSH(BETAN)/COSH(BETAN)) /EN | 08220 |
| | RHS(II) = CNST10*(BETAN/ COSH(BETAN)/COSH(BETAN) -TANH(BETAN)) | 08230 |
| 75 | EM = -1.0 | 08240 |
| | DO 80 JJ=1,IULIM | 08250 |
| | EM = EM + 2.0 | 08260 |
| | 0 MOMENT(II,JJ) = CNST9*(1.0/((EM**3)*(EN*EN/(EM*EM)+ASPECT) | 08270 |
| | 1 *(EN*EN/(EM*EM)+ASPECT))) | 08280 |
| | 80 CONTINUE | 08290 |
| | MN = ILIM | 08300 |
| | NM = 1 | 08310 |
| | CALL SEQ5 (MOMENT,RHS,MN,NM) | 08320 |
| | C | 08330 |
| | C===== THIS SECTION GENERATES DEFORMATIONS FOR HINGED EDGES | 08340 |
| | C | 08350 |
| | 100 I = I + 1 | 08360 |

| | | |
|-----|---|-------|
| 105 | J = J+1 | 08370 |
| | K = K+1 | 08380 |
| | K1 = I | 08390 |
| | K2 = J | 08400 |
| | CALL PACWRD (K1,K2,1) | 08410 |
| | JPN(K) = K1 | 08420 |
| | W(I,J) = 0.0 | 08430 |
| | IF(NPAN.EQ.2) DWX(I,J)=W(I,J) | 08440 |
| | EM = -1.0 | 08450 |
| 110 | EM = EM + 2.0 | 08460 |
| | EJ=I-1 | 08470 |
| | DWY=DEL*EJ | 08480 |
| | CNSTA = EM*PI/A | 08490 |
| | ALPHAM = CNSTA*B/2.0 | 08500 |
| | MMM = EM | 08510 |
| | CNST11 = -1.0 | 08520 |
| | IF (((MMM-1)/2-((MMM-1)/4)*2) .EQ. 0) CNST11=1.0 | 08530 |
| | CNST11 = CNST11/(EM**5) | 08540 |
| | CNST12 = EM*CNST11 | 08550 |
| | CNST13 = COSH(ALPHAM) | 08560 |
| | CNST14 = (2.0+ALPHAM*TANH(ALPHAM))/(2.0*CNST13) | 08570 |
| 0 | WSIM = CNST1*CNST11*(1.0-CNST14*COSH(CNSTA*DWY) | 08580 |
| 1 | +CNSTA*DWY *SINH(CNSTA*DWY)/(2.0*CNST13))* | 08590 |
| 2 | COS(CNSTA*X(I,J)) | 08600 |
| | IF (IBC .EQ. 2) GO TO 200 | 08610 |
| | W(I,J) = W(I,J) + WSIM | 08620 |
| 96 | IF(NPAN.EQ.2) DWX(I,J)=W(I,J) | 08630 |
| | IF (EM .LE. TERMS) GO TO 110 | 08640 |
| | X(I,J+1) = X(I,J) + DEL | 08650 |
| 2 | IF (X(I,J+1) .LE. (A/2.0)) GO TO 105 | 08660 |
| | X(I,J+1) = 0.0 | 08670 |
| | J = 0 | 08680 |
| | X(I+1,J+1) = 0.0 | 08690 |
| | EJ=I | 08700 |
| | DWY=EJ*DEL | 08710 |
| | IF (DWY .LE. (B/2.0)) GO TO 100 | 08720 |
| | GO TO 300 | 08730 |
| | C | 08740 |
| | C==== THIS SECTION GENERATES DEFORMATIONS FOR CLAMPED EDGES | 08750 |
| | C | 08760 |
| | C | 08770 |
| 200 | CNSTB = EM*PI/B | 08780 |
| | BETAM = CNSTB*A/2.0 | 08790 |
| | MMM = EM | 08800 |
| | CNST15 = -1.0 | 08810 |
| | IF (((MMM-1)/2-((MMM-1)/4)*2) .EQ. 0) CNST15=1.0 | 08820 |
| | CNST15 = CNST15/(EM*EM) | 08830 |

| | | |
|----|--|-------|
| | CNST16 = EM*CNST15 | 08840 |
| | CNST17 = COSH(BETAM) | 08850 |
| | CNST18 = ALPHAM*TANH(ALPHAM)/CNST13 | 08860 |
| | CNST19 = BETAM*TANH(BETAM)/CNST17 | 08870 |
| | EMM = EM/2.0 + 0.5 | 08880 |
| | M = EMM | 08890 |
| | EJ=I-1 | 08900 |
| | DWY=EJ*DEL | 08910 |
| | 0 WMOE = -CNST3*CNST15*EANDF(M)*(CNSTA*DWY *SINH(CNSTA*DWY)/ | 08920 |
| | 1 CNST13 -CNST18*COSH(CNSTA*DWY))*COS(CNSTA*X(I,J)) | 08930 |
| | EEE = IULIM | 08940 |
| | EMM = EM/2.0 + EEE + 0.5 | 08950 |
| | M = EMM | 08960 |
| | 0 WMOF = -CNST5*CNST15*EANDF(M)*(CNSTB*X(I,J)*SINH(CNSTB*X(I,J)))/ | 08970 |
| | 1 CNST17 -CNST19*COSH(CNSTB*X(I,J)))*COS(CNSTB*DWY) | 08980 |
| | W(I,J) = W(I,J) + WSIM + WMOE + WMOF | 08990 |
| | IF(NPAN.EQ.2) DWX(I,J)=W(I,J) | 09000 |
| | IF (EM .LE. TERMS) GO TO 110 | 09010 |
| | X(I,J+1) = X(I,J) + DEL | 09020 |
| | IF (X(I,J+1) .LE. (A/2.0)) GO TO 105 | 09030 |
| | X(I,J+1) = 0.0 | 09040 |
| | J = 0 | 09050 |
| | X(I+1,J+1) = 0.0 | 09060 |
| | EJ=I | 09070 |
| | DWY=DEL*EJ | 09080 |
| | IF (DWY .LE. (B/2.0)) GO TO 100 | 09090 |
| 97 | 300 NGP = K | 09100 |
| | 800 RETURN | 09110 |
| | END | 09120 |
| | \$IBFTC MS23D4 | 09130 |
| | CSEQS | 09140 |
| | C | 09150 |
| | SUBROUTINE SEQS (A,B,N,M) | 09160 |
| | C | 09170 |
| | C MATRIX INVERSION WITH ACCOMPANYING SOLUTION OF LINEAR EQUATIONS | 09180 |
| | C | 09190 |
| | C | 09200 |
| | COMMON DUM | 09210 |
| | 0 EQUIVALENCE (DUM(1),CON),(DUM(501),X),(DUM(1001),Y) | 09220 |
| | 1,(DUM(1501),W),(DUM(2001),DWX),(DUM(2501),DWY),(DUM(3001),JPN) | 09230 |
| | 2,(DUM(3501),RTV) | 09240 |
| | DOUBLE PRECISION A,B,AMAX,PIVOT,SWAP,T | 09250 |
| | DIMENSION IPIVOT(32),A(32,32), INDEX(32,2),PIVOT(32),B(32,2) | 09260 |
| | EQUIVALENCE (IROW,JROW),(AMAX,T,SWAP),(ICOLUJ,JCOLUJ) | 09270 |
| | C | 09280 |
| | C | 09290 |
| | C====INITIALIZATION | 09300 |

| | | | |
|----|---|--|-------|
| | C | | 09310 |
| | | 10 DETERM=1.0 | 09320 |
| | | 15 DO 20 J=1,N | 09330 |
| | | 20 IPIVOT(J)=0 | 09340 |
| | | 30 DO 550 I=1,N | 09350 |
| | C | | 09360 |
| | | C====SEARCH FOR PIVOT ELEMENT | 09370 |
| | C | | 09380 |
| | | 40 AMAX=0.0 | 09390 |
| | | 45 DO 105 J=1,N | 09400 |
| | | 50 IF (IPIVOT(J)-1) 60, 105, 60 | 09410 |
| | | 60 DO 100 K=1,N | 09420 |
| | | 70 IF (IPIVOT(K)-1) 80, 100, 740 | 09430 |
| | | 80 IF(DABS(AMAX)-DABS(A(J,K)))85,100,100 | 09440 |
| | | 85 IROW=J | 09450 |
| | | 90 ICOLUM=K | 09460 |
| | | 95 AMAX=A(J,K) | 09470 |
| | | 100 CONTINUE | 09480 |
| | | 105 CONTINUE | 09490 |
| | | IF (AMAX) 128,107,128 | 09500 |
| | | 107 PRINT 108 | 09510 |
| | | 108 FORMAT (22H MATRIX IS SINGULAR.) | 09520 |
| | | NCE = 1 | 09530 |
| | | GO TO 740 | 09540 |
| | | 128 IPIVOT(ICOLUM) =IPIVOT(ICOLUM)+1 | 09550 |
| 86 | C | | 09560 |
| | | C====INTERCHANGE ROWS TO PUT PIVOT ELEMENT ON DIAGONAL | 09570 |
| | C | | 09580 |
| | | 130 IF (IROW-ICOLUM) 140, 260, 140 | 09590 |
| | | 140 DETERM=-DETERM | 09600 |
| | | 150 DO 200 L=1,N | 09610 |
| | | 160 SWAP=A(IROW,L) | 09620 |
| | | 170 A(IROW,L)=A(ICOLUM,L) | 09630 |
| | | 200 A(ICOLUM,L)=SWAP | 09640 |
| | | 205 IF(M) 260, 260, 210 | 09650 |
| | | 210 DO 250 L=1, M | 09660 |
| | | 220 SWAP=B(IROW,L) | 09670 |
| | | 230 B(IROW,L)=B(ICOLUM ,L) | 09680 |
| | | 250 B(ICOLUM,L)=SWAP | 09690 |
| | | 260 INDEX(I,1)=IROW | 09700 |
| | | 270 INDEX(I,2)=ICOLUM | 09710 |
| | | 310 PIVOT(I)=A(ICOLUM,ICOLUM) | 09720 |
| | | 320 CONTINUE | 09730 |
| | C | | 09740 |
| | | C====DIVIDE PIVOT ROW BY PIVOT ELEMEN. | 09750 |
| | C | | 09760 |
| | | 330 A(ICOLUM,ICOLUM)=10.0D-1 | 09770 |

| | | |
|----|---|-------|
| | 340 DO 350 L=1,N | 09780 |
| | 350 A(ICOLUM,L)=A(ICOLUM,L)/PIVOT(I) | 09790 |
| | 355 IF(M) 380, 380, 360 | 09800 |
| | 360 DO 370 L=1,M | 09810 |
| | 370 B(ICOLUM,L)=B(ICOLUM,L)/PIVOT(I) | 09820 |
| C | | 09830 |
| C | C=====REDUCE NON-PIVOT ROWS | 09840 |
| C | | 09850 |
| | 380 DO 550 L1=1,N | 09860 |
| | 390 IF(L1-ICOLUM) 400, 550, 400 | 09870 |
| | 400 T=A(L1,ICOLUM) | 09880 |
| | 420 A(L1,ICOLUM)=0.0 | 09890 |
| | 430 DO 450 L=1,N | 09900 |
| | 450 A(L1,L)=A(L1,L)-A(ICOLUM,L)*T | 09910 |
| | 455 IF(M) 550, 550, 460 | 09920 |
| | 460 DO 500 L=1,M | 09930 |
| | 500 B(L1,L)=B(L1,L)-B(ICOLUM,L)*T | 09940 |
| | 550 CONTINUE | 09950 |
| C | | 09960 |
| C | C=====INTERCHANGE COLUMNS | 09970 |
| C | | 09980 |
| | 600 DO 710 I=1,N | 09990 |
| | 610 L=N+1-I | 10000 |
| | 620 IF (INDEX(L,1)-INDEX(L,2)) 630, 710, 630 | 10010 |
| | 630 JROW= INDEX(L,1) | 10020 |
| | 640 JCOLUM=INDEX(L,2) | 10030 |
| 66 | 650 DO 705 K=1,N | 10040 |
| | 660 SWAP=A(K,JROW) | 10050 |
| | 670 A(K,JROW)=A(K,JCOLUM) | 10060 |
| | 700 A(K,JCOLUM)=SWAP | 10070 |
| | 705 CONTINUE | 10080 |
| | 710 CONTINUE | 10090 |
| | 740 RETURN | 10100 |
| | END | 10110 |
| | \$IBFTC MS23D5 | 10120 |
| | CTRPZOD | 10130 |
| | SUBROUTINE TRPZOD | 10140 |
| C | THIS SUBROUTINE READS IN THE TRAPEZOIDAL DEFORMATION DATA FROM | 10150 |
| C | PUNCHED CARDS. THE CODES ARE BROKEN DOWN AND REASSEMBLED IN THE | 10160 |
| C | FORMAT NECESSARY FOR THE RAY TRACE PROGRAMS. | 10170 |
| C | | 10180 |
| C | DWX = SLOPE IN X DIR. AT POINT LOC | 10190 |
| C | DWY = SLOPE IN Y DIR. AT POINT LOC | 10200 |
| C | ELM = ELEMENT VALVE AT LOC | 10210 |
| C | IBY = =1 INDICATES POINT IS OUTSIDE PLANFORM BOUNDARY | 10220 |
| C | ICOL = COLUMN NUMBER | 10230 |
| C | IDIR = DEGREE OF FREEDOM 1=X, 2=Y, 3=Z, 4=TX, 5= TY, 6=TZ | 10240 |

| | | | |
|---|--------|--|-------|
| C | ILD | = LOAD NUMBER OUTPUT BY SAMIS (COLUMN CODE) | 10250 |
| C | IROW | = ROW NUMBER | 10260 |
| C | ITEM | = TEMPORARY | 10270 |
| C | JLD | = LOAD NUMBER DESIRED. THE LOAD NUMBER IS A PART OF THE | 10280 |
| C | | ELEMENT CODE GENERATED BY SAMIS. | 10290 |
| C | LOC | = COORDINATE LOCATION CODE | 10300 |
| C | M | = GRIDPOINT COUNTER | 10310 |
| C | NCRD | = NO. OF ELEMENT DATA CARDS TO BE READ IN. | 10320 |
| C | NGP | = NUMBER OF GRIDPOINTS | 10330 |
| C | SCLFAC | = SCALE FACTOR TO MULTIPLY DEFLECTIONS BY | 10340 |
| C | W | = DEFLECTION AT POINT LOC | 10350 |
| C | X | = X COORDINATE ARRAY | 10360 |
| C | XS | = X COORDINATE AT POINT LOC | 10370 |
| C | YS | = Y COORDINATE AT POINT LOC | 10380 |
| C | | | 10390 |
| C | | COMMON DUM | 10400 |
| C | | | 10410 |
| | 0 | EQUIVALENCE (DUM(1), CON), (DUM(501), X), | 10420 |
| | 1 | (DUM(1501), W), (DUM(2251), DWX), | 10430 |
| | 2 | (DUM(3001), JPN), (DUM(3501), RTV) | 10440 |
| C | | | 10450 |
| | 0 | EQUIVALENCE (CON(1), DIMA), (CON(2), DIMB), | 10460 |
| | 1 | (CON(3), DIMC), (CON(4), DEL), (CON(5), GNU), | 10470 |
| | 2 | (CON(6), THIC), (CON(7), SPAD), (CON(8), PRSS), | 10480 |
| | 3 | (CON(9), NPAN), (CON(10), ISI), (CON(11), ISO), | 10490 |
| | 4 | (CON(12), IBC), (CON(13), NGP), (CON(14), LP7), | 10500 |
| | 5 | (CON(15), FR), (CON(16), LOCP), (CON(17), IPD), | 10510 |
| | 6 | (CON(18), IPR), (CON(19), CHAP), (CON(20), ISCR1), | 10520 |
| | 7 | (CON(21), ISCR2), (CON(22), SKAL), (CON(23), ISEC), | 10530 |
| | 8 | (CON(24), NPAG), (CON(25), YONG), (CON(26), ILGD), | 10540 |
| | 9 | (CON(27), IREL), (CON(28), LP5), (CON(29), CPRSS) | 10550 |
| C | | | 10560 |
| | 0 | EQUIVALENCE (CON(30), IRM), (CON(31), IPB), | 10570 |
| | 1 | (CON(53), SCAL), (CON(61), SPAC), (CON(69), PRES), | 10580 |
| | 2 | (CON(77), PLNA), (CON(85), RAYA), (CON(93), RI), | 10590 |
| | 3 | (CON(101), RES), (CON(315), STAT), (CON(371), OIF) | 10600 |
| | 4 | (OIF(1),IDX), (OIF(2),IDY), (OIF(3),X1), (OIF(4),Y1), (OIF(11),N2) | 10610 |
| C | | | 10620 |
| | 0 | DIMENSION CON(500), X(21,33), W(21,33), | 10630 |
| | 1 | DWX(21,33),JPN(500),OIF(4) | 10640 |
| C | | | 10650 |
| | | DIMENSION LOC(3), ILD(3), ELM(3) | 10660 |
| C | | | 10670 |
| | | READ (ISI,500) JLD, NCRD, SCLFAC,X1,Y1,IDX,IDY | 10680 |
| | 500 | FORMAT (2I5,3E10.0,2I5) | 10690 |
| | | WRITE (ISO,503) SCLFAC | 10700 |
| | 503 | FORMAT (1H1, 42HSCALE FACTOR FOR TRAPEZOID DEFLECTIONS IS | 10710 |

| | | | |
|--|-----|---|-------|
| | 1 | E16.4,1H.) | 10720 |
| | | WRITE (ISO,505) X1,Y1 | 10730 |
| | 505 | FORMAT (1H, 31HINTERPOLATION CENTER IS AT X1= E12.4, 6H, Y1= | 10740 |
| | 1 | E12.4,1H.) | 10750 |
| | | WRITE (ISO,507)IDX,IDY | 10760 |
| | 507 | FORMAT (1H, 35HCENTER OF INTERPOLATION SQUARES IS I5, | 10770 |
| | 1 | 17H X INTERVALS AND I5, 25H Y INTERVALS FROM ORIGIN.) | 10780 |
| | C | X1,Y1 = COORDINATES OF TRANSLATED ORIGIN | 10790 |
| | C | IDX= NO. OF INTERVALS IN X FOR INTERPOLATION CENTER | 10800 |
| | C | IDY= NO. OF INTERVALS IN Y FOR INTERPOLATION CENTER | 10810 |
| | C | IF JLD IS MINUS, CARD DATA FOR WINDOW IN ACTUAL CONFIGURATION IS GIVEN. | 10820 |
| | C | IF NCRD IS MINUS, CARD DATA IS GIVEN FOR ONLY 1 OF 2 PANES AND BOTH | 10830 |
| | C | ARE THE SAME. | 10840 |
| | | N1=1 | 10850 |
| | | N2=1 | 10860 |
| | | IF(NCRD)2,6,6 | 10870 |
| | 2 | N1=2 | 10880 |
| | | NCRD=-NCRD | 10890 |
| | 6 | IR=21 | 10900 |
| | | IC=33 | 10910 |
| | | IF(JLD) 10,15,15 | 10920 |
| | 10 | N2=2 | 10930 |
| | | JLD=-JLD | 10940 |
| | | IR=20 | 10950 |
| | | IC=20 | 10960 |
| | 15 | M=0 | 10970 |
| | | DO 104 I=1,NCRD | 10980 |
| | | READ (ISI,501) (LOC(J), ILD(J), ELM(J), J=1,3) | 10990 |
| | 501 | FORMAT (3(I6,I6,0I2)) | 11000 |
| | C | | 11010 |
| | C | ==== TEST TO SEE IF DATA IS ACCEPTABLE | 11020 |
| | | DO 104 J=1,3 | 11030 |
| | | IF (ILD(J) .NE. JLD) GO TO 104 | 11040 |
| | | IF (LOC(J) .LE. 0) GO TO 104 | 11050 |
| | | IROW = LOC(J)/1000 | 11060 |
| | | ITEM = LOC(J) - IROW*1000 | 11070 |
| | | ICOL = ITEM/10 | 11080 |
| | | IDIR = ITEM - ICOL*10 | 11090 |
| | | IF ((IDIR.EQ.1) .OR. (IDIR.EQ.2) .OR. (IDIR.EQ.6)) GO TO 104 | 11100 |
| | | IF((ICOL.GT.IC).OR.(IROW.GT.IR))GO TO 20 | 11110 |
| | | XS = ICOL - 1 | 11120 |
| | | YS = IROW - 1 | 11130 |
| | | GO TO 30 | 11140 |
| | 20 | XS=ICOL-1-IC | 11150 |
| | | YS=IROW-1-IR | 11160 |
| | 30 | IBY=0 | 11170 |
| | | XS=XS*DEL | 11180 |

| | | |
|-----|---|-------|
| | YS=YS*DEL | 11190 |
| | CALL BONDY (XS, YS, IBY) | 11200 |
| | IF (IBY .EQ. 1) GO TO 104 | 11210 |
| | K1 = IROW | 11220 |
| | K2 = ICOL | 11230 |
| | CALL PACWRD (K1,K2,1) | 11240 |
| | IF((IROW.LE.IR).AND.(ICOL.LE.IC))GO TO 32 | 11250 |
| | IF((IROW.GT.IR).AND.(ICOL.GT.IC))GO TO 40 | 11260 |
| | GO TO 104 | 11270 |
| 32 | K=IROW | 11280 |
| | L = ICOL | 11290 |
| | X(K,L) = ICOL - 1 | 11300 |
| | X(K,L)=X(K,L)*DEL | 11310 |
| | C | 11320 |
| | C===== STORE ACCEPTABLE DATA | 11330 |
| | IF((IDIR.EQ.3).AND.(N2.EQ.1)) W(K,L)=ELM(J)*SCLFAC | 11340 |
| | IF((IDIR.EQ.3).AND.(N2.EQ.2)) DWX(K,L)=ELM(J)*SCLFAC | 11350 |
| | IF (IDIR .EQ. 3) M = M+1 | 11360 |
| | IF (IDIR .EQ. 3) JPN(M) = K1 | 11370 |
| | GO TO (104,34),N1 | 11390 |
| 34 | DWX(K,L)=W(K,L) | 11400 |
| | GO TO 104 | 11410 |
| 40 | IF(NPAN-2)104,44,104 | 11420 |
| 44 | K=IROW-IR | 11430 |
| | L=ICOL-IC | 11440 |
| | IF((IDIR.EQ.3).AND.(N2.EQ.1)) DWX(K,L)=ELM(J)*SCLFAC | 11450 |
| | IF((IDIR.EQ.3).AND.(N2.EQ.2)) W(K,L)=ELM(J)*SCLFAC | 11460 |
| 104 | CONTINUE | 11470 |
| | NGP = M | 11480 |
| 800 | RETURN | 11490 |
| | END | 11500 |
| | \$IBFTC MS23D6 | 11510 |
| | CLRGDEF | 11520 |
| | SUBROUTINE LRGDEF | 11530 |
| | C | 11540 |
| | C THIS PROGRAM USES EQUATIONS DERIVED FROM AN ENERGY METHOD | 11550 |
| | C DEVELOPED IN TIMOSHENKOS THEORY OF PLATES AND SHELLS, P. 419 TO | 11560 |
| | C 424 TO FIND THE APPROXIMATE LARGE DEFLECTION SOLUTION FOR A | 11570 |
| | C RECTANGULAR PLATE. | 11580 |
| | C | 11590 |
| | C A = HALF RECTANGLE LENGTH | 11600 |
| | C A1 = CONSTANTS IN CUBIC EQUATION | 11610 |
| | C B = HALF RECTANGLE WIDTH | 11620 |
| | C CI = CONSTANTS IN CUBIC EQUATION | 11630 |
| | C CON1 = CONSTANTS IN LARGE DEFLECTION EQUATION | 11640 |
| | C CON2 = CONSTANTS IN LARGE DEFLECTION EQUATION | 11650 |
| | C CON3 = CONSTANTS IN LARGE DEFLECTION EQUATION | 11660 |

| | | | | |
|---|--|-------------------|---|-------|
| C | CON4 | = | CONSTANTS IN LARGE DEFLECTION EQUATION | 11670 |
| C | CON5 | = | CONSTANTS IN LARGE DEFLECTION EQUATION | 11680 |
| C | D1 | = | CONSTANTS IN CUBIC EQUATION | 11690 |
| C | DUX | = | LARGE DEFLECTION THEORY DEFLECTION FOR FIRST PANE | 11700 |
| C | Q | = | CONSTANTS IN SOLUTION OF CUBIC EQUATION | 11710 |
| C | QR | = | CONSTANTS IN SOLUTION OF CUBIC EQUATION | 11720 |
| C | R | = | CONSTANTS IN SOLUTION OF CUBIC EQUATION | 11730 |
| C | S1 | = | CONSTANTS IN SOLUTION OF CUBIC EQUATION | 11740 |
| C | S2 | = | CONSTANTS IN SOLUTION OF CUBIC EQUATION | 11750 |
| C | SQR | = | CONSTANTS IN SOLUTION OF CUBIC EQUATION | 11760 |
| C | TM | = | CONSTANTS IN SOLUTION OF CUBIC EQUATION | 11770 |
| C | TP | = | CONSTANTS IN SOLUTION OF CUBIC EQUATION | 11780 |
| C | U | = | LARGE DEFLECTION THEORY DEFLECTION FOR SECOND PANE | 11790 |
| C | WO | = | CONSTANTS IN SOLUTION OF CUBIC EQUATION | 11800 |
| C | | | | 11810 |
| | | | DOUBLE PRECISION PI,CON1,CON2,CON3,CON4,CON5,A1,C1,Q,R,QR,SQR,TP, | 11820 |
| 1 | S1,TM,S2,WO,Q1,Q2,QC | | | 11830 |
| C | | | | 11840 |
| | | | COMMON DUM | 11850 |
| C | | | | 11860 |
| 0 | EQUIVALENCE | (DUM(1), CON), | (DUM(501), X), | 11870 |
| 1 | | (DUM(1501), W), | (DUM(2001), DWX), | 11880 |
| 2 | | (DUM(3001), JPN), | (DUM(3501), RTV), | 11890 |
| 3 | (DUM(4001), U), | (DUM(4751), DUX), | (DUM(5501), R), | 11900 |
| 4 | (DUM(6001), S), | (DUM(6501), T), | (DUM(7251), DTX) | 11910 |
| C | | | | 11920 |
| 0 | EQUIVALENCE | (CON(1), DIMA), | (CON(2), DIMB), | 11930 |
| 1 | (CON(3), DIMC), | (CON(4), DEL), | (CON(5), GNU), | 11940 |
| 2 | (CON(6), THIC), | (CON(7), SPAD), | (CON(8), PRSS), | 11950 |
| 3 | (CON(9), NPAN), | (CON(10), ISI), | (CON(11), ISO), | 11960 |
| 4 | (CON(12), IBC), | (CON(13), NGP), | (CON(14), LP7), | 11970 |
| 5 | (CON(15), FR), | (CON(16), LOCP), | (CON(17), IPD), | 11980 |
| 6 | (CON(18), IPR), | (CON(19), CHAP), | (CON(20), ISCR1), | 11990 |
| 7 | (CON(21), ISCR2), | (CON(22), SKAL), | (CON(23), ISEC), | 12000 |
| 8 | (CON(24), NPAG), | (CON(25), YONG), | (CON(26), ILGD), | 12010 |
| 9 | (CON(27), IREL), | (CON(28), LP5), | (CON(29), CPRSS) | 12020 |
| C | | | | 12030 |
| 0 | EQUIVALENCE | (CON(30), IRM), | (CON(31), IPB), | 12040 |
| 1 | (CON(32), MIBP), | (CON(33), IWD), | (CON(34), IDS), | 12050 |
| 2 | (CON(53), SCAL), | (CON(61), SPAC), | (CON(69), PRES), | 12060 |
| 3 | (CON(77), PLNA), | (CON(85), RAYA), | (CON(93), RI), | 12070 |
| 4 | (CON(101), RES), | (CON(315), STAT), | (CON(371), OIF), | 12080 |
| 5 | (CON(401),EANDF), | (CON(451), RHS) | | 12090 |
| C | | | | 12100 |
| | | | EQUIVALENCE (RTV,BI),(OIF(1),NDX),(OIF(2),NDY),(X1,OIF(3)), | 12110 |
| 1 | (Y1,OIF(4)),(OIF(5),CONST1),(OIF(6),CONST2),(OIF(7),CONST3), | | | 12120 |
| 2 | (OIF(8),CONST4),(OIF(9),CONST5),(OIF(10),CONST6) | | | 12130 |

104

| | | | |
|--|-----|---|-------|
| | C | | 12140 |
| | | 0 DIMENSION CON(500), X(21,33), W(21,33), DWX(21,33), | 12150 |
| | | 1 JPN(500),RTV(500),OIF(10), U(21,33), DUX(21,33) | 12160 |
| | C | | 12170 |
| | | IF (CHAP.NE.2.) GO TO 900 | 12180 |
| | | NTIMES=0 | 12190 |
| | | III=1 | 12200 |
| | | IF(NPAN.EQ.2) III=2 | 12210 |
| | 100 | DO 700 II=1,III | 12220 |
| | | II=II | 12230 |
| | | NTIMES=NTIMES+1 | 12240 |
| | | PRSSS=PRSS | 12250 |
| | | IF (NTIMES.EQ.2) PRSSS=-(PRSS-CPRSS) | 12260 |
| | | DO 102 I=1,21 | 12270 |
| | | DO 102 J=1,33 | 12280 |
| | 102 | U(I,J)=W(I,J)*PRSSS | 12290 |
| | | PI = 3.14159265358979323846 | 12300 |
| | | A = DIMA/2.0 | 12310 |
| | | B = DIMB/2.0 | 12320 |
| | C | CONSTANTS IN LARGE DEFLECTION EQUATION. | 12330 |
| | | CON1 = 480.0*A*B/(YONG*THIC*PI**4) | 12340 |
| | | CON2 = (PI**2/16.0)*(9.0*B/(A**3) + 2.0/(A*B) + 9.0*A/(B**3)) | 12350 |
| | 0 | CON3 = (PI**2/3.0)*(16.0*B/(A**2) + 1.0/A + 1.0/B + 16.0*A/ | 12360 |
| | 1 | (B**2))**2 | 12370 |
| | | CON4 = (35.0*(PI**2)*B/A + 35.0*(PI**2)*A/B + 640.0/9.0) | 12380 |
| | | CON5 = CON1/(CON2 - (2.0/3.0)*(CON3/CON4)) | 12390 |
| | C | CONSTANTS IN CUBIC EQUATION | 12400 |
| | | A1 = 1.0/CON5 | 12410 |
| | | C1= PRSSS/(U(1,1) *3.) | 12420 |
| | | D1 = -PRSSS | 12430 |
| | C | SOLUTION OF CUBIC EQUATION. | 12440 |
| | | Q = A1*C1 | 12450 |
| | | R = -0.5*(A1**2)*D1 | 12460 |
| | | INEG = 0 | 12470 |
| | | QR = Q**3 + R**2 | 12480 |
| | | SQR = DSQRT(QR) | 12490 |
| | | TP = R + SQR | 12500 |
| | | IF (TP .GT. 0.0) GO TO 106 | 12510 |
| | | INEG = 1 | 12520 |
| | 106 | S1 = ABS(TP)**(1.0/3.0) | 12530 |
| | | IF (INEG .NE. 1) GO TO 108 | 12540 |
| | | S1 = -S1 | 12550 |
| | | INEG = 0 | 12560 |
| | 108 | TM = R - SQR | 12570 |
| | | IF (TM .GT. 0.0) GO TO 110 | 12580 |
| | | INEG = 1 | 12590 |
| | 110 | S2 = ABS(TM)**(1.0/3.0) | 12600 |

| | | |
|---------|--|-------|
| | IF (INEG .NE. 1) GO TO 112 | 12610 |
| | S2 = -S2 | 12620 |
| 112 | INEG = 0 | 12630 |
| | WO = (S1 + S2)/A1 | 12640 |
| C | DETERMINATION OF SMALL DEFLECTION THEORY AND LARGE DEFLECTION | 12650 |
| C | THEORY PRESSURES. | 12660 |
| | Q2 = (WO**3)/CON5 | 12670 |
| | Q1 = PRSSS- Q2 | 12680 |
| C | THIS SECTION DETERMINES THE DEFLECTION AND SLOPES. | 12690 |
| 116 | IF(NTIMES.EQ.1) GO TO 103 | 12700 |
| | CONST4=Q1 | 12710 |
| | CONST5=PRSSS | 12720 |
| | CONST6=WO | 12730 |
| | GO TO 105 | 12740 |
| 103 | CONST1=Q1 | 12750 |
| | CONST2=PRSSS | 12760 |
| | CONST3=WO | 12770 |
| 105 | DO 104 I=1,NGP | 12780 |
| | K1 = JPN(I) | 12790 |
| | CALL PACWRD (K1,K2,2) | 12800 |
| | CX = PI*X(K1,K2)/(2.0*A) | 12810 |
| | EJ=K1-1 | 12820 |
| | YY=DEL*EJ | 12830 |
| | CY=PI*YY/(2.0*B) | 12840 |
| | TE1 = U(K1,K2)*(ABS(Q1/PRSSS)) | 12850 |
| | TE2 = WO*COS(CX)*COS(CY) | 12860 |
| 104 | U(K1,K2) = (TE1 + TE2)/2.0 | 12870 |
| | IF(NTIMES.EQ.2) GO TO 700 | 12880 |
| | DO 120 I=1,21 | 12890 |
| | DO 120 J=1,33 | 12900 |
| 120 | DUX(I,J)=U(I,J) | 12910 |
| 700 | CONTINUE | 12920 |
| 800 | RETURN | 12930 |
| 900 | WRITE(ISO,500) | 12940 |
| 500 | FORMAT('IHI,99HINPUT ERROR. LARGE DEFLECTION REQUIRED FOR PLANFORM 1OTHER THAN RECTANGLE.') | 12950 |
| | STOP | 12970 |
| | END | 12980 |
| \$IBFTC | MS23D7 | 12990 |
| C | DEFRES | 13000 |
| | SUBROUTINE DEFRES (IDI, NOPRT) | 13010 |
| C | | 13020 |
| C | THIS SUBROUTINE PRINTS OUT THE PLATE DEFLECTION DATA. | 13030 |
| C | | 13040 |
| C | CONC = BOUNDARY CONDITION | 13050 |
| C | DTX = TEMPORARY ARRAY FOR SLOPE IN X DIR. | 13060 |
| C | DTY = TEMPORARY ARRAY FOR SLOPE IN Y DIR. | 13070 |

| | | | |
|---|------|---|-------|
| C | R | = TEMPORARY ARRAY FOR X COORDINATES | 13080 |
| C | S | = TEMPORARY ARRAY FOR Y COORDINATES | 13090 |
| C | T | = TEMPORARY ARRAY FOR DEFLECTION | 13100 |
| C | | | 13110 |
| | | COMMON DUM | 13120 |
| C | | | 13130 |
| | 0 | EQUIVALENCE (DUM(1), CON), (DUM(501), X), | 13140 |
| | 1 | (DUM(1501), W), (DUM(2251), DWX), | 13150 |
| | 2 | (DUM(3001), JPN), (DUM(3501), RTV), | 13160 |
| | 3 | (DUM(4001), U), (DUM(4751), DUX), | 13170 |
| | 4 | (DUM(5501), R), (DUM(6001), S), | 13180 |
| | 5 | (DUM(6501), T), (DUM(7251), DTX) | 13190 |
| C | | | 13200 |
| | 0 | EQUIVALENCE (CON(1), DIMA), (CON(2), DIMB), | 13210 |
| | 1 | (CON(3), DIMC), (CON(4), DEL), (CON(5), GNU), | 13220 |
| | 2 | (CON(6), THIC), (CON(7), SPAD), (CON(8), PRSS), | 13230 |
| | 3 | (CON(9), NPAN), (CON(10), ISI), (CON(11), ISO), | 13240 |
| | 4 | (CON(12), IBC), (CON(13), NGP), (CON(14), LP7), | 13250 |
| | 5 | (CON(15), FR), (CON(16), LOCP), (CON(17), IPD), | 13260 |
| | 6 | (CON(18), IPR), (CON(19), CHAP), (CON(20), ISCRI), | 13270 |
| | 7 | (CON(21), ISCR2), (CON(22), SKAL), (CON(23), ISEC), | 13280 |
| | 8 | (CON(24), NPAG), (CON(25), YONG), (CON(26), ILRG), | 13290 |
| | 9 | (CON(27), IREL), (CON(28), LP5), (CON(29), CPRSS) | 13300 |
| C | | | 13310 |
| | 0 | EQUIVALENCE (CON(30), IRM), (CON(31), IPB), | 13320 |
| | 1 | (CON(53), SCAL), (CON(61), SPAC), (CON(69), PRES), | 13330 |
| | 2 | (CON(77), PLNA), (CON(85), RAYA), (CON(93), RI), | 13340 |
| | 3 | (CON(101), RES), (CON(315), STAT), (CON(371), OIF), | 13350 |
| | 4 | (CON(401), EANDF), (CON(451), RHS) | 13360 |
| C | | | 13370 |
| | 0 | DIMENSION CON(500), X(21,33), W(21,33), | 13380 |
| | 2 | R(500), S(500), T(750), DTX(750) | 13390 |
| | 3 | , U(21,33), DUX(21,33) | 13400 |
| | 3 | , DWX(21,33), JPN(500) | 13410 |
| C | | | 13420 |
| | 0 | DIMENSION RT30(3), RT31(3), RT32(3), RT36(2), RT37(2), RT38(2), | 13430 |
| | 1 | RT39(2) | 13440 |
| C | | | 13450 |
| | 0 | DATA RT30(1)/13HELLIPSE A=/, RT31(1)/13HRECTANGLE A=/, | 13460 |
| | 1 | RT32(1)/13HTRAPEZOID A=/, RT33/4H B=/, RT34/4H C=/, | 13470 |
| | 2 | RT35/6HSCALE=/, RT36(1)/10HTHICKNESS=/, | 13480 |
| | 3 | RT37(1)/9H PANES=/, RT38(1)/11H SPACING=/, | 13490 |
| | 4 | RT39(1)/12H PRESSURE=/ | 13500 |
| | | DATA HING/6HHINGED7, CH/1H7, CLMP/6HCLAMPE7, CC/1HD7 | 13510 |
| C | | | 13520 |
| C | ==== | THIS SECTION MULTIPLIES THE UNITIZED DEFORMATIONS BY THE PRESSURE | 13530 |
| C | | LOAD. | 13540 |

| | | | |
|--|--------|--|-------|
| | | | 13550 |
| | | IS7 = ISO' | 13560 |
| | | IF (NOPRT .EQ. 0) IS7 = ISCR1 | 13570 |
| | | DO 101 I=1,NGP | 13580 |
| | | K1 = JPN(I) | 13590 |
| | | CALL PACWRD (K1,K2,2) | 13600 |
| | | EJ=K1-1 | 13610 |
| | | R(I) = X(K1,K2) | 13620 |
| | | S(I)=DEL*EJ | 13630 |
| | | IF(ILRG.EQ.1) GO TO 100 | 13640 |
| | | IF(CHAP.EQ.3.) GO TO 99 | 13650 |
| | | T(I) = W(K1,K2)*(CPRSS-PRSS) | 13660 |
| | | DTX(I)=DWX(K1,K2)*PRSS | 13670 |
| | | GO TO 101 | 13680 |
| | 99 | T(I)=W(K1,K2) | 13690 |
| | | DTX(I)=DWX(K1,K2) | 13700 |
| | | GO TO 101 | 13710 |
| | 100 | T(I)=U(K1,K2) | 13720 |
| | | DTX(I)=DUX(K1,K2) | 13730 |
| | | IF(NPAN.EQ.1) DTX(I)=0. | 13740 |
| | 101 | CONTINUE | 13750 |
| | C | | 13760 |
| | C===== | THIS SECTION PRINTS THE TITLE AND HEADING INFORMATION. | 13770 |
| | C | | 13780 |
| | | CALL PAGE (IPD, LINE, IS7, IDT) | 13790 |
| | | IF (ILRG .EQ. 0) GO TO 607 | 13800 |
| | | WRITE (IS7,529) | 13810 |
| | 529 0 | FORMAT (1H0, 38X,38HW I N D O W D E F O R M A T I O N , | 13820 |
| | 1 | 7HD A T A/1H ,49X,23H(LARGE DEFLECTION DATA)/1H) | 13830 |
| | | GO TO 608 | 13840 |
| | 607 | WRITE (IS7,500) | 13850 |
| | 500 0 | FORMAT (1H0/1H ,38X,38HW I N D O W D E F O R M A T I O N , | 13860 |
| | 1 | 7HD A T A/1H) | 13870 |
| | 608 | ICHAP = CHAP | 13880 |
| | | IF (IBC .NE. 1) GO TO 302 | 13890 |
| | | CONC = HING | 13900 |
| | | CF = CH | 13910 |
| | 302 | IF (IBC .NE. 2) GO TO 303 | 13920 |
| | | CONC = CLMP | 13930 |
| | | CF = CC | 13940 |
| | 303 | GO TO (102,103,104), ICHAP | 13950 |
| | 102 0 | WRITE (IS7,501) (RT30(I),I=1,3), DIMA, RT33, DIMB, | 13960 |
| | 1 | RT35, SKAL, (RT36(I),I=1,2), THIC, (RT37(I),I=1,2), NPAN, | 13970 |
| | 2 | (RT38(I),I=1,2), SPAD, (RT39(I),I=1,2), PRSS, CONC, CF | 13980 |
| | 501 0 | FORMAT (1H0,2A6,A1,F5.2,A4,F5.2,14X,A6,F4.2,3X,A6,A4,F5.2,A6,A3, | 13990 |
| | 1 | I1,A6,A5,F3.1,2A6,F5.1,3X,A6,A1) | 14000 |
| | | GO TO 105 | 14010 |

| | | | |
|-----|---|---|-------|
| 103 | 0 | WRITE (IS7,501) (RT31(I),I=1,3), DIMA, RT33, DIMB, | 14020 |
| | 1 | RT35, SKAL, (RT36(I),I=1,2), THIC, (RT37(I),I=1,2), NPAN, | 14030 |
| | 2 | (RT38(I),I=1,2), SPAD, (RT39(I),I=1,2), PRSS, CONC, CF | 14040 |
| | | GO TO 105 | 14050 |
| 104 | 0 | WRITE (IS7,518) (RT32(I),I=1,3), DIMA, RT33, DIMB, RT34, DIMC, | 14060 |
| | 1 | RT35, SKAL, (RT36(I),I=1,2), THIC, (RT37(I),I=1,2), NPAN, | 14070 |
| | 2 | (RT38(I),I=1,2), SPAD, (RT39(I),I=1,2), PRSS, CONC, CF | 14080 |
| 518 | 0 | FORMAT (1H0,2A6,A1,F5.2,A4,F5.2,A4,F5.2,5X,A6,F4.2,3X,A6,A4,F5.2, | 14090 |
| | 1 | A6,A3,I1,A6,A5,F3.1,2A6,F5.1,3X,A6,A1) | 14100 |
| 105 | | WRITE (IS7,505) | 14110 |
| 505 | 0 | FORMAT (1H0/1H ,1X,11HCOORDINATES,18X,12HDEFORMATIONS,14X, | 14120 |
| | 1 | 11HCOORDINATES,18X,12HDEFORMATIONS/1H0, | 14130 |
| | 2 | 44H X Y DEFL. PANE 1 DEFL. PANE 2 ,11X, | 14140 |
| | 3 | 44H X Y DEFL. PANE 1 DEFL. PANE 2) | 14150 |
| | | LINE = LINE + 11 | 14160 |
| | | JRM = NGP-2*(NGP/2) | 14170 |
| | | DO 114 K=1,NGP,2 | 14180 |
| | | IF (LINE - 45) 112,107,107 | 14190 |
| 107 | | CALL PAGE (IPD, LINE, IS7, IDT) | 14200 |
| | | WRITE (IS7,500) | 14210 |
| | | GO TO (108,109,110), ICHAP | 14220 |
| 108 | 0 | WRITE (IS7,501) (RT30(I),I=1,3), DIMA, RT33, DIMB, | 14230 |
| | 1 | RT35, SKAL, (RT36(I),I=1,2), THIC, (RT37(I),I=1,2), NPAN, | 14240 |
| | 2 | (RT38(I),I=1,2), SPAD, (RT39(I),I=1,2), PRSS, CONC, CF | 14250 |
| | | GO TO 111 | 14260 |
| 109 | 0 | WRITE (IS7,501) (RT31(I),I=1,3), DIMA, RT33, DIMB, | 14270 |
| | 1 | RT35, SKAL, (RT36(I),I=1,2), THIC, (RT37(I),I=1,2), NPAN, | 14280 |
| | 2 | (RT38(I),I=1,2), SPAD, (RT39(I),I=1,2), PRSS, CONC, CF | 14290 |
| | | GO TO 111 | 14300 |
| 110 | 0 | WRITE (IS7,518) (RT32(I),I=1,3), DIMA, RT33, DIMB, RT34, DIMC, | 14310 |
| | 1 | RT35, SKAL, (RT36(I),I=1,2), THIC, (RT37(I),I=1,2), NPAN, | 14320 |
| | 2 | (RT38(I),I=1,2), SPAD, (RT39(I),I=1,2), PRSS, CONC, CF | 14330 |
| 111 | | WRITE (IS7,505) | 14340 |
| | | LINE = LINE + 11 | 14350 |
| 112 | | IF ((JRM .EQ. 1) .AND. (K .EQ. NGP)) GO TO 113 | 14360 |
| | | J = K+1 | 14370 |
| | 0 | WRITE (IS7,506) R(K), S(K), T(K), DTX(K) | 14380 |
| | 1 | , R(J), S(J), T(J), DTX(J) | 14390 |
| 506 | 0 | FORMAT (1H ,F5.2,F7.2,2(2X,E13.6),13X | 14400 |
| | 1 | , F5.2,F7.2,2(2X,E13.6)) | 14410 |
| | | GO TO 114 | 14420 |
| 113 | | WRITE (IS7,506) R(K), S(K), T(K), DTX(K) | 14430 |
| 114 | | LINE = LINE + 1 | 14440 |
| 800 | | RETURN | 14450 |
| | | END | 14460 |
| | | \$IBFTC MS23D8 | 14470 |
| | | GRAYTRA | 14480 |

| | | | | |
|---|---|--------------------|-------------------------------------|-------|
| | SUBROUTINE RAYTRA (XQ, YQ, ZQ, PLANA, RAYAN) | | | 14490 |
| C | ALPHAI = PLANE ANGLE 0-360 DEG MEASURED CCW FROM X TO Y AXIS. | | | 14500 |
| C | DELTAN = RAY ANGLE 0-90 DEG MEASURER FROM +Z AXIS TO XY PLANE. | | | 14510 |
| C | | | | 14520 |
| C | PRSS = FIRST WINDOW PRESSURE FACTOR TO SCALE DEFORMATIONS | | | 14530 |
| C | PRSF = 2ND WINDOW PRESSURE FACTOR TO SCALE DEFORMATIONS | | | 14540 |
| C | RES(IJ+ 1) = X COORDINATE OF ENTERING RAY | | | 14550 |
| C | RES(IJ+ 11) = Y COORDINATE OF ENTERING RAY | | | 14560 |
| C | RES(IJ+ 21) = RAY ANGLE OF ENTERING RAY | | | 14570 |
| C | RES(IJ+ 31) = PLANE ANGLE OF ENTERING RAY | | | 14580 |
| C | RES(IJ+ 41) = Z COORDINATE OF EXITING RAY | | | 14590 |
| C | RES(IJ+ 51) = PLATE SLOPE ABOUT X-AXIS AT POINT OF ENTERING RAY | | | 14600 |
| C | RES(IJ+ 61) = PLATE SLOPE ABOUT Y-AXIS AT POINT OF ENTERING RAY | | | 14610 |
| C | RES(IJ+ 71) = X COORDINATE OF EXITING RAY | | | 14620 |
| C | RES(IJ+ 81) = Y COORDINATE OF EXITING RAY | | | 14630 |
| C | RES(IJ+ 91) = Z COORDINATE OF EXITING RAY | | | 14640 |
| C | RES(IJ+101) = PLANE ANGLE OF EXITING RAY | | | 14650 |
| C | RES(IJ+111) = RAY ANGLE OF EXITING RAY | | | 14660 |
| C | RES(IJ+121) = PLANE ANGLE DIFFERENCE OF ENTERING-EXITING RAY | | | 14670 |
| C | RES(IJ+131) = RAY ANGLE DIFFERENCE OF ENTERING-EXITING RAY | | | 14680 |
| C | RES(IJ+141) = VECTOR DIFFERENCE BETWEEN ENTERING-EXITING RAY | | | 14690 |
| C | RES(IJ+151) = X COMPONENT OF ENT-EXT VECTOR DIFFERENCE | | | 14700 |
| C | RES(IJ+161) = Y COMPONENT OF ENT-EXT VECTOR DIFFERENCE | | | 14710 |
| C | RES(IJ+171) = Z COMPONENT OF ENT-EXT VECTOR DIFFERENCE | | | 14720 |
| C | | | | 14730 |
| | COMMON DUM | | | 14740 |
| C | | | | 14750 |
| | 0 | EQUIVALENCE | (DUM(1), CON), (DUM(501), X), | 14760 |
| | 1 | (DUM(1001), Y), | (DUM(1501), W), (DUM(2001), DWX), | 14770 |
| | 2 | (DUM(2501), DWY), | (DUM(3001), JPN), (DUM(3501), RTV) | 14780 |
| C | | | | 14790 |
| | 0 | EQUIVALENCE | (CON(1), DIMA), (CON(2), DIMB), | 14800 |
| | 1 | (CON(3), DIMC), | (CON(4), DEL), (CON(5), GNU), | 14810 |
| | 2 | (CON(6), THIC), | (CON(7), SPAD), (CON(8), PRSS), | 14820 |
| | 3 | (CON(9), NPAN), | (CON(10), IST), (CON(11), ISO), | 14830 |
| | 4 | (CON(12), IBC), | (CON(13), NGP), (CON(14), LP7), | 14840 |
| | 5 | (CON(15), FR), | (CON(16), LOCP), (CON(17), IPD), | 14850 |
| | 6 | (CON(18), IPR), | (CON(19), CHAP), (CON(20), ISCR1), | 14860 |
| | 7 | (CON(21), ISCR2), | (CON(22), SKAL), (CON(23), ISEC), | 14870 |
| | 8 | (CON(24), NPAG), | (CON(25), YONG), (CON(26), ILGD), | 14880 |
| | 9 | (CON(27), IREL), | (CON(28), LP5), (CON(29), CPRSS) | 14890 |
| C | | | | 14900 |
| | 0 | EQUIVALENCE | (CON(30), IRM), (CON(31), IPB), | 14910 |
| | 1 | (CON(53), SCAL), | (CON(61), SPAC), (CON(69), PRES), | 14920 |
| | 2 | (CON(77), PLNA), | (CON(85), RAYA), (CON(93), RI), | 14930 |
| | 3 | (CON(101), RES), | (CON(315), STAT), (CON(371), OIF), | 14940 |
| | 4 | (CON(401), EANDF), | (CON(451), RHS) | 14950 |

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|--|-----|---|--|-------|
| | C | | | 14960 |
| | | 0 | DIMENSION CON(500), X(22,22), Y(22,22), W(22,22), | 14970 |
| | | 1 | DWX(22,22), DWY(22,22), JPN(500), RTV(500), RES(180) | 14980 |
| | C | | | 14990 |
| | | | DIMENSION CI(3), DELTAP(6), CN(3), RI(7), CR(3), D(3) | 15000 |
| | C | | | 15010 |
| | | | XS = XQ | 15020 |
| | | | YS = YQ | 15030 |
| | | | ZS = ZQ | 15040 |
| | | | ALPHAI = PLANA | 15050 |
| | | | DELTAN = RAYAN | 15060 |
| | | | DELTAI = (90.0-DELTAN) | 15070 |
| | | | IJ = LP7-1 | 15080 |
| | | | IF (NPAN .EQ. 2) PRSS = -(PRSS-CPRSS) | 15090 |
| | | | RES(IJ+ 1) = XS | 15100 |
| | | | RES(IJ+ 11) = YS | 15110 |
| | | | RES(IJ+ 21) = DELTAN | 15120 |
| | | | RES(IJ+ 31) = ALPHAI | 15130 |
| | | | D(1) = THIC | 15140 |
| | | | D(2) = D(1) + SPAD | 15150 |
| | | | D(3) = D(2) + THIC | 15160 |
| | | | N = NPAN*2 | 15170 |
| | | | DO 100 I=1,N | 15180 |
| | 100 | | DELTAP(I) = 1.0 | 15190 |
| | | | RAD = 0.017453292519 | 15200 |
| | 110 | | DEG = 1.0/RAD | 15210 |
| | | | SEC = 206264.8064 | 15220 |
| | | | PI = 3.141592653 | 15230 |
| | | | K = 1 | 15240 |
| | | | ZP = 0.0 | 15250 |
| | | | IF (DELTAI .NE. 90.0) GO TO 105 | 15260 |
| | C | | COMPLETE COMPONENTS OF INCIDENT RAY | 15270 |
| | | | ALPHAI = ALPHAI*RAD | 15280 |
| | | | DELTAI = DELTAI*RAD | 15290 |
| | | | CI(1) = 0.0 | 15300 |
| | | | CI(2) = 0.0 | 15310 |
| | | | CI(3) = 1.0 | 15320 |
| | | | GO TO 110 | 15330 |
| | 105 | | ALPHAI = ALPHAI*RAD | 15340 |
| | | | DELTAI = DELTAI*RAD | 15350 |
| | | | CI(1) = COS(DELTAI)*COS(ALPHAI) | 15360 |
| | | | CI(2) = COS(DELTAI)*SIN(ALPHAI) | 15370 |
| | | | CI(3) = SIN(DELTAI) | 15380 |
| | C | | COMPUTE POINT OF INTERSECTION OF INCIDENT RAY WITH XY PLANE. | 15390 |
| | 110 | | SIGMAI = (ACOS(CI(1))) | 15400 |
| | | | BETAI = (ACOS(CI(2))) | 15410 |
| | | | GAMMAI = (1.5707963268-DELTAI) | 15420 |

| | | | |
|-----|--|---|-------|
| | | IF (DELTAN .EQ. 0.0) GAMMAI = 0.0 | 15430 |
| 115 | | XP = XS - ZS*CI(1)/CI(3) | 15440 |
| | | YP = YS - ZS*CI(2)/CI(3) | 15450 |
| | | IBY = 0 | 15460 |
| | | CALL BONDY (XP, YP, IBY) | 15470 |
| | | IF (IBY .EQ. 1) GO TO 800 | 15471 |
| C | | CALCULATE INTERSECTION OF RAY WITH WINDOW SURFACE | 15480 |
| C | | | 15490 |
| | | CALL ITERAT (XP, YP, K, DELTAP, CI, DELZ, OWX, OWY) | 15500 |
| C | | | 15510 |
| | | ZP = ZP + DELZ | 15520 |
| C | | CALCULATE NORMAL TO WINDOW SURFACE | 15530 |
| C | | | 15540 |
| | | CALL NORMAL (OWX, OWY, K, DELTAP, CN) | 15550 |
| C | | | 15560 |
| | | QRI = RI(K+1)/RI(K) | 15570 |
| C | | CALCULATE REFRACTED RAY IN NEXT MEDIUM. | 15580 |
| C | | | 15590 |
| | | CALL REFRCI (CI, CN, QRI, CR, ISO) | 15600 |
| C | | | 15610 |
| 119 | | IF (N-K) 130,130,120 | 15620 |
| 120 | | XS = XP | 15630 |
| | | YS = YP | 15640 |
| | | ZS = ZP - D(K) | 15650 |
| | | DO 125 I=1,3 | 15660 |
| 125 | | CI(I) = CR(I) | 15670 |
| | | ZP = D(K) | 15680 |
| | | K = K+1 | 15690 |
| | | IF (K .EQ. 3) PRSS = -(PRSS-CPRSS) | 15700 |
| | | GO TO 115 | 15710 |
| 130 | | CALL BONDY (XP, YP, IBY) | 15720 |
| | | IF (IBY .EQ. 1) GO TO 800 | 15730 |
| | | RES(IJ+ 41) = ZP | 15740 |
| | | RES(IJ+ 51) = OWX | 15750 |
| | | RES(IJ+ 61) = OWY | 15760 |
| | | CRPI = COS(BETAI)*CR(3) - COS(GAMMAI)*CR(2) | 15770 |
| | | CRPJ = COS(GAMMAI)*CR(1) - COS(SIGMAI)*CR(3) | 15780 |
| | | CRPK = COS(SIGMAI)*CR(2) - COS(BETAI)*CR(1) | 15790 |
| | | CROSSR = SQRT (CRPI**2 + CRPJ**2 + CRPK**2) | 15800 |
| | | DELINC = ASIN(CROSSR)*SEC | 15810 |
| | | TEM = SQRT (CR(1)**2 + CR(2)**2) | 15820 |
| | | DELTAR = ACOS(1.0) | 15830 |
| | | IF (TEM .LT. 1.0) DELTAR = ACOS(TEM) | 15840 |
| | | DELTAM = (90.0*RAD - DELTAR) | 15850 |
| | | IF (CR(1) .NE. 0.0) GO TO 361 | 15860 |
| | | ALPHAR = 0.0 | 15870 |
| | | GO TO 362 | 15880 |

111

| | | |
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| 361 | ALPHAR = ATAN2(CR(2),CR(1)) | 15890 |
| 362 | IF (ALPHAI) 140,140,505 | 15900 |
| 505 | IF (ALPHAR) 520,140,140 | 15910 |
| 520 | ALPHAR = ALPHAR + 6.283185072 | 15920 |
| 140 | DELDEC = (DELTAN*RAD - DELTAM)*SEC | 15930 |
| | DELDEL = (DELTAI - DELTAR)*SEC | 15940 |
| | DELALP = (ALPHAI-ALPHAR)*SEC | 15950 |
| | DELTAM = DELTAM*DEG | 15960 |
| | ALPHAR = ALPHAR*DEG | 15970 |
| | DELTAR = DELTAR*DEG | 15980 |
| | RES(IJ+ 71) = XP | 15990 |
| | RES(IJ+ 81) = YP | 16000 |
| | RES(IJ+ 91) = ZP | 16010 |
| | RES(IJ+101) = ALPHAR | 16020 |
| | RES(IJ+111) = DELTAM | 16030 |
| | RES(IJ+121) = DELALP | 16040 |
| | RES(IJ+131) = DELDEC | 16050 |
| | RES(IJ+141) = DELINC | 16060 |
| | RES(IJ+151) = CRPI*SEC | 16070 |
| | RES(IJ+161) = CRPJ*SEC | 16080 |
| | RES(IJ+171) = CRPK*SEC | 16090 |
| 800 | IF((K.LT.3).AND.(NPAN.EQ.2)) PRSS=-(PRSS-CPRSS) | 16100 |
| | RETURN | 16101 |
| | END | 16110 |
| | \$IBFTC MS23D9 | 16120 |
| | CITERAT | 16130 |
| | SUBROUTINE ITERAT (XP, YP, K, DELTAP, CI, DELZ, OWX, OWY) | 16140 |
| | C | 16150 |
| | C THIS SUBROUTINE PERFORMS THE ITERATION TO FIND THE POINT XP,YP ON | 16160 |
| | C THE DEFORMED SURFACE. | 16170 |
| | C | 16180 |
| | COMMON DUM | 16190 |
| | 0 EQUIVALENCE (DUM(1), CON) | 16200 |
| | 0 EQUIVALENCE (CON(1), DIMA), (CON(2), DIMB) | 16210 |
| | C | 16220 |
| | DIMENSION CI(3), DELTAP(6) | 16230 |
| | C | 16240 |
| | J = 1 | 16250 |
| | DELTA A = 0.0 | 16260 |
| 101 | CALL INCOTB (XP, YP, OWF, OWX, OWY, K) | 16270 |
| | DELZ = OWF*DELTAP(K) | 16280 |
| | A = (DELZ - DELTAA*CI(3))*CI(3) | 16290 |
| | IF (ABS(A) - 1.0E-06) 800,800,102 | 16300 |
| 102 | DELTA A = DELTAA + A | 16310 |
| | XP = XP + A*CI(1) | 16320 |
| | YP = YP + A*CI(2) | 16330 |
| | DIMA=2.*DIMA | 16340 |

| | | |
|---|---|-------|
| | DIMB=2.*DIMB | 16350 |
| | IBY=0 | 16360 |
| | CALL BONDY (XP,YP,IBY) | 16370 |
| | DIMA=DIMA/2. | 16380 |
| | DIMB=DIMB/2. | 16390 |
| | IF(IBY.EQ.1) GO TO 800 | 16400 |
| | J = J+1 | 16410 |
| | IF (J-25) 101,800,800 | 16420 |
| | 800 RETURN | 16430 |
| | END | 16440 |
| | SIBFTC MS23E0 | 16450 |
| | CINCOTB | 16460 |
| | SUBROUTINE INCOTB (XP, YP, OWF, OWX, OWY, L) | 16470 |
| C | | 16480 |
| C | THIS SUBROUTINE GENERATES THE TABLE OF INTERPOLATION COEFFICIENTS | 16490 |
| C | | 16500 |
| | DOUBLE PRECISION A,BR,A1,A2,A3,A4 | 16510 |
| C | | 16520 |
| | COMMON DUM | 16530 |
| C | | 16540 |
| | 0 EQUIVALENCE (DUM(1), CON), (DUM(501), X), | 16550 |
| | 1 (DUM(1501), W), (DUM(2251), DWX), | 16560 |
| | 2 (DUM(3001), JPN), (DUM(3501), RTV) | 16570 |
| | 3 ,(DUM(4001),BR),(DUM(6100),B) | 16580 |
| C | | 16590 |
| | 0 EQUIVALENCE (CON(1), DIMA), (CON(2), DIMB), | 16600 |
| | 1 (CON(3), DIMC), (CON(4), DEL), (CON(5), GNU), | 16610 |
| | 2 (CON(6), THIC), (CON(7), SPAD), (CON(8), PRSS), | 16620 |
| | 3 (CON(9), NPAN), (CON(10), IST), (CON(11), ISO), | 16630 |
| | 4 (CON(12), IBC), (CON(13), NGP), (CON(14), LP7), | 16640 |
| | 5 (CON(15), FR), (CON(16), LOCP), (CON(17), IPD), | 16650 |
| | 6 (CON(18), IPR), (CON(19), CHAP), (CON(20), ISCR1), | 16660 |
| | 7 (CON(21), ISCR2), (CON(22), SKAL), (CON(23), ISEC), | 16670 |
| | 8 (CON(24), NPAG), (CON(25), YONG), (CON(26), ILGD), | 16680 |
| | 9 (CON(27), IREL), (CON(28), LP5), (CON(29), CPRSS) | 16690 |
| C | | 16700 |
| | 0 EQUIVALENCE (CON(30), IRM), (CON(31), IPB), | 16710 |
| | 1 (CON(32), MIBP), (CON(33), IWD), (CON(34), IDS), | 16720 |
| | 2 (CON(53), SCAL), (CON(61), SPAC), (CON(69), PRES), | 16730 |
| | 3 (CON(77), PLNA), (CON(85), RAYA), (CON(93), RI), | 16740 |
| | 4 (CON(101), RES), (CON(315), STAT), (CON(371), OIF), | 16750 |
| | 5 (CON(401),EANDF), (CON(451), RHS) | 16760 |
| C | | 16770 |
| | 0 EQUIVALENCE (RTV,BI),(OIF(1),NDX),(OIF(2),NDY),(X1,OIF(3)), | 16780 |
| | 1 (Y1,OIF(4)),(OIF(5),CONST1),(OIF(6),CONST2),(OIF(7),CONST3), | 16790 |
| | 2 (OIF(8),CONST4),(OIF(9),CONST5),(OIF(10),CONST6) | 16800 |
| C | | 16810 |

| | | | | | | | |
|---|-------------|----------------------------|---|------------|-----------|----------|-------|
| | 0 DIMENSION | CON(500), | X(21,33), | W(21,33), | 16820 | | |
| | 1 | DWX(21,33), | JPN(500), | RTV(500), | OIF(10) | 16830 | |
| C | | | | | 16840 | | |
| | | DIMENSION | A(25), | BR(32,32), | B(36,25), | WC(36,2) | 16850 |
| | 1, | A1(25,2), | A2(25,2), | A3(25,2), | A4(32,2) | 16860 | |
| C | | | | | 16870 | | |
| | | DATA | PI/3.14159265/ | | | 16880 | |
| C | | | | | 16890 | | |
| | | JUMP=5 | | | | 16900 | |
| | | IF(MIBP) | 304,304,400 | | | 16910 | |
| | 304 | ICHAP = | CHAP | | | 16920 | |
| | | JUMP=1 | | | | 16930 | |
| | | X1P=X1 | | | | 16940 | |
| | | Y1P=Y1 | | | | 16950 | |
| | | GO TO | (20,40,60), | ICHAP | | 16960 | |
| | 20 | IDX=5 | | | | 16970 | |
| | | IDY=5 | | | | 16980 | |
| | | GO TO | 309 | | | 16990 | |
| | 40 | IDX=DIMA | | | | 17000 | |
| | | IDX=IDX/2 | | | | 17010 | |
| | | IDY=DIMB | | | | 17020 | |
| | | IDY=IDY/2 | | | | 17030 | |
| | 305 | IF(IDX.LT.5) | IDX=5 | | | 17040 | |
| | | IF(IDY.LT.5) | IDY=5 | | | 17050 | |
| | | GO TO | 309 | | | 17060 | |
| | 60 | IDX=NDX | | | | 17070 | |
| | | IDY=NDY | | | | 17080 | |
| | | IF(IDX.LT.5) | GO TO | 306 | | 17090 | |
| | | IF(IDY.LT.5) | GO TO | 306 | | 17100 | |
| | | GO TO | 311 | | | 17110 | |
| | 306 | WRITE (ISO, | 307) | | | 17120 | |
| | 307 | FORMAT (1H0, | 78H INTERPOLATION FAILS. GRID HAS LESS THAN SIX NODES | | | 17130 | |
| | | 1 IN THE X OR Y DIRECTION, |) | | | 17140 | |
| | | STOP | | | | 17150 | |
| | 309 | IF(IDX.GT.10) | IDX=IDX/2 | | | 17151 | |
| | | IF(IDY.GT.10) | IDY=IDY/2 | | | 17152 | |
| | 311 | CONTINUE | | | | 17160 | |
| | | DTX=IDX | | | | 17170 | |
| | | DTX=DTX*DEL | | | | 17180 | |
| | | DTY=IDY | | | | 17190 | |
| | | DTY=DTY*DEL | | | | 17200 | |
| | | DO 300 | I1=1,4 | | | 17210 | |
| | | GO TO | (310,318,314,322), | I1 | | 17220 | |
| | 310 | I3=IDY+1 | | | | 17230 | |
| | | I2=I3-5 | | | | 17240 | |
| | | J3=IDX+1 | | | | 17250 | |
| | | J2=J3-5 | | | | 17260 | |

| | | |
|------|-------------------------|-------|
| | GO TO 308 | 17270 |
| 314 | I2=IDY+1 | 17280 |
| | I3=I2+5 | 17290 |
| | J3=IDX+1 | 17300 |
| | J2=J3-5 | 17310 |
| | GO TO 308 | 17320 |
| 318 | I3=IDY+1 | 17330 |
| | I2=I3-5 | 17340 |
| | J2=IDX+1 | 17350 |
| | J3=J2+5 | 17360 |
| | GO TO 308 | 17370 |
| 322 | I2=IDY+1 | 17380 |
| | I3=I2+5 | 17390 |
| | J2=IDX+1 | 17400 |
| | J3=J2+5 | 17410 |
| 308 | CONTINUE | 17420 |
| | AA=DIMA/2. | 17430 |
| | BB=DIMB/2. | 17440 |
| | DO 200 I=1,36 | 17450 |
| | DO 200 J=1,25 | 17460 |
| 200 | B(I,J) = 0.0 | 17470 |
| | K = 0 | 17480 |
| | DO 202 J=J2,J3 | 17490 |
| | EJ=J | 17500 |
| | DO 202 I=I2,I3 | 17510 |
| | K = K+1 | 17520 |
| | EI=I | 17530 |
| | U=DEL*(EJ-1.)-X1P | 17540 |
| | V=DEL*(EI-1.)-Y1P | 17550 |
| 8040 | B(K, 1) = (U**4)*(V**4) | 17560 |
| | B(K, 2) = (U**4)*(V**3) | 17570 |
| | B(K, 3) = (U**3)*(V**4) | 17580 |
| | B(K, 4) = (U**4)*(V**2) | 17590 |
| | B(K, 5) = (U**3)*(V**3) | 17600 |
| | B(K, 6) = (U**2)*(V**4) | 17610 |
| | B(K, 7) = (U**4)*(V | 17620 |
| | B(K, 8) = (U**3)*(V**2) | 17630 |
| | B(K, 9) = (U**2)*(V**3) | 17640 |
| | B(K,10) = (U | 17650 |
| | B(K,11) = (U**4) | 17660 |
| | B(K,12) = (U**3)*(V | 17670 |
| | B(K,13) = (U**2)*(V**2) | 17680 |
| | B(K,14) = (U | 17690 |
| | B(K,15) = (V**4) | 17700 |
| | B(K,16) = (U**3) | 17710 |
| | B(K,17) = (U**2)*(V | 17720 |
| | B(K,18) = (U | 17730 |

| | | |
|--|--|-------|
| | B(K,19) = (V**3) | 17740 |
| | B(K,20) = (U**2) | 17750 |
| | B(K,21) = (U)*(V) | 17760 |
| | B(K,22) = (V**2) | 17770 |
| | B(K,23) = (U) | 17780 |
| | B(K,24) = (V) | 17790 |
| | B(K,25) = 1.0 | 17800 |
| | WC(K,1)=W(I,J) | 17810 |
| | WC(K,2)=DWX(I,J) | 17820 |
| | IF(ILRG.NE.1) GO TO 201 | 17830 |
| | WC(K,1)=0.5*(W(I,J)*CONST2*(ABS(CONST1/CONST2))+CONST3*COS(PI*U/ | 17840 |
| | 1 (AA*2.))*COS(PI*V/(BB*2.))) | 17850 |
| | IF(NPAN.NE.2) GO TO 201 | 17860 |
| | WC(K,1)=0.5*(W(I,J)*CONST5*(ABS(CONST4/CONST5))+ | 17870 |
| | 1 CONST6*COS(PI*U/(AA*2.))*COS(PI*V/(BB*2.))) | 17880 |
| | WC(K,2)=0.5*(W(I,J)*CONST2*(ABS(CONST1/CONST2))+CONST3*COS(PI*U/ | 17890 |
| | 1 (AA*2.))*COS(PI*V/(BB*2.))) | 17900 |
| | 201 IF(ABS(X(I,J)-X1P-U)-1.0E-7)202,202,206 | 17910 |
| | 206 DO 210 LM=1,25 | 17920 |
| | 210 B(K,LM)=0. | 17930 |
| | 202 CONTINUE | 17940 |
| | DO 240 K=1,2 | 17950 |
| | DO 240 I=1,25 | 17960 |
| | A4(I,K)=0. | 17970 |
| | DO 240 J=1,36 | 17980 |
| | 240 A4(I,K)=A4(I,K)+B(J,I)*WC(J,K) | 17990 |
| | C | 18000 |
| | C===== THIS SECTION MULTIPLIES THE COEFFICIENT MATRIX BY ITS TRANSPOSE | 18010 |
| | C | 18020 |
| | DO 124 I=1,25 | 18030 |
| | DO 124 J=1,25 | 18040 |
| | 122 BR(I,J) = 0.0 | 18050 |
| | DO 124 K=1,36 | 18060 |
| | 124 BR(I,J) = BR(I,J) + B(K,I)*B(K,J) | 18070 |
| | C | 18080 |
| | C===== THIS SECTION INVERTS THE INTERMEDIATE MATRIX. | 18090 |
| | C===== THIS SECTION CALCULATES THE COEFFICIENTS. | 18100 |
| | C | 18110 |
| | NR = 25 | 18120 |
| | NC=2 | 18130 |
| | CALL SEQS (BR,A4,NR,NC) | 18140 |
| | DO 280 I=1,25 | 18150 |
| | GO TO (260,264,268,300),I1 | 18160 |
| | 260 A1(I,1)=A4(I,1) | 18170 |
| | A1(I,2)=A4(I,2) | 18180 |
| | GO TO 280 | 18190 |
| | 264 A2(I,1)=A4(I,1) | 18200 |

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A2(I,2)=A4(I,2)-----18210
GO TO 280-----18220
268 A3(I,1)=A4(I,1)-----18230
A3(I,2)=A4(I,2)-----18240
280 CONTINUE-----18250
300 CONTINUE-----18260
C-----18270
C==== THIS SECTION INTERPOLATES TO OBTAIN THE DEFLECTION AND SLOPES AT
C THE POINT XP, YP.-----18280
C-----18290
C-----18300
400 J=1-----18310
IF(L.GE.3) J=2-----18320
IF(JUMP.EQ.5) GO TO 504-----18330
410 GO TO (420,522,526,534,504),JUMP-----18340
420 SXP=XP-----18350
SYP=YP-----18360
XP=DTX-----18370
YP=DTY-----18380
GO TO 512-----18390
504 IF(ABS(XP)-DTX)510,510,518-----18400
510 IF(ABS(YP)-DTY)512,512,526-----18410
512 DO 514 K=1,25-----18420
514 A(K)=A1(K,J)-----18430
GO TO 540-----18440
518 IF(ABS(YP)-DTY)522,522,534-----18450
522 DO 524 K=1,25-----18460
524 A(K)=A2(K,J)-----18470
GO TO 540-----18480
526 DO 530 K=1,25-----18490
530 A(K)=A3(K,J)-----18500
GO TO 540-----18510
534 DO 538 K=1,25-----18520
538 A(K)=A4(K,J)-----18530
540 CONTINUE-----18540
XP=XP-X1P-----18550
YP=YP-Y1P-----18560
0 OWA = A( 1)*(XP**4)*(YP**4) + A( 2)*(XP**4)*(YP**3)-----18570
1 + A( 3)*(XP**3)*(YP**4) + A( 4)*(XP**4)*(YP**2)-----18580
2 + A( 5)*(XP**3)*(YP**3) + A( 6)*(XP**2)*(YP**4)-----18590
3 + A( 7)*(XP**4)*(YP ) + A( 8)*(XP**3)*(YP**2)-----18600
4 + A( 9)*(XP**2)*(YP**3) + A(10)*(XP )*(YP**4)-----18610
5 + A(11)*(XP**4) + A(12)*(XP**3)*(YP )-----18620
6 + A(13)*(XP**2)*(YP**2) + A(14)*(XP )*(YP**3)-----18630
7 + A(15)* (YP**4) + A(16)*(XP**3)-----18640
8 + A(17)*(XP**2)*(YP ) + A(18)*(XP )*(YP**2)-----18650
9 + A(19)* (YP**3) + A(20)*(XP**2)-----18660
0 OWB = A(21)*(XP )*(YP ) + A(22)* (YP**2)-----18670

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| | | | | |
|-----|--|---------------------------|---------|-------|
| 1 | + A(23)*(XP) | + A(24)* | (YP) | 18680 |
| 2 | + A(25) | | | 18690 |
| | OWF = OWA + OWB | | | 18700 |
| 0 | OWX = 4.0*A(1)*(XP**3)*(YP**4) + 4.0*A(2)*(XP**3)*(YP**3) | | | 18710 |
| 1 | + 3.0*A(3)*(XP**2)*(YP**4) + 4.0*A(4)*(XP**3)*(YP**2) | | | 18720 |
| 2 | + 3.0*A(5)*(XP**2)*(YP**3) + 2.0*A(6)*(XP)*(YP**4) | | | 18730 |
| 3 | + 4.0*A(7)*(XP**3)*(YP) + 3.0*A(8)*(XP**2)*(YP**2) | | | 18740 |
| 4 | + 2.0*A(9)*(XP)*(YP**3) + A(10)* | | (YP**4) | 18750 |
| 5 | + 4.0*A(11)*(XP**3) | + 3.0*A(12)*(XP**2)*(YP) | | 18760 |
| 6 | + 2.0*A(13)*(XP)*(YP**2) + A(14)* | | (YP**3) | 18770 |
| 7 | + 3.0*A(16)*(XP**2) | + 2.0*A(17)*(XP)*(YP) | | 18780 |
| 8 | + A(18)* | (YP**2) + 2.0*A(20)*(XP) | | 18790 |
| 9 | + A(21)* | (YP) + A(23) | | 18800 |
| 0 | OWY = 4.0*A(1)*(XP**4)*(YP**3) + 3.0*A(2)*(XP**4)*(YP**2) | | | 18810 |
| 1 | + 4.0*A(3)*(XP**3)*(YP**3) + 2.0*A(4)*(XP**4)*(YP) | | | 18820 |
| 2 | + 3.0*A(5)*(XP**3)*(YP**2) + 4.0*A(6)*(XP**2)*(YP**3) | | | 18830 |
| 3 | + A(7)*(XP**4) | + 2.0*A(8)*(XP**3)*(YP) | | 18840 |
| 4 | + 3.0*A(9)*(XP**2)*(YP**2) + 4.0*A(10)*(XP)*(YP**3) | | | 18850 |
| 5 | + A(12)*(XP**3) | + 2.0*A(13)*(XP**2)*(YP) | | 18860 |
| 6 | + 3.0*A(14)*(XP)*(YP**2) + 4.0*A(15)* | | (YP**3) | 18870 |
| 7 | + A(17)*(XP**2) | + 2.0*A(18)*(XP)*(YP) | | 18880 |
| 8 | + 3.0*A(19)* | (YP**2) + A(21)*(XP) | | 18890 |
| 9 | + 2.0*A(22)* | (YP) + A(24) | | 18900 |
| | XP=XP+X1P | | | 18910 |
| | YP=YP+Y1P | | | 18920 |
| | JUMP=JUMP+1 | | | 18930 |
| | GO TO(580,574,580,580,576,600),JUMP | | | 18940 |
| 574 | WRITE (ISO,575) | | | 18950 |
| 575 | FORMAT (1H1) | | | 18960 |
| | GO TO 580 | | | 18970 |
| 576 | XP=SXP | | | 18980 |
| | YP=SYF | | | 18990 |
| 580 | WRITE (ISO,581) OWF,OWX,OWY | | | 19000 |
| 581 | FORMAT (1H , 39H TEST INTERPOLATION VALUES AT CENTER = ,E16.6, | | | 19010 |
| | 1 1H,, E16.6,1H,, E16.6) | | | 19020 |
| | GO TO 410 | | | 19030 |
| 600 | MIBP=1 | | | 19040 |
| | IF((ICHP.EQ.3).OR.(ILRG.EQ.1)) GO TO 800 | | | 19050 |
| | OWF=OWF*PRSS | | | 19060 |
| | OWX=OWX*PRSS | | | 19070 |
| | OWY=OWY*PRSS | | | 19080 |
| 800 | RETURN | | | 19090 |
| | END | | | 19100 |
| | \$IBFTC MS23E1 | | | 19110 |
| | CNORMAL | | | 19120 |
| | SUBROUTINE NORMAL (OWX, OWY, K, DELTAP, CN) | | | 19130 |
| | | | | 19140 |

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C      THIS SUBROUTINE FINDS THE NORMAL TO THE SURFACE.      19150
C      19160
C      DIMENSION CN(3), DELTAP( 6)      19170
C      19180
      AMAG = SQRT ((OWX**2 + OWY**2)*(DELTAP(K)**2) + 1.0)      19190
      CN(1) = (-DELTAP(K)*OWX)/AMAG      19200
      CN(2) = (-DELTAP(K)*OWY)/AMAG      19210
      CN(3) = 1.0/AMAG      19220
      800 RETURN      19230
      END      19240
$IBFTC MS23E2      19250
CREFRCI      19260
      SUBROUTINE REFRCI (CI, CN, QRI, CR, ISO)      19270
C      19280
C      THIS SUBROUTINE CALCULATES NEW DIRECTION OF RAY UPON ENTERING      19290
C      NEW MEDIA.      19300
C      19310
      DIMENSION CI(3), CN(3), CR(3)      19320
      DOTP = 0.0      19330
      DO 101 I=1,3      19340
      101 DOTP = DOTP + CI(I)*CN(I)      19350
      ROOT = QRI**2 -1.0 + DOTP**2      19360
      IF (ROOT) 103,105,105      19370
      103 ROUT = 0.0      19380
      WRITE (ISO,500) ROOT      19390
      500 FORMAT (1H0,6HROOT= ,E16.8/)      19400
      GO TO 107      19410
      105 ROUT = SQRT (ROOT)      19420
      107 DO 109 I=1,3      19430
      109 CR(I) = (CI(I) + (ROUT-DOTP)*CN(I))/QRI      19440
      800 RETURN      19450
      END      19460
$IBFTC MS23E3      19470
CRESPRT      19480
      SUBROUTINE RESPRT (IRT, NOPRT)      19490
C      19500
C      THIS SUBROUTINE PRINTS THE RESULTS OBTAINED BY THE RAYTRA PROG.      19510
C      19520
      COMMON DUM      19530
C      19540
      0 EQUIVALENCE (DUM( 1), CON), (DUM( 501), X),      19550
      1 (DUM(1001), Y), (DUM(1501), W), (DUM(2001), DWX),      19560
      2 (DUM(2501), DWY), (DUM(3001), JPN), (DUM(3501), RTV)      19570
C      19580
      0 EQUIVALENCE (CON( 1), DIMA), (CON( 2), DIMB),      19590
      1 (CON( 3), DIMC), (CON( 4), DEL), (CON( 5), GNU),      19600
      2 (CON( 6), THIC), (CON( 7), SPAD), (CON( 8), PRSS),      19610

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| | | | | |
|---|--------------------|-------------------|--------------------|-------|
| 3 | (CON(9), NPAN), | (CON(10), ISI), | (CON(11), ISO), | 19620 |
| 4 | (CON(12), IBC), | (CON(13), NGP), | (CON(14), LP7), | 19630 |
| 5 | (CON(15), FR), | (CON(16), LOCP), | (CON(17), IPD), | 19640 |
| 6 | (CON(18), IPR), | (CON(19), CHAP), | (CON(20), ISCR1), | 19650 |
| 7 | (CON(21), ISCR2), | (CON(22), SKAL), | (CON(23), ISEC), | 19660 |
| 8 | (CON(24), NPAG), | (CON(25), YONG), | (CON(26), ILGD), | 19670 |
| 9 | (CON(27), IREL), | (CON(28), LP5), | (CON(29), CPRSS) | 19680 |

C 19690

| | | | | |
|---|--------------------|-------------------|-------------------|-------|
| 0 | EQUIVALENCE | (CON(30), IRM), | (CON(31), IPB), | 19700 |
| 1 | (CON(53), SCAL), | (CON(61), SPAC), | (CON(69), PRES), | 19710 |
| 2 | (CON(77), PLNA), | (CON(85), RAYA), | (CON(93), RI), | 19720 |
| 3 | (CON(101), RES), | (CON(315), STAT), | (CON(371), OIF), | 19730 |
| 4 | (CON(401), EANDF), | (CON(451), RHS) | | 19740 |

C 19750

| | | | | |
|---|------------------|------------------|------------------|-------|
| 0 | EQUIVALENCE | (STAT(1), NMP), | (STAT(9), AVG), | 19760 |
| 1 | (STAT(25), AVS), | (STAT(41), AMN), | (STAT(49), STD) | 19770 |

C 19780

EQUIVALENCE (CON(33), ITEST) 19790

C 19800

| | | | |
|---|--|--|-------|
| 0 | DIMENSION | RT10(3), RT20(5), RT30(3), RT36(2), RT37(2), | 19810 |
| 1 | RT38(2), RT39(2), RT31(3), RT32(3), RES(200), PLNA(8), AMN(8), | 19820 | |
| 2 | STD(8), NMP(8) | 19830 | |

C 19840

DATA RT20(1)/27HR A Y T R A C E D A T A/ 19850

C 19860

| | | | |
|---|-------------|---|-------|
| 0 | DATA | RT30(1)/13HELLIPSE A=/, RT31(1)/13HRECTANGLE A=/, | 19870 |
| 1 | | RT32(1)/13HTRAPEZOID A=/, RT33/4H B=/, RT34/4H C=/, | 19880 |
| 2 | | RT35/6HSCALE=/, RT36(1)/10HTHICKNESS=/, | 19890 |
| 3 | | RT37(1)/9H PANES=/, RT38(1)/11H SPACING=/, | 19900 |
| 4 | RT39(1)/12H | PRESSURE=/ | 19910 |

C 19920

DATA HING/6HHINGED/, CH/1H /, CLMP/6HCLAMPE/, CC/1HD/ 19930

G 19940

DATA RT40/4HX = /, RT41/4HY = /, RT42/4HD1 =/ 19950

C 19960

| | | | |
|---|------|---|-------|
| 0 | DATA | RT50/6HA1 /, RT51/4HDEG./, RT52/6HXOUT /, RT53/4H IN./, | 19970 |
| 1 | | RT54/6HYOUT /, RT55/4H IN./, RT56/6HZOUT /, RT57/4H IN./, | 19980 |
| 2 | | RT58/6HA2OUT /, RT59/4HDEG./, RT60/6HD2OUT /, RT61/4HDEG./, | 19990 |

| | | | |
|---|--|---|-------|
| 3 | | RT62/6HA1-A2 /, RT63/4HSEC./, RT64/6HD1-D2 /, RT65/4HSEC./, | 20000 |
| 4 | | RT66/6HTHETA /, RT67/4HSEC./, RT68/6HITHE /, RT69/4HSEC./, | 20010 |
| 5 | | RT70/6HJTHE /, RT71/4HSEC./, RT72/6HKTHE /, RT73/4HSEC./ | 20020 |

C 20030

INITIALIZE INDEXES. 20040

C 20050

IS10=10 20060

IS8 = ISO 20070

| | | |
|-----|---|-------|
| | IS9=ISCR2+1 | 20080 |
| | IF (NOPRT .EQ. 0) IS8 = ISCR2 | 20090 |
| | IF (NOPRT .EQ. 0) IS9 = IS8 + 1 | 20100 |
| | ICHAP = CHAP | 20110 |
| | IF (IBC .NE. 1) GO TO 102 | 20120 |
| | CONC = HING | 20130 |
| | CF = CH | 20140 |
| 102 | IF (IBC .NE. 2) GO TO 104 | 20150 |
| | CONC = CLMP | 20160 |
| | CF = CC | 20170 |
| 104 | GO TO (106,140), ISEC | 20180 |
| 106 | MPRT = NOPRT + 1 | 20190 |
| | GO TO (108,128,800), MPRT | 20200 |
| 108 | GO TO (110, 116, 116, 116), LOCP | 20210 |
| 110 | LOCP = 2 | 20220 |
| C | | 20230 |
| C | THIS SECTION PRINTS THE RAY TRACE RESULTS ON TAPE 8 | 20240 |
| C | | 20250 |
| | CALL PAGE (IPR, LINE, IS8, IRT) | 20260 |
| | WRITE (IS8,500) RT20 | 20270 |
| 500 | FORMAT (1H,46X,4A6,A3) | 20280 |
| | GO TO (112, 113, 114), ICHAP | 20290 |
| 112 | 0 WRITE (IS8,501) (RT30(I),I=1,3), DIMA, RT33, DIMB, | 20300 |
| | 1 RT35, SKAL, (RT36(I),I=1,2), THIC, (RT37(I),I=1,2), NPAN, | 20310 |
| | 2 (RT38(I),I=1,2), SPAD, (RT39(I),I=1,2), PRSS, CONC, CF | 20320 |
| 501 | 0 FORMAT (1H0,2A6,A1,F5.2,A4,F5.2,14X,A6,F4.2,3X,A6,A4,F5.2,A6,A3, | 20330 |
| | 1 I1,A6,A5,F3.1,2A6,F5.1,3X,A6,A1) | 20340 |
| | GO TO 115 | 20350 |
| 113 | 0 WRITE (IS8,501) (RT31(I),I=1,3), DIMA, RT33, DIMB, | 20360 |
| | 1 RT35, SKAL, (RT36(I),I=1,2), THIC, (RT37(I),I=1,2), NPAN, | 20370 |
| | 2 (RT38(I),I=1,2), SPAD, (RT39(I),I=1,2), PRSS, CONC, CF | 20380 |
| | GO TO 115 | 20390 |
| 114 | 0 WRITE (IS8,502) (RT32(I),I=1,3), DIMA, RT33, DIMB, RT34, DIMC, | 20400 |
| | 1 RT35, SKAL, (RT36(I),I=1,2), THIC, (RT37(I),I=1,2), NPAN, | 20410 |
| | 2 (RT38(I),I=1,2), SPAD, (RT39(I),I=1,2), PRSS, CONC, CF | 20420 |
| 502 | 0 FORMAT (1H0,2A6,A1,F5.2,A4,F5.2,A4,F5.2,5X,A6,F4.2,3X,A6,A4,F5.2, | 20430 |
| | 1 A6,A3,I1,A6,A5,F3.1,2A6,F5.1,3X,A6,A1) | 20440 |
| 115 | WRITE (IS8,503) RT40, RES(I), RT41, RES(11), RT42, RES(21) | 20450 |
| 503 | FORMAT (1H0, 40X,A4,F5.2,5X,A4,F5.2,5X,A5,F6.2) | 20460 |
| | GO TO 117 | 20470 |
| 116 | LOCP = LOCP + 1 | 20480 |
| | WRITE (IS8,503) RT40, RES(1), RT41, RES(11), RT42, RES(21) | 20490 |
| 117 | 0 WRITE (IS8,504) | 20500 |
| | 1 RT50,RT51, (RES(I),I= 31, 38), RT52,RT53, (RES(I),I= 71, 78), | 20510 |
| | 2 RT54,RT55, (RES(I),I= 81, 88), RT56,RT57, (RES(I),I= 91, 98), | 20520 |
| | 3 RT58,RT59, (RES(I),I=101,108), RT60,RT61, (RES(I),I=111,118), | 20530 |
| | 4 RT62,RT63, (RES(I),I=121,128), RT64,RT65, (RES(I),I=131,138), | 20540 |

| | | | |
|-----|-----|---|-------|
| | 5 | RT66,RT67, (RES(I),I=141,148), RT68,RT69, (RES(I),I=151,158), | 20550 |
| | 6 | RT70,RT71, (RES(I),I=161,168), RT72,RT73, (RES(I),I=171,178) | 20560 |
| 504 | 0 | FORMAT (1H ,A6,A4,8F13.6/1H ,A6,A4,8F13.6/1H ,A6,A4,8F13.6/ | 20570 |
| | 1 | 1H ,A6,A4,8F13.6/1H ,A6,A4,8F13.6/1H ,A6,A4,8F13.6/ | 20580 |
| | 2 | 1H ,A6,A4,8E13.4/1H ,A6,A4,8E13.4/1H ,A6,A4,8E13.4/ | 20590 |
| | 3 | 1H ,A6,A4,8F13.6/1H ,A6,A4,8F13.6/1H ,A6,A4,8F13.6) | 20600 |
| | C | | 20610 |
| | C | THIS SECTION PRINTS THE RAY TRACE RESULTS ON TAPE 9 | 20620 |
| | C | | 20630 |
| | | MOCP = LOCP - 1 | 20640 |
| | | IF (MOCP .EQ. 1) NOCP = 1 | 20650 |
| | | IF (MOCP .EQ. 2) NOCP = 2 | 20660 |
| | | IF (MOCP .EQ. 3) NOCP = 1 | 20670 |
| | | IF (MOCP .EQ. 4) NOCP = 2 | 20680 |
| | 119 | GO TO (120,125), NOCP | 20690 |
| | 120 | CALL PAGE (IPB, LIME, IS9, IRT) | 20700 |
| | | WRITE (IS9) (RT20(I), I=1,5) | 20710 |
| | | GO TO (122,123,124), ICHAP | 20720 |
| | 122 | 0 WRITE (IS9) (RT30(I),I=1,3), DIMA, RT33, DIMB, RT34, DIMC, | 20730 |
| | 1 | RT35, SKAL, (RT36(I),I=1,2), THIC, (RT37(I),I=1,2), NPAN, | 20740 |
| | 2 | (RT38(I),I=1,2), SPAD, (RT39(I),I=1,2), PRSS, CONC, CF | 20750 |
| | | GO TO 125 | 20760 |
| | 123 | 0 WRITE (IS9) (RT31(I),I=1,3), DIMA, RT33, DIMB, RT34, DIMC, | 20770 |
| | 1 | RT35, SKAL, (RT36(I),I=1,2), THIC, (RT37(I),I=1,2), NPAN, | 20780 |
| | 2 | (RT38(I),I=1,2), SPAD, (RT39(I),I=1,2), PRSS, CONC, CF | 20790 |
| | | GO TO 125 | 20800 |
| | 124 | 0 WRITE (IS9) (RT32(I),I=1,3), DIMA, RT33, DIMB, RT34, DIMC, | 20810 |
| | 1 | RT35, SKAL, (RT36(I),I=1,2), THIC, (RT37(I),I=1,2), NPAN, | 20820 |
| | 2 | (RT38(I),I=1,2), SPAD, (RT39(I),I=1,2), PRSS, CONC, CF | 20830 |
| | 125 | WRITE (IS9) RT40, RES(1), RT41, RES(11), RT42, RES(21) | 20840 |
| | 127 | 0 WRITE (IS9) | 20850 |
| | 1 | RT50,RT51, (RES(I),I= 31, 38), RT52,RT53, (RES(I),I= 71, 78), | 20860 |
| | 2 | RT54,RT55, (RES(I),I= 81, 88), RT56,RT57, (RES(I),I= 91, 98), | 20870 |
| | 3 | RT58,RT59, (RES(I),I=101,108), RT60,RT61, (RES(I),I=111,118), | 20880 |
| | 4 | RT62,RT63, (RES(I),I=121,128), RT64,RT65, (RES(I),I=131,138), | 20890 |
| | 5 | RT66,RT67, (RES(I),I=141,148), RT68,RT69, (RES(I),I=151,158), | 20900 |
| | 6 | RT70,RT71, (RES(I),I=161,168), RT72,RT73, (RES(I),I=171,178) | 20910 |
| | | IF (LOCP .EQ. 5) LOCP = 1 | 20920 |
| | | GO TO 800 | 20930 |
| | C | | 20940 |
| | C | THIS SECTION PRINTS THE RAY TRACE RESULTS ON TAPE 6 | 20950 |
| | C | | 20960 |
| | 128 | GO TO (130,136), LOCP | 20970 |
| | 130 | NOCP=LOCP | 20980 |
| | | LOCP = 2 | 20990 |
| | | CALL PAGE (IPR, LINE, IS8, IRT) | 21000 |
| | | WRITE (IS8,510) RT20 | 21010 |

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| | | |
|-------|--|-------|
| 510 | FORMAT (1H0,46X,4A6,A3) | 21020 |
| | GO TO (132, 133, 134), ICHAP | 21030 |
| 132 0 | WRITE (IS8,501) (RT30(I),I=1,3), DIMA, RT33, DIMB, | 21040 |
| 1 | RT35, SKAL, (RT36(I),I=1,2), THIC, (RT37(I),I=1,2), NPAN, | 21050 |
| 2 | (RT38(I),I=1,2), SPAD, (RT39(I),I=1,2), PRSS, CONC, CF | 21060 |
| | GO TO 135 | 21070 |
| 133 0 | WRITE (IS8,501) (RT31(I),I=1,3), DIMA, RT33, DIMB, | 21080 |
| 1 | RT35, SKAL, (RT36(I),I=1,2), THIC, (RT37(I),I=1,2), NPAN, | 21090 |
| 2 | (RT38(I),I=1,2), SPAD, (RT39(I),I=1,2), PRSS, CONC, CF | 21100 |
| | GO TO 135 | 21110 |
| 134 0 | WRITE (IS8,502) (RT32(I),I=1,3), DIMA, RT33, DIMB, RT34, DIMC, | 21120 |
| 1 | RT35, SKAL, (RT36(I),I=1,2), THIC, (RT37(I),I=1,2), NPAN, | 21130 |
| 2 | (RT38(I),I=1,2), SPAD, (RT39(I),I=1,2), PRSS, CONC, CF | 21140 |
| 135 | WRITE (IS8,512) RT40, RES(1), RT41, RES(11), RT42, RES(21) | 21150 |
| | GO TO 137 | 21160 |
| 136 | NOCP=LOCP | 21170 |
| | LOCP = 1 | 21180 |
| | WRITE (IS8,512) RT40, RES(1), RT41, RES(11), RT42, RES(21) | 21190 |
| 512 | FORMAT (1H0/1H ,40X,A4,F5.2,5X,A4,F5.2,5X,A5,F6.2) | 21200 |
| 137 0 | WRITE (IS8,514) | 21210 |
| 1 | RT50,RT51, (RES(I),I= 31, 38), RT52,RT53, (RES(I),I= 71, 78), | 21220 |
| 2 | RT54,RT55, (RES(I),I= 81, 88), RT56,RT57, (RES(I),I= 91, 98), | 21230 |
| 3 | RT58,RT59, (RES(I),I=101,108), RT60,RT61, (RES(I),I=111,118), | 21240 |
| 4 | RT62,RT63, (RES(I),I=121,128), RT64,RT65, (RES(I),I=131,138), | 21250 |
| 5 | RT66,RT67, (RES(I),I=141,148), RT68,RT69, (RES(I),I=151,158), | 21260 |
| 6 | RT70,RT71, (RES(I),I=161,168), RT72,RT73, (RES(I),I=171,178) | 21270 |
| 514 0 | FORMAT (1H0,A6,A4,8F13.6/1H0,A6,A4,8F13.6/1H ,A6,A4,8F13.6/ | 21280 |
| 1 | 1H ,A6,A4,8F13.6/1H ,A6,A4,8F13.6/1H ,A6,A4,8F13.6/ | 21290 |
| 2 | 1H0,A6,A4,8E13.4/1H ,A6,A4,8E13.4/1H ,A6,A4,8E13.4/ | 21300 |
| 3 | 1H0,A6,A4,8F13.6/1H ,A6,A4,8F13.6/1H ,A6,A4,8F13.6) | 21310 |
| | GO TO 119 | 21320 |
| C | | 21330 |
| C | THIS SECTION PRINTS OUT THE MEAN AND RMS SUMMATION DATA. | 21340 |
| C | | 21350 |
| 140 | ISQ=ISO | 21360 |
| | CALL PAGE (IRM, LYN, ISQ, IRT) | 21370 |
| | WRITE (ISQ,500) RT20 | 21390 |
| | WRITE (ISQ,546) | 21400 |
| 546 | FORMAT (1H0,39X,43HM E A N A N D R M S S U M M A T I O N) | 21410 |
| | GO TO (142,144,146), ICHAP | 21420 |
| 142 0 | WRITE (ISQ,501) (RT30(I),I=1,3), DIMA, RT33, DIMB, | 21430 |
| 1 | RT35, SKAL, (RT36(I),I=1,2), THIC, (RT37(I),I=1,2), NPAN, | 21440 |
| 2 | (RT38(I),I=1,2), SPAD, (RT39(I),I=1,2), PRSS, CONC, CF | 21450 |
| | GO TO 148 | 21460 |
| 144 0 | WRITE (ISQ,501) (RT31(I),I=1,3), DIMA, RT33, DIMB, | 21470 |
| 1 | RT35, SKAL, (RT36(I),I=1,2), THIC, (RT37(I),I=1,2), NPAN, | 21480 |
| 2 | (RT38(I),I=1,2), SPAD, (RT39(I),I=1,2), PRSS, CONC, CF | 21490 |

| | | | | |
|--|-----|-----------|--|-------|
| | | GO TO 148 | | 21500 |
| | 146 | 0 | WRITE (ISQ,502) (RT32(I),I=1,3), DIMA, RT33, DIMB, RT34, DIMC, | 21510 |
| | | 1 | RT35, SKAL, (RT36(I),I=1,2), THIC, (RT37(I),I=1,2), NPAN, | 21520 |
| | | 2 | (RT38(I),I=1,2), SPAD, (RT39(I),I=1,2), PRSS, CONC, CF | 21530 |
| | 148 | | WRITE (ISQ,548) RES(21) | 21540 |
| | 548 | | FORMAT (1H0,48X,17HRAY ANGLE (D1) = ,F6.2,5H DEG.) | 21550 |
| | | | WRITE (ISQ, 549) | 21560 |
| | 549 | | FORMAT (1H0,47HPLANE ANGLE MEAN RMS NO. POINTS) | 21570 |
| | 0 | | WRITE (ISQ,550) (PLNA(I), AMN(I), STD(I), NMP(I), I=1, NPAG) | 21580 |
| | 550 | | FORMAT (1H0,F7.1,6X,E11.4,2X,E11.4,6X,I3) | 21590 |
| | | | IF(ITEST.EQ.0) GO TO 800 | 21600 |
| | | | WRITE(ISQ,551) | 21610 |
| | 551 | | FORMAT(1H0,60HNOTE - THE ABOVE SUMMATION DATA WAS CALCULATED BASED | 21620 |
| | | 1 | ONLY ON/8X,54HPOINTS IN THE FIRST QUADRANT OF ELLIPSES OR RECTANG | 21630 |
| | | 2 | LES/8X,45HOR ON POINTS IN THE FIRST HALF OF TRAPEZOIDS.) | 21640 |
| | 800 | | RETURN | 21650 |
| | | | END | 21660 |
| | | | \$IRFTC MS23E4) | 21670 |
| | | | CMENRMS | 21680 |
| | | | SUBROUTINE MENRMS | 21690 |
| | | C | | 21700 |
| | | | DOUBLE PRECISION AVG, AVS, VAL, CON2 | 21710 |
| | | C | | 21720 |
| | | | COMMON DUM | 21730 |
| | | C | | 21740 |
| | | 0 | EQUIVALENCE (DUM(1), CON), (DUM(501), X), | 21750 |
| | | 1 | (DUM(1001), Y), (DUM(1501), W), (DUM(2001), DWX), | 21760 |
| | | 2 | (DUM(2501), DWY), (DUM(3001), JPN), (DUM(3501), RTV) | 21770 |
| | | C | | 21780 |
| | | 0 | EQUIVALENCE (CON(1), DIMA), (CON(2), DIMB), | 21790 |
| | | 1 | (CON(3), DIMC), (CON(4), DEL), (CON(5), GNU), | 21800 |
| | | 2 | (CON(6), THIC), (CON(7), SPAD), (CON(8), PRSS), | 21810 |
| | | 3 | (CON(9), NPAN), (CON(10), ISI), (CON(11), ISO), | 21820 |
| | | 4 | (CON(12), IBC), (CON(13), NGP), (CON(14), LP7), | 21830 |
| | | 5 | (CON(15), FR), (CON(16), LOCP), (CON(17), IPD), | 21840 |
| | | 6 | (CON(18), IPR), (CON(19), CHAP), (CON(20), ISCR1), | 21850 |
| | | 7 | (CON(21), ISCR2), (CON(22), SKAL), (CON(23), ISEC), | 21860 |
| | | 8 | (CON(24), NPAG), (CON(25), YONG), (CON(26), ILGD), | 21870 |
| | | 9 | (CON(27), IREL), (CON(28), LP5), (CON(29), CPRSS) | 21880 |
| | | C | | 21890 |
| | | 0 | EQUIVALENCE (CON(30), IRM), (CON(31), IPB), | 21900 |
| | | 1 | (CON(53), SCAL), (CON(61), SPAC), (CON(69), PRES), | 21910 |
| | | 2 | (CON(77), PLNA), (CON(85), RAYA), (CON(93), RI), | 21920 |
| | | 3 | (CON(101), RES), (CON(315), STAT), (CON(371), OIF), | 21930 |
| | | 4 | (CON(401),EANDF), (CON(451), RHS) | 21940 |
| | | C | | 21950 |
| | | 0 | EQUIVALENCE (STAT(1), NMP), (STAT(9), AVG), | 21960 |

| | | |
|-------|---|-------|
| | 1 (STAT(25), AVS), (STAT(41), AMN), (STAT(49), STD) | 21970 |
| C | EQUIVALENCE (CON(33), ITEST), (OIF(11), N2) | 21980 |
| C | | 21990 |
| | DIMENSION NMP(8), AVG(8), AVS(8), AMN(8), STD(8), RES(180) | 22000 |
| C | | 22010 |
| C | XS = XIN | 22020 |
| C | YS = YIN | 22030 |
| C | XP = XOUT | 22040 |
| C | YP = YOUT | 22050 |
| C | | 22060 |
| | XXX=1. | 22070 |
| | IF(N2.EQ.2) XXX=0. | 22080 |
| | GO TO (101,110), ISEC | 22090 |
| 101 | DO 109 I=1, NPAG | 22100 |
| | IJ = I-1 | 22110 |
| | XS = RES(IJ+ 1) | 22120 |
| | YS = RES(IJ+ 11) | 22130 |
| | XP = RES(IJ+ 71) | 22140 |
| | YP = RES(IJ+ 81) | 22150 |
| | ICHAP = CHAP | 22160 |
| | GO TO (102,103,104), ICHAP | 22170 |
| | | 22180 |
| C | | 22190 |
| C==== | IS POINT MORE THAN 1 INCH INSIDE ELLIPSE BOUNDARY | 22200 |
| 102 | A = DIMA/2.0 | 22210 |
| | B = DIMB/2.0 | 22220 |
| | IF (XS .GT. A) GO TO 109 | 22230 |
| | IF (YS .GT. B) GO TO 109 | 22240 |
| | XLIM = A*SQRT(1.0-(YS**2/(B*B))) | 22250 |
| | YLIM = B*SQRT(1.0-(XS**2/(A*A))) | 22260 |
| | IF (XS .GT. (XLIM-1.0)) GO TO 109 | 22270 |
| | IF (YS .GT. (YLIM-1.0)) GO TO 109 | 22280 |
| | IF (XP .GT. A) GO TO 109 | 22290 |
| | IF (YP .GT. B) GO TO 109 | 22300 |
| | XLIM = A*SQRT(1.0-(YP**2/(B*B))) | 22310 |
| | YLIM = B*SQRT(1.0-(XP**2/(A*A))) | 22320 |
| | IF (XP .GT. (XLIM-1.0)) GO TO 109 | 22330 |
| | IF (YP .GT. (YLIM-1.0)) GO TO 109 | 22340 |
| | GO TO 108 | 22350 |
| | | 22360 |
| C | | 22370 |
| C==== | IS POINT MORE THAN 1 INCH INSIDE RECTANGLE BOUNDARY | 22380 |
| 103 | A = DIMA/2.0 | 22390 |
| | B = DIMB/2.0 | 22400 |
| | IF (XS .GT. (A-1.0)) GO TO 109 | 22410 |
| | IF (YS .GT. (B-1.0)) GO TO 109 | 22420 |
| | IF (XP .GT. (A-1.0)) GO TO 109 | 22430 |
| | IF (YP .GT. (B-1.0)) GO TO 109 | 22440 |

| | | |
|--------|---|-------|
| | GO TO 108 | 22440 |
| C | | 22450 |
| C===== | IS POINT MORE THAN 1 INCH INSIDE TRAPEZOID BOUNDARY | 22460 |
| 104 | A = DIMA/2.0 | 22470 |
| | B = DIMB | 22480 |
| | C = DIMC/2.0 | 22490 |
| | IF((N2.EQ.2) .AND. (XP.LT.0.)) GO TO 109 | 22500 |
| | IF((N2.EQ.2) .AND. (YP.LT.0.)) GO TO 109 | 22510 |
| | IF (YS .GT. B) GO TO 109 | 22520 |
| | XLIM = C + ((A-C)/B)*(B-YS) | 22530 |
| | YLIM = B | 22540 |
| | IF (XS .LE. C) GO TO 105 | 22550 |
| | IF (XS .GT. A) GO TO 109 | 22560 |
| | IF ((A-C) .NE. 0.0) GO TO 114 | 22570 |
| | YLIM = B | 22580 |
| | GO TO 105 | 22590 |
| 114 | YLIM = (B/(A-C))*(A-XS) | 22600 |
| 105 | IF (XS .GT. (XLIM-XXX)) GO TO 109 | 22610 |
| | IF (YS .GT. (YLIM-XXX)) GO TO 109 | 22620 |
| | IF (IREL .EQ. 1) GO TO 106 | 22630 |
| | IF (YS .LT. XXX) GO TO 109 | 22640 |
| | IF (YP .GT. B) GO TO 109 | 22650 |
| 126 | 106 XLIM = C + ((A-C)/B)*(B-YP) | 22660 |
| | YLIM = B | 22670 |
| | IF (XP .LE. C) GO TO 107 | 22680 |
| | IF (XP .GT. A) GO TO 109 | 22690 |
| | IF ((A-C) .NE. 0.0) GO TO 115 | 22700 |
| | YLIM = B | 22710 |
| | GO TO 107 | 22720 |
| 115 | YLIM = (B/(A-C))*(A-XP) | 22730 |
| 107 | IF (XP .GT. (XLIM-XXX)) GO TO 109 | 22740 |
| | IF (YP .GT. (YLIM-XXX)) GO TO 109 | 22750 |
| | IF (IREL .EQ. 1) GO TO 108 | 22760 |
| | IF (YP .LT. XXX) GO TO 109 | 22770 |
| | | 22780 |
| C | | 22790 |
| C===== | STORE COMPONENTS NEEDED FOR MEAN AND RMS | 22800 |
| C | | 22810 |
| 108 | NMP(I) = NMP(I) + 1 | 22820 |
| | RES1 = RES(IJ+141) | 22830 |
| | RES2 = RES1*RES1 | 22840 |
| | AVG(I) = AVG(I) + RES1 | 22850 |
| | AVS(I) = AVS(I) + RES2 | 22860 |
| | IF(N2.EQ.2) GO TO 109 | 22870 |
| | IF(ITEST.EQ.1) GO TO 109 | 22880 |
| | IF((XS.EQ.0.) .AND. (YS.EQ.0.)) GO TO 109 | 22890 |
| | IF(XS.EQ.0.) GO TO 116 | 22900 |
| | IF(I.EQ.1) J=5 | 22900 |

| | | |
|--------|---|-------|
| | IF(I.EQ.2) J=4 | 22910 |
| | IF(I.EQ.3) J=3 | 22920 |
| | IF(I.EQ.4) J=2 | 22930 |
| | IF(I.EQ.5) J=1 | 22940 |
| | IF(I.EQ.6) J=8 | 22950 |
| | IF(I.EQ.7) J=7 | 22960 |
| | IF(I.EQ.8) J=6 | 22970 |
| | NMP(J)=NMP(J)+1 | 22980 |
| | AVG(J)=AVG(J)+RES1 | 22990 |
| | AVS(J)=AVS(J)+RES2 | 23000 |
| 116 | IF(ICHAP.EQ.3) GO TO 109 | 23010 |
| | IF(YS.EQ.0.) GO TO 109 | 23020 |
| | IF(I.EQ.1) J=5 | 23030 |
| | IF(I.EQ.2) J=6 | 23040 |
| | IF(I.EQ.3) J=7 | 23050 |
| | IF(I.EQ.4) J=8 | 23060 |
| | IF(I.EQ.5) J=1 | 23070 |
| | IF(I.EQ.6) J=2 | 23080 |
| | IF(I.EQ.7) J=3 | 23090 |
| | IF(I.EQ.8) J=4 | 23100 |
| | NMP(J)=NMP(J)+1 | 23110 |
| | AVG(J)=AVG(J)+RES1 | 23120 |
| | AVS(J)=AVS(J)+RES2 | 23130 |
| 117 | IF(XS.EQ.0.) GO TO 109 | 23140 |
| | IF(I.EQ.1) J=1 | 23150 |
| | IF(I.EQ.2) J=8 | 23160 |
| | IF(I.EQ.3) J=7 | 23170 |
| | IF(I.EQ.4) J=6 | 23180 |
| | IF(I.EQ.5) J=5 | 23190 |
| | IF(I.EQ.6) J=4 | 23200 |
| | IF(I.EQ.7) J=3 | 23210 |
| | IF(I.EQ.8) J=2 | 23220 |
| | NMP(J)=NMP(J)+1 | 23230 |
| | AVG(J)=AVG(J)+RES1 | 23240 |
| | AVS(J)=AVS(J)+RES2 | 23250 |
| 109 | CONTINUE | 23260 |
| | GO TO 800 | 23270 |
| C | | 23280 |
| C===== | THIS SECTION CALCULATES THE MEAN (AMN) AND RMS (STD). | 23290 |
| C | | 23300 |
| 110 | DO 112 I=1, NPAG | 23310 |
| | AMP = 0.0 | 23320 |
| | AMP = NMP(I) | 23330 |
| | IF (AMP .EQ. 0.0) GO TO 113 | 23340 |
| | AMN(I) = AVG(I)/AMP | 23350 |
| | VAL = (AVS(I) - AVG(I)*AVG(I))/AMP | 23360 |
| | IF (VAL .GT. 0.0) GO TO 111 | 23370 |

| | | |
|-----|---|-------|
| | VAL = ABS(VAL) | 23380 |
| 111 | STD(I) = SQRT(VAL)/(SQRT(AMP-1.0)) | 23390 |
| | SMN = AMN(I)*(1.0E-6) | 23400 |
| | IF (STD(I) .LT. SMN) STD(I) = 0.0 | 23410 |
| | GO TO 112 | 23420 |
| 113 | AMN(I) = 0.0 | 23430 |
| | STD(I) = 0.0 | 23440 |
| 112 | CONTINUE | 23450 |
| 800 | RETURN | 23460 |
| | END | 23470 |
| | \$IRFTC H523E5 | 23471 |
| | C MAXMIN | 23480 |
| | SUBROUTINE MAXMIN(IRT) | 23490 |
| | C | 23500 |
| | C THIS SUBROUTINE CALCULATES THE MAXIMUM AND MINIMUM SLOPES AT A | 23510 |
| | C POINT. | 23520 |
| | C | 23530 |
| | COMMON DUM | 23540 |
| | C | 23550 |
| | 0 EQUIVALENCE (DUM(1), CON), (DUM(501), X), | 23560 |
| | 1 (DUM(1501), W), (DUM(2251), DWX), | 23570 |
| | 2 (DUM(3001), JPN), (DUM(3501), RTV) | 23580 |
| | C | 23590 |
| | 0 EQUIVALENCE (CON(1), DIMA), (CON(2), DIMB), | 23600 |
| | 1 (CON(3), DIMC), (CON(4), DEL), (CON(5), GNU), | 23610 |
| | 2 (CON(6), THIC), (CON(7), SPAD), (CON(8), PRSS), | 23620 |
| | 3 (CON(9), NPAN), (CON(10), ISI), (CON(11), ISO), | 23630 |
| | 4 (CON(12), IBC), (CON(13), NGP), (CON(14), LP7), | 23640 |
| | 5 (CON(15), FR), (CON(16), LOCP), (CON(17), IPD), | 23650 |
| | 6 (CON(18), IPR), (CON(19), CHAP), (CON(20), ISCR1), | 23660 |
| | 7 (CON(21), ISCR2), (CON(22), SKAL), (CON(23), ISEC), | 23670 |
| | 8 (CON(24), NPAG), (CON(25), YONG), (CON(26), ILGD), | 23680 |
| | 9 (CON(27), IREL), (CON(28), LP5), (CON(29), CPRSS) | 23690 |
| | C | 23700 |
| | 0 EQUIVALENCE (CON(30), IRM), (CON(31), IPB), | 23710 |
| | 1 (CON(53), SCAL), (CON(61), SPAC), (CON(69), PRES), | 23720 |
| | 2 (CON(77), PLNA), (CON(85), RAYA), (CON(93), RI), | 23730 |
| | 3 (CON(101), RES), (CON(315), STAT), (CON(371), OIF), | 23740 |
| | 4 (CON(401), EANDF), (CON(451), RHS) | 23750 |
| | C | 23760 |
| | 0 DIMENSION CON(500), X(21,33), W(21,33), | 23770 |
| | 1 DWX(21,33), JPN(500), RTV(500), OIF(12) | 23780 |
| | C | 23790 |
| | 0 DIMENSION RT30(3), RT31(3), RT32(3), RT36(2), RT37(2), RT38(2), | 23800 |
| | 1 RT39(2) | 23810 |
| | C | 23820 |
| | 0 DATA RT30(1)/13HELLIPSE A=/, RT31(1)/13HRECTANGLE A=/, | 23830 |

| | | | |
|--|-------|---|-------|
| | 1 | RT32(1)/13HTRAPEZOID A=7, RT33/4H B=7, RT34/4H C=7, | 23840 |
| | 2 | RT35/6HSCALE=/, RT36(1)/1CHTHICKNESS=/, | 23850 |
| | 3 | RT37(1)/9H PANES=/, RT38(1)/11H SPACING=/, | 23860 |
| | 4 | RT39(1)/12H PRESSURE=/ | 23870 |
| | C | | 23880 |
| | | DATA HING/6HHINGED/, CH/1H /, CLMP/6HCLAMPE/, CC/1HD/ | 23890 |
| | | RAD = 0.017453292519 | 23900 |
| | | IDT = IRT | 23910 |
| | | LINE=0 | 23920 |
| | C | | 23930 |
| | C | THIS SECTION GENERATES A POINT IN THE MIDDLE OF A GRID AND THEN | 23940 |
| | C | DETERMINES IF THE GRID EXISTS. | 23950 |
| | C | | 23960 |
| | | DO 120 K=1,NGP | 23970 |
| | | IPG = 2 | 23980 |
| | | K1 = JPN(K) | 23990 |
| | | CALL PACWRD (K1, K2, 2) | 24000 |
| | | XP = X(K1,K2) + DEL/2.0 | 24010 |
| | | EJ=K1-1 | 24020 |
| | | YP=EJ*DEL + DEL/2.0 | 24030 |
| | | CALL INCOTB (XP, YP, OWF, OWX, OWY, IPG) | 24040 |
| | | IF (IPG .EQ. 1) GO TO 120 | 24050 |
| | | R = 0.0001 | 24060 |
| | | SMX = 0.0 | 24070 |
| | | DO 114 J=1,181,2 | 24080 |
| | | RJ = J-1 | 24090 |
| | | THE = RJ*RAD | 24100 |
| | | XL = XP + R*COS(THE) | 24110 |
| | | YL = YP + R*SIN(THE) | 24120 |
| | | CALL INCOTB(XL,YL,OWG,OWX,OWY,IPG) | 24130 |
| | | OWR = (ABS(OWF) - ABS(OWG))/R | 24140 |
| | | OWS = ABS(OWR) | 24150 |
| | | IF (J .EQ. 1) SMN = OWR | 24160 |
| | | IF (J .EQ. 1) SMX = OWR | 24170 |
| | | THF = THE/RAD | 24180 |
| | | IF (OWS .LT. ABS(SMX)) GO TO 112 | 24190 |
| | | SMX = OWR | 24200 |
| | | AMX = THE/RAD | 24210 |
| | 112 | IF (OWS .GT. ABS(SMN)) GO TO 114 | 24220 |
| | | SMN = OWR | 24230 |
| | | AMN = THE/RAD | 24240 |
| | 114 | CONTINUE | 24250 |
| | | IF(K.EQ.1) GO TO 115 | 24260 |
| | | IF(LINE-45) 116,115,115 | 24270 |
| | 115 | CALL PAGE (IPD, LINE, ISO, IDT) | 24280 |
| | | WRITE (ISO,500) | 24290 |
| | 500 0 | FORMAT (1H0/1H ,3X,40H" I N D O W : D E F O R M A T I O N S - , | 24300 |
| | 1 | 49H D E F L E C T I O N , M A X I M U M A N D , | 24310 |

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2 25HM IN I M U M S L O P E / 1 H )
  ICHAP = CHAP
  IF ( IBC .NE. 1) GO TO 302
  CONC = HING
  CF = CH
302 IF (IBC .NE. 2) GO TO 303
  CONC = CLMP
  CF = CC
303 GO TO (102,103,104), ICHAP
102 0 WRITE (ISO,501) (RT30(I),I=1,3), DIMA, RT33, DIMB,
  1 RT35, SKAL, (RT36(I),I=1,2), THIC, (RT37(I),I=1,2), NPAN,
  2 (RT38(I),I=1,2), SPAD, (RT39(I),I=1,2), PRSS, CONC, CF
501 0 FORMAT (1H0,2A6,A1,F5.2,A4,F5.2,14X,A6,F4.2,3X,A6,A4,F5.2,A6,A3,
  1 I1,A6,A5,F3.1,2A6,F5.1,3X,A6,A1)
  GO TO 105
103 0 WRITE (ISO,501) (RT31(I),I=1,3), DIMA, RT33, DIMB,
  1 RT35, SKAL, (RT36(I),I=1,2), THIC, (RT37(I),I=1,2), NPAN,
  2 (RT38(I),I=1,2), SPAD, (RT39(I),I=1,2), PRSS, CONC, CF
  GO TO 105
104 0 WRITE (ISO,518) (RT32(I),I=1,3), DIMA, RT33, DIMB, RT34, DIMC,
  1 RT35, SKAL, (RT36(I),I=1,2), THIC, (RT37(I),I=1,2), NPAN,
  2 (RT38(I),I=1,2), SPAD, (RT39(I),I=1,2), PRSS, CONC, CF
518 0 FORMAT (1H0,2A6,A1,F5.2,A4,F5.2,A4,F5.2,5X,A6,F4.2,3X,A6,A4,F5.2,
  1 A6,A3,I1,A6,A5,F3.1,2A6,F5.1,3X,A6,A1)
105 WRITE (ISO,505)
505 0 FORMAT (1H0/1H ,43H(ANGLE IS IN DEGREES MEASURED WITH RESPECT ,
  1 23HTO THE POSITIVE X-AXIS)/1H0,12H COORDINATES,26X,8HMAXIMUM ,
  2 5HSLOPE,10X,14HMINIMUM SLOPE/1H ,3H X,7X,1HY,8X,10HDEFLECTION,
  3 8X,15HSLOPE ANGLE,8X,15HSLOPE ANGLE)
116 WRITE (ISO,506) XP, YP, OWF, SMX, AMX, SMN, AMN
506 FORMAT (1H ,F5.2,3X,F5.2,4X,E12.5,2(4X,E12.5,3X,F4.0))
120 CONTINUE
800 RETURN
  END
$IRFTC MS23E6
CRTVLST
  SUBROUTINE RTVLST (IRT, LIN, IPV)
  C
  C III = SWITCH TO BYPASS RETRIEVAL PAGING PRINTOUT
  C IPV = PAGE COUNTER FOR RETRIEVAL INDEX PRINTOUT
  C ISO = SYSTEM OUTPUT TAPE
  C JT1 = RETRIEVAL NUMBER
  C JT7 = NUMBER OF PAGES
  C JT10 = BOUNDARY COORDINATE SWITCH
  C LIN = RETRIEVAL INDEX OUTPUT LINE COUNTER
  C RT2 = PLANFORM SELECTION SWITCH
  C RT3 = BASE LENGTH OF PLANFORM
  C RT4 = WIDTH OF PLANFORM
  C RT5 = UPPER X DIMENSION OF TRAPEZOID

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|---|-----------------------------|----------------------------|-------------------------------|-------|
| C | RT6 = GLASS THICKNESS | | | 24790 |
| C | RT8 = SPACING BETWEEN PANES | | | 24800 |
| C | RT9 = INTERSTITIAL PRESSURE | | | 24810 |
| C | | | | 24820 |
| | COMMON DUM | | | 24830 |
| C | | | | 24840 |
| | 0 EQUIVALENCE | (DUM(1), CON), | (DUM(501), X), | 24850 |
| | 1 (DUM(1001), Y), | (DUM(1501), W), | (DUM(2001), DWX), | 24860 |
| | 2 (DUM(2501), DWY), | (DUM(3001), JPN), | (DUM(3501), RTV) | 24870 |
| C | | | | 24880 |
| | 0 EQUIVALENCE | (CON(1), DIMA), | (CON(2), DIMB), | 24890 |
| | 1 (CON(3), DIMC), | (CON(4), DEL), | (CON(5), GNU), | 24900 |
| | 2 (CON(6), THIC), | (CON(7), SPAD), | (CON(8), PRSS), | 24910 |
| | 3 (CON(9), NPAN), | (CON(10), ISI), | (CON(11), ISO), | 24920 |
| | 4 (CON(12), IBC), | (CON(13), NGP), | (CON(14), LP7), | 24930 |
| | 5 (CON(15), FR), | (CON(16), LOCP), | (CON(17), IPD), | 24940 |
| | 6 (CON(18), IPR), | (CON(19), CHAP), | (CON(20), ISCR1), | 24950 |
| | 7 (CON(21), ISCR2), | (CON(22), SKAL), | (CON(23), ISEC), | 24960 |
| | 8 (CON(24), NPAG), | (CON(25), YONG), | (CON(26), ILGD), | 24970 |
| | 9 (CON(27), IREL), | (CON(28), LP5), | (CON(29), CPRSS) | 24980 |
| C | | | | 24990 |
| | 0 EQUIVALENCE | (CON(30), IRM), | (CON(31), IPB), | 25000 |
| | 1 (CON(53), SCAL), | (CON(61), SPAC), | (CON(69), PRES), | 25010 |
| | 2 (CON(77), PLNA), | (CON(85), RAYA), | (CON(93), RI), | 25020 |
| | 3 (CON(101), RES), | (CON(315), STAT), | (CON(371), OIF), | 25030 |
| | 4 (CON(401), EANDF), | (CON(451), RHS) | | 25040 |
| C | | | | 25050 |
| | 0 EQUIVALENCE | (RTV(1), JT1), | (RTV(41), RT2), | 25060 |
| | 1 (RTV(81), RT3), | (RTV(121), RT4), | (RTV(161), RT5), | 25070 |
| | 2 (RTV(201), RT6), | (RTV(241), JT7), | (RTV(281), RT8), | 25080 |
| | 3 (RTV(321), RT9), | (RTV(361), JT10), | (RTV(401), RT11) | 25090 |
| C | | | | 25100 |
| | 0 DIMENSION | CON(500), | X(22,22), Y(22,22), W(22,22), | 25110 |
| | 1 DWX(22,22), DWY(22,22), | JPN(500), | RTV(500) | 25120 |
| C | | | | 25130 |
| | 0 DIMENSION | SCAL(8), | SPAC(8), PRES(8), PLNA(8), | 25140 |
| | 1 RAYA(8), RI(7), | RES(180), | | 25150 |
| | 2 RT30(2), RT31(2), | RT32(2), RT33(2), RT34(2), | SHAP(2), CONC(2) | 25160 |
| C | | | | 25170 |
| | 0 DIMENSION | JT1(50), RT2(50), RT3(50), | RT4(50), RT5(50), RT6(50), | 25180 |
| | 1 JT7(50), RT8(50), | RT9(50), JT10(50) | | 25190 |
| C | | | | 25200 |
| | 0 DATA | RT30(1)/9HELLIPSE /, | RT31(1)/9HRECTANGLE/, | 25210 |
| | 1 | RT32(1)/9HTRAPEZOID/, | RT33(1)/7HHINGED /, | 25220 |
| | 2 | RT34(1)/7HCLAMPED/, | STAR/5H*****/ | 25230 |
| C | | | | 25240 |
| | LIN = LIN + 1 | | | 25250 |

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| | IF (LIN .LT. 100) GO TO 100 | 25260 |
| | LIN = LIN - 101 | 25270 |
| | GO TO 101 | 25280 |
| 100 | JT1(LIN) = IRT | 25290 |
| | RT2(LIN) = CHAP | 25300 |
| | RT3(LIN) = DIMA | 25310 |
| | RT4(LIN) = DIMB | 25320 |
| | RT5(LIN) = DIMC | 25330 |
| | RT6(LIN) = THIC | 25340 |
| | JT7(LIN) = NPAN | 25350 |
| | RT8(LIN) = SPAD | 25360 |
| | IF (NPAN .EQ. 1) RT8(LIN) = STAR | 25370 |
| | RT9(LIN) = PRSS | 25380 |
| | JT10(LIN) = IBC | 25390 |
| | IF (LIN .LT. 40) GO TO 800 | 25400 |
| 101 | III = 0 | 25410 |
| | CALL PAGE (IPV, LIN, ISO, III) | 25420 |
| | WRITE (ISO, 500) | 25430 |
| 500 0 | FORMAT (1H0,42HRETRIEVAL SHAPE A B C , | 25440 |
| 1 | 59HTHICKNESS PANES SPACING PRESSURE FIXITY / | 25450 |
| 2 | 7H NUMBER,16X,17HIN. IN. IN.,6X,3HIN.,16X,3HIN.,8X,3HLB., | 25460 |
| 3 | 16X/1H) | 25470 |
| | DO 114 I=1,LIN | 25480 |
| | IF (RT2(I) .NE. 1.0) GO TO 102 | 25490 |
| | SHAP(1) = RT30(1) | 25500 |
| | SHAP(2) = RT30(2) | 25510 |
| 102 | IF (RT2(I) .NE. 2.0) GO TO 104 | 25520 |
| | SHAP(1) = RT31(1) | 25530 |
| | SHAP(2) = RT31(2) | 25540 |
| 104 | IF (RT2(I) .NE. 3.0) GO TO 106 | 25550 |
| | SHAP(1) = RT32(1) | 25560 |
| | SHAP(2) = RT32(2) | 25570 |
| 106 | IF (JT10(I) .NE. 1) GO TO 108 | 25580 |
| | CONC(1) = RT33(1) | 25590 |
| | CONC(2) = RT33(2) | 25600 |
| 108 | IF (JT10(I) .NE. 2) GO TO 112 | 25610 |
| | CONC(1) = RT34(1) | 25620 |
| | CONC(2) = RT34(2) | 25630 |
| 112 | IF (NPAN .EQ. 2) GO TO 113 | 25640 |
| 0 | WRITE (ISO,502) JT1(I), (SHAP(J),J=1,2), RT3(I), RT4(I), RT5(I), | 25650 |
| 1 | RT6(I), JT7(I), RT8(I), RT9(I), (CONC(J),J=1,2) | 25660 |
| 502 0 | FORMAT (1H ,3X,I3,4X,A6,A3,2X,F5.2,2X,F5.2,2X,F5.2,4X,F5.2,7X,I1, | 25670 |
| 1 | 6X,A5, 5X,F5.1,5X,A6,A1,4X) | 25680 |
| | GO TO 114 | 25690 |
| 113 0 | WRITE (ISO,503) JT1(I), (SHAP(J),J=1,2), RT3(I), RT4(I), RT5(I), | 25700 |
| 1 | RT6(I), JT7(I), RT8(I), RT9(I), (CONC(J),J=1,2) | 25710 |
| 503 0 | FORMAT (1H ,3X,I3,4X,A6,A3,2X,F5.2,2X,F5.2,2X,F5.2,4X,F5.2,7X,I1, | 25720 |

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| | 1-6X,F5.2,5X,F5.1,5X,A6,A1) | 25730 |
| 114 | CONTINUE | 25740 |
| | LIN = 0 | 25750 |
| 800 | RETURN | 25760 |
| | END | 25770 |
| | \$IBFTC MS23E7 | 25780 |
| | CBONDRY | 25790 |
| | SUBROUTINE BONDRY (XP, YP, IBY) | 25800 |
| C | | 25810 |
| C | THIS SUBROUTINE TESTS THE X AND Y COORDINATES OF A POINT TO BE | 25820 |
| C | SURE THEY ARE INSIDE THE BOUNDARY. | 25830 |
| C | | 25840 |
| C | A = DEFINED BELOW | 25850 |
| C | B = DEFINED BELOW | 25860 |
| C | C = DEFINED BELOW | 25870 |
| C | CHAP = ICHAP = PLANFORM SELECTION SWITCH | 25880 |
| C | DIMA = LOWER LENGTH OF PLANFORM | 25890 |
| C | DIMB = HEIGHT OF PLANFORM | 25900 |
| C | DIMC = UPPER X DIMENSION OF TRAPEZOID | 25910 |
| C | IBY = 1 INDICATES POINT IS OUTSIDE PLANFORM BOUNDARY | 25920 |
| C | XLIM = X VALUE AT PLANFORM BOUNDARY CORRESPONDING TO YP | 25930 |
| C | XP = X COORDINATE OF POINT BEING CHECKED | 25940 |
| C | YP = Y COORDINATE OF POINT BEING CHECKED | 25950 |
| C | | 25960 |
| | COMMON DUM | 25970 |
| C | | 25980 |
| | 0 EQUIVALENCE (DUM(1), CON), (DUM(501), X), | 25990 |
| | 1 (DUM(1001), Y), (DUM(1501), W), (DUM(2001), DWX), | 26000 |
| | 2 (DUM(2501), DWY), (DUM(3001), JPN), (DUM(3501), RIV) | 26010 |
| G | | 26020 |
| | 0 EQUIVALENCE (CON(1), DIMA), (CON(2), DIMB), | 26030 |
| | 1 (CON(3), DIMC), (CON(4), DEL), (CON(5), GNU), | 26040 |
| | 2 (CON(6), THIC), (CON(7), SPAD), (CON(8), PRSS), | 26050 |
| | 3 (CON(9), NPAN), (CON(10), ISI), (CON(11), ISO), | 26060 |
| | 4 (CON(12), IBC), (CON(13), NGP), (CON(14), LP7), | 26070 |
| | 5 (CON(15), FR), (CON(16), LOCP), (CON(17), IPD), | 26080 |
| | 6 (CON(18), IPR), (CON(19), CHAP), (CON(20), ISCR1), | 26090 |
| | 7 (CON(21), ISCR2), (CON(22), SKAL), (CON(23), ISEC), | 26100 |
| | 8 (CON(24), NPAG), (CON(25), YONG), (CON(26), ILGD), | 26110 |
| | 9 (CON(27), IREL), (CON(28), LP5), (CON(29), CPRSS) | 26120 |
| C | | 26130 |
| | 0 EQUIVALENCE (CON(30), IRM), (CON(31), IPB), | 26140 |
| | 1 (CON(53), SCAL), (CON(61), SPAC), (CON(69), PRES), | 26150 |
| | 2 (CON(77), PLNA), (CON(85), RAYA), (CON(93), RI), | 26160 |
| | 3 (CON(101), RES), (CON(315), STAT), (CON(371), OIF), | 26170 |
| | 4 (CON(401), EANDF), (CON(451), RHS) | 26180 |
| C | | 26190 |

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END ..... 26670
$IBFTC MS23E9 ..... 26680
CPAGE ..... 26690
SUBROUTINE PAGE (IPN, LINE, ISN, INX) ..... 26700
C THIS SUBROUTINE PRINTS THE TIME AND PAGE NUMBER AT THE PAGE TOP ..... 26710
C ..... 26720
C INX = RETRIEVAL NUMBER ..... 26730
C IPN = PAGE NUMBER ..... 26740
C ISN = TAPE NUMBER ..... 26750
C LINE = LINE NUMBER ..... 26760
C ..... 26770
C DIMENSION RT10(3) ..... 26780
C ..... 26790
G DATA RT10(1)/18HRETRIEVAL NUMBER =/, RT11/4HPAGE/ ..... 26800
IPN = IPN + 1 ..... 26810
IF (INX .EQ. 0) GO TO 100 ..... 26820
IF (ISN .EQ. 9) GO TO 102 ..... 26830
WRITE (ISN,500) (RT10(I), I=1,3), INX, RT11, IPN ..... 26840
500 FORMAT (1H1,3A6,I5,89X,A4,I4) ..... 26850
GO TO 800 ..... 26860
102 WRITE (ISN) (RT10(I), I=1,3), INX, RT11, IPN ..... 26870
GO TO 800 ..... 26880
100 WRITE (ISN, 501) RT11, IPN ..... 26890
501 FORMAT (1H1,112X,A4,I4) ..... 26900
800 LINE = 1 ..... 26910
RETURN ..... 26920
END ..... 26930
$IBFTC MS23F0 ..... 26940
CSHRDEF ..... 26950
SUBROUTINE SHRDEF ..... 26960
C ..... 26970
C ETA = FACTOR TO MODIFY DEFLECTION BY TO OBTAIN SHEAR DEFORMATION ..... 26980
C ..... 26990
COMMON DUM ..... 27000
C ..... 27010
0 EQUIVALENCE (DUM( 1), CON), (DUM( 501), X), ..... 27020
1 (DUM(1001), Y), (DUM(1501), W), (DUM(2001), DWX), ..... 27030
2 (DUM(2501), DWY), (DUM(3001), JPN), (DUM(3501), RTV) ..... 27040
C ..... 27050
0 EQUIVALENCE (CON( 1), DIMA), (CON( 2), DIMB), ..... 27060
1 (CON( 3), DIMC), (CON( 4), DEL), (CON( 5), GNU), ..... 27070
2 (CON( 6), THIC), (CON( 7), SPAD), (CON( 8), PRSS), ..... 27080
3 (CON( 9), NPAN), (CON(10), ISI), (CON(11), ISO), ..... 27090
4 (CON(12), IBC), (CON(13), NGP), (CON(14), LP7), ..... 27100
5 (CON(15), FR), (CON(16), LOCP), (CON(17), IPD), ..... 27110
6 (CON(18), IPR), (CON(19), CHAP), (CON(20), ISCR1), ..... 27120

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| | 7 (CON(21),ISCR2), | (CON(22), SKAL), | (CON(23), ISEC), | 27140 | | |
| | 8 (CON(24), NPAG), | (CON(25), YONG), | (CON(26), ILRG), | 27150 | | |
| | 9 (CON(27), IREL), | (CON(28), LP5), | (CON(29),CPRSS) | 27160 | | |
| C | | | | 27170 | | |
| | 0 EQUIVALENCE | (CON(30), IRM), | (CON(31), IPB), | 27180 | | |
| | 1 (CON(53), SCAL), | (CON(61), SPAC), | (CON(69), PRES), | 27190 | | |
| | 2 (CON(77), PLNA), | (CON(85), RAYA), | (CON(93), RI), | 27200 | | |
| | 3 (CON(101), RES), | (CON(315), STAT), | (CON(371), OIF), | 27210 | | |
| | 4 (CON(401),EANDF), | (CON(451), RHS) | | 27220 | | |
| C | | | | 27230 | | |
| | 0 DIMENSION | CON(500), | X(22,22), | Y(22,22), | W(22,22), | 27240 |
| | 1 DWX(22,22), | DWY(22,22), | JPN(500), | RTV(500) | | 27250 |
| C | | | | | | 27260 |
| | PI2 = 3.141592653*3.141592653 | | | | | 27270 |
| | BET2 = (DIMA/DIMB)**2 | | | | | 27280 |
| | ETA = PI2*(1.0 + BETA)*(THIC**2)/((DIMA**2)*(1.0 - GNU)*3.0) | | | | | 27290 |
| | DO 100 I=1,22 | | | | | 27300 |
| | DO 100 J = 1,22 | | | | | 27310 |
| 100 | W(I,J) = W(I,J)*ETA | | | | | 27320 |
| 800 | RETURN | | | | | 27330 |
| | END | | | | | 27340 |
| | \$IBFTC MS23F1 | | | | | 27350 |
| | FUNCTION SINH(ARC) | | | | | 27360 |
| C | | | | | | 27370 |
| C | THIS FUNCTION CALCULATES THE DOUBLE PRECISION HYPERBOLIC SINE | | | | | 27380 |
| C | BUT RETURNS THE SINGLE PRECISION HYPERBOLIC SINE. | | | | | 27390 |
| C | | | | | | 27400 |
| | DOUBLE PRECISION ARG,DSINH | | | | | 27410 |
| C | | | | | | 27420 |
| | ARG = ARC | | | | | 27430 |
| | IF(ARC .GT. 88.0) ARG=88.0 | | | | | 27440 |
| | DSINH = 5.0D-1*(DEXP(ARG)-DEXP(-ARG)) | | | | | 27450 |
| | SINH = DSINH | | | | | 27460 |
| | RETURN | | | | | 27470 |
| | END | | | | | 27480 |
| | \$IBFTC MS23F2 | | | | | 27490 |
| | FUNCTION COSH(ARC) | | | | | 27500 |
| C | | | | | | 27510 |
| C | THIS FUNCTION CALCULATES THE DOUBLE PRECISION HYPERBOLIC COSINE | | | | | 27520 |
| C | BUT RETURNS THE SINGLE PRECISION HYPERBOLIC COSINE. | | | | | 27530 |
| C | | | | | | 27540 |
| | DOUBLE PRECISION ARG,DCOSH | | | | | 27550 |
| C | | | | | | 27560 |
| | ARG = ARC | | | | | 27570 |
| | IF(ARC .GT. 88.0) ARG=88.0 | | | | | 27580 |
| | DCOSH = 5.0D-1*(DEXP(ARG)+DEXP(-ARG)) | | | | | 27590 |
| | COSH = DCOSH | | | | | 27600 |

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|---------|--|-------|
| | RETURN | 27610 |
| | END | 27620 |
| \$IBFTC | MS23F3 | 27630 |
| | FUNCTION TANH(ARC) | 27640 |
| C | | 27650 |
| C | THIS FUNCTION CALCULATES THE DOUBLE PRECISION HYPERBOLIC TANGENT | 27660 |
| C | BUT RETURNS THE SINGLE PRECISION HYPERBOLIC TANGENT. | 27670 |
| C | | 27680 |
| C | DOUBLE PRECISION ARG,DTANH | 27690 |
| | | 27700 |
| | ARG = ARC | 27710 |
| | IF(ARC .GT. 88.0) ARG=88.0 | 27720 |
| | DTANH = (DEXP(ARG)-DEXP(-ARG))/(DEXP(ARG)+DEXP(-ARG)) | 27730 |
| | TANH = DTANH | 27740 |
| | RETURN | 27750 |
| | END | 27760 |

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| | \$IBFTC MS23G0 | 00000 |
| | CWINTWO | 00010 |
| | C | 00020 |
| | C * STARED PROGRAMS CONTAIN DIFFERENT FLOW LOGIC THAN SINGLE RAY | 00030 |
| | C PROGRAMS OF THE SAME NAME. THE CON EQUIVALENCE IS DIFFERENT FROM | 00040 |
| | C SINGLE RAY TRACE PROGRAMS IN ALL TWO RAY TRACE PROGRAMS. | 00050 |
| | C G0 * WINTWO - APOLLO WINDOW DEFORMATION AND LINE OF SIGHT DRIVER | 00060 |
| | C G1 ELIPSE - ELLIPSE DEFORMATION GENERATOR | 00070 |
| | C G2 ELIPIT - ELLIPTIC COORDINATE GENERATOR | 00080 |
| | C G3 RECTAG - RECTANGULAR DEFORMATION GENERATOR | 00090 |
| | C G4 SEQS - MATRIX INVERSION AND LINEAR EQUATION SOLUTION | 00100 |
| | C G5 TRPZOD - READS IN TRAPEZOIDAL DEFORMATION DATA FROM SAMIS | 00110 |
| | C G6 LRGDEF - LARGE DEFLECTION GENERATOR FOR RECTANGLES | 00120 |
| | C G7 DEFRES - PRINTS PLATE (WINDOW) DEFORMATION DATA | 00130 |
| | C G8 * RAYTWO - DRIVER FOR RAY TRACE PROCEDURE | 00140 |
| | C G9 * TRACE - TRACES RAY THRU WINDOW | 00150 |
| | C H0 ITERAT - ITERATES TO FIND LOCATION OF RAY ON NEXT SURFACE | 00160 |
| | C H1 INCOTB - DETERMINES DEFORMATION OF PLATE AT INTERSECTION W/RAY | 00170 |
| | C H2 NORMAL - CALCULATES NORMAL TO PLATE AT RAY INTERSECTION POINT | 00180 |
| | C H3 REFRCI - CALCULATES NEW DIRECTION OF RAY UPON ENTERING NEW MEDIUM | 00190 |
| | C H4 CROPOD - FINDS CROSS PRODUCT OF 2 VECTORS | 00200 |
| | C H5 * RESTWO - PRINTS RAY TRACE AND MEAN-RMS RESULTS | 00210 |
| 138 | C H6 * MENRMS - STORES DATA FOR MEAN AND RMS CALCULATIONS | 00220 |
| Y | C H7 MAXMIN - CALCULATES MAX/MIN SLOPES AT GRID POINTS | 00230 |
| | C H8 RTVLST - RETRIEVAL LIST | 00240 |
| | C H9 BONDRY - TEST TO SEE IF POINT OF RAY IS OUTSIDE PLAN FORM BNDRY | 00250 |
| | C J0 PACWRD - INDEX WORD PACKING-UNPACKING ROUTINE | 00260 |
| | C J1 PAGE - PRINTS PAGE NO. AT TOP OF EACH PAGE (AND RETRIEVAL NO.) | 00270 |
| | C J2 SHRDEF - SHEAR DEFORMATION GENERATOR | 00280 |
| | C J3 SINH - CALCULATES HYPERBOLIC SINE | 00290 |
| | C J4 COSH - CALCULATES HYPERBOLIC COSINE | 00300 |
| | C J5 TANH - CALCULATES HYPERBOLIC TANGENT | 00310 |
| | C | 00320 |
| | C AA = X DIMENSION OF SHAPE | 00330 |
| | C = LENGTH OF ELLIPSE SEMI AXIS | 00340 |
| | C = LENGTH OF RECTANGLE | 00350 |
| | C = 1/2 BASE LENGTH OF TRAPEZOID | 00360 |
| | C AMN = ARRAY FOR STORING MEANS | 00370 |
| | C AVG = ARRAY FOR STORING MEAN DATA | 00380 |
| | C AVS = ARRAY FOR STORING RMS DATA | 00390 |
| | C BB = Y DIMENSION OF SHAPE | 00400 |
| | C = HEIGHT OF ELLIPSE SEMI AXIS | 00410 |
| | C = HEIGHT OF RECTANGLE | 00420 |
| | C = HEIGHT OF TRAPEZOID | 00430 |
| | C BONC = BOUNDARY CONDITION | 00440 |
| | C CC = UPPER X DIMENSION OF TRAPEZOID | 00450 |
| | C CHAP = ICHAP = SHAP = GEOMETRIC SHAPE | 00460 |

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|---|-------|--|-------|
| C | CON | = DUMMY ARRAY FOR CONSTANT AND VARIABLE STORAGE | 00470 |
| C | CPRSS | = CABIN PRESSURE | 00480 |
| C | DEL | = GRID SPACING | 00490 |
| C | DIMA | = A DIMENSION | 00500 |
| C | DIMB | = B DIMENSION | 00510 |
| C | DIMC | = C DIMENSION | 00520 |
| C | DON | = CONSTANT IN REFRACTIVE INDEX EQUATION | 00530 |
| C | DWX | = ARRAY OF GRIDPOINT DEFLECTIONS FOR SECOND PANE | 00540 |
| C | EANDF | = ARRAY USED IN RECTNG | 00550 |
| C | FR | = PLATE STIFFNESS (D) | 00560 |
| C | GNU | = POISSONS RATIO | 00570 |
| C | IBC | = BOUNDARY CONDITION SWITCH | 00580 |
| C | ICHAP | = SEE CHAP | 00590 |
| C | IDT | = DEFORMATION DATA RETRIEVAL SEQUENCE NUMBER | 00600 |
| C | ILGD | = 1, FIND DEFORMATIONS BY LARGE DEFORMATION METHOD | 00610 |
| C | ILRG | = 1, LARGE DEFLECTIONS WERE CALCULATED | 00620 |
| C | IMAN | = 1, FIND MAX./MIN. SLOPES OF DEFORMED POINTS | 00630 |
| C | INDX | = 1, PRINT RETRIEVAL INDEX AT TOP OF PAGE =0,NO PRINT | 00640 |
| C | IPB | = PAGE NUMBER COUNTER IN RESRPT FOR TAPE 9 | 00650 |
| C | IPD | = PAGE NUMBER COUNTER IN DEFRES | 00660 |
| C | IPR | = PAGE NUMBER COUNTER IN RESRPT | 00670 |
| C | IPV | = RETRIEVAL LIST PAGE NUMBER | 00680 |
| C | IREL | = 1, REAL WINDOW INCLUDE OTHER SIDE OF SYMMETRY AXIS | 00690 |
| C | IRM | = PAGE NUMBER COUNTER IN RESRPT FOR RMS OUTPUT ON TAPE 6 | 00700 |
| C | IRT | = LOS DATA RETRIEVAL SEQUENCE NUMBER | 00710 |
| C | ISCR1 | = SCRATCH TAPE UNIT 7 FOR DEFORMATION DATA | 00720 |
| C | ISCR2 | = SCRATCH TAPE UNIT 8 FOR LINE OF SIGHT (LOS) DATA | 00730 |
| C | ISEC | = 1, PRINT LOS DATA, =2, PRINT RMS DATA | 00740 |
| C | ISI | = INPUT TAPE NUMBER | 00750 |
| C | ISO | = OUTPUT TAPE NUMBER | 00760 |
| C | IS9 | = SCRATCH TAPE UNIT 9 FOR LINE OF SIGHT DATA BINARY CODED | 00770 |
| C | ISHR | = 1, CALCULATE SHEAR DEFORMATIONS | 00780 |
| C | JPN | = ARRAY OF GRIDPOINT COORDINATE INDEXES | 00790 |
| C | LIN | = RETRIEVAL LIST LINE COUNTER | 00800 |
| C | LOCP | = KEYS HEADINGS AT TOP OF LOS PRINTED PAGE LOCP=2,NO HEAD | 00810 |
| C | LP1 | = INDEX ON NO. OF BOUNDARY CONDITIONS | 00820 |
| C | LP2 | = INDEX ON NO. OF SCALES | 00830 |
| C | LP3 | = INDEX ON NO. OF SPACES | 00840 |
| C | LP4 | = INDEX ON NO. OF PRESSURES | 00850 |
| C | LP5 | = INDEX ON NO. OF RAY ANGLES | 00860 |
| C | LP6 | = INDEX ON NO. OF GRID POINTS | 00870 |
| C | LP7 | = INDEX ON NO. OF PLANE ANGLES | 00880 |
| C | MIBP | = 1, BYPASS GENERATION OF INVERSION MATRIX FOR INTERPOLATION | 00890 |
| C | MRT | = BYPASS SWITCH FOR TAPE REWIND STATEMENTS IN WINTWO | 00900 |
| C | NBC | = NO. OF BOUNDARY CONDITIONS | 00910 |
| C | NGP | = NO. OF GRID POINTS | 00920 |
| C | NMP | = ARRAY OF NUMBER OF DATA PTS. IN MEAN | 00930 |

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|---|---|-------|
| C | NOPRT = KEYS TAPES ON WHICH OUTPUT DATA APPEARS | 00940 |
| C | = 0, DEFORMATIONS ON TAPE 7, LOS ON TAPES 8 AND 9 | 00950 |
| C | = 1, ALL DATA ON SYSTEM OUTPUT TAPE | 00960 |
| C | = 2, OUTPUT ONLY RMS DATA ON OUTPUT TAPE | 00970 |
| C | NPAG = NO. OF PLANE ANGLES | 00980 |
| C | NPAN = NO. OF PANES | 00990 |
| C | NPRS = NO. OF PRESSURES | 01000 |
| C | NRAG = NO. OF RAY ANGLES | 01010 |
| C | NRFI = NO. OF REFRACTIVE INDEXES TO BE READ IN | 01020 |
| C | NSCL = NO. OF SCALES | 01030 |
| C | NSPC = NO. OF SPACES | 01040 |
| C | OIF = SUPPLEMENTAL ARRAY | 01050 |
| C | PLNA = ARRAY OF PLANE ANGLES | 01060 |
| C | PRES = ARRAY FOR STORING INTERSTITIAL PRESSURES | 01070 |
| C | PRSS = PRES(I) = PRESSURE ON PLATE | 01080 |
| C | RAYA = ARRAY OF RAY ANGLES | 01090 |
| C | RES = ARRAY FOR STORING LOS OUTPUT | 01100 |
| C | RI = ARRAY OF REFRACTIVE INDEXES | 01110 |
| C | RIC = REFRACTIVE INDEX COEFFICIENT | 01120 |
| C | RHS = ARRAY USED IN RECT'NG | 01130 |
| C | RTV = ARRAY FOR STORING RETRIEVAL INFORMATION | 01140 |
| C | SCAL = ARRAY FOR STORING GEOMETRIC SCALE FACTORS | 01150 |
| C | SHAP = SEE CHAP | 01160 |
| C | SKAL = SCAL(I) = DIMENSIONAL SCALING FACTOR | 01170 |
| C | SPAC = ARRAY FOR STORING SPACE FACTORS | 01180 |
| C | SPAD = SPAC(I) = SPACE BETWEEN PLATES | 01190 |
| C | STAT = ARRAY FOR STORING MEAN AND RMS DATA | 01200 |
| C | STD = ARRAY FOR STORING RMSES | 01210 |
| C | THIC = PLATE THICKNESS | 01220 |
| C | W = ARRAY OF GRIDPOINT DEFLECTIONS FOR FIRST PANE | 01230 |
| C | WORD = ARRAY FOR TITLE | 01240 |
| C | X = ARRAY OF X COORDINATES OF GRIDPOINTS IN DEFORMATION TABLE | 01250 |
| C | YONG = YOUNGS MODULUS | 01260 |
| C | | 01270 |
| C | DOUBLE PRECISION AVG,AVS | 01280 |
| C | | 01290 |
| C | COMMON DUM | 01300 |
| C | | 01310 |
| | 0 EQUIVALENCE (DUM(1), CON), (DUM(501), X), | 01320 |
| | 1 (DUM(1501), W), (DUM(2251), DWX), | 01330 |
| | 2 (DUM(3001), JPN), (DUM(3501), RTV) | 01340 |
| C | | 01350 |
| | 0 EQUIVALENCE (CON(1), DIMA), (CON(2), DIMB), | 01360 |
| | 1 (CON(3), DIMC), (CON(4), DEL), (CON(5), GNU), | 01370 |
| | 2 (CON(6), THIC), (CON(7), SPAD), (CON(8), PRSS), | 01390 |
| | 3 (CON(9), NPAN), (CON(10), ISI), (CON(11), ISO), | 01400 |
| | 4 (CON(12), IBC), (CON(13), NGP), (CON(14), LP7), | 01410 |

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|-------|-----------------------------------|--|-------------------|-------|
| 5 | (CON(15), FR), | (CON(16), LOCP), | (CON(17), IPD), | 01420 |
| 6 | (CON(18), IPR), | (CON(19), CHAP), | (CON(20), ISCR1), | 01430 |
| 7 | (CON(21), ISCR2), | (CON(22), SKAL), | (CON(23), ISEC), | 01440 |
| 8 | (CON(24), NPAG), | (CON(25), YONG), | (CON(26), ILRG), | 01450 |
| 9 | (CON(27), IREL), | (CON(28), LP5), | (CON(29), CPRSS) | 01460 |
| C | | | | 01470 |
| 0 | EQUIVALENCE | (CON(31), SCAL), | (CON(41), SPAC), | 01480 |
| 1 | (CON(51), PRES), | (CON(61), PLNA), | (CON(71), RAYA), | 01490 |
| 2 | (CON(81), PAIA), | (CON(91), THEA), | (CON(101), RI), | 01500 |
| 3 | (CON(111), RES), | (CON(291), STAT), | (CON(351), OIF), | 01510 |
| 4 | (CON(30), IRM), | (OIF(1), IDX), | | 01520 |
| 5 | (OIF(2), IDY), | (OIF(3), X1), | (OIF(4), Y1) | 01530 |
| C | | | | 01540 |
| 0 | EQUIVALENCE | (STAT(1), NMP), | (STAT(9), AVG), | 01550 |
| 1 | (STAT(25), AVS), | (STAT(41), AMN), | (STAT(49), STD) | 01560 |
| C | | | | 01570 |
| 0 | EQUIVALENCE | (RTV(1), JT1), | (RTV(51), RT2), | 01580 |
| 1 | (RTV(101), RT3), | (RTV(151), RT4), | (RTV(201), RT5), | 01590 |
| 2 | (RTV(251), RT6), | (RTV(301), JT7), | (RTV(351), RT8), | 01600 |
| 3 | (RTV(401), RT9), | (RTV(451), JT10), | (RTV(501), RT11) | 01610 |
| C | | | | 01620 |
| | EQUIVALENCE | (PLNA,BETA), (RAYA,PSIA), (OIF(11),N2), (OIF(12),MIBP) | | 01630 |
| C | | | | 01640 |
| 0 | DIMENSION | CON(500), X(21,33), | W(21,33), | 01650 |
| 1 | DWX(21,33), | SCAL(8), SPAC(8), PRES(8), | | 01660 |
| 2 | PLNA(8), RAYA(8), | RI(7), JPN(500), KOD(5), | | 01670 |
| 3 | RES(180), NMP(8), | AVG(8), AVS(8), AMN(8), | | 01680 |
| 4 | STD(8), BETA(8), | PSIA(8), PAIA(8), THEA(8), | | 01690 |
| 5 | ZSEXT(8), RTV(500), | WORD(15) | | 01700 |
| C | | | | 01710 |
| | DATA TRAP/4HTRAP/, | ELIP/4HELIP/, RECT/4HRECT/ | | 01720 |
| | DATA HING/4HHING/, | CLMP/4HCLMP/, BOTH/4HBOTH/, | STAR/5H*****/ | 01730 |
| C | | | | 01740 |
| C==== | THIS SECTION INITIALIZES INDEXES. | | | 01750 |
| C | | | | 01760 |
| | CALL CLOCK (TIME) | | | 01770 |
| | WRITE (6,600) TIME | | | 01780 |
| 600 | FORMAT (IHO,25HWINTWO TIME = | | ,F10.4) | 01790 |
| | ISI = 5 | | | 01800 |
| | ISO = 6 | | | 01810 |
| | ISCR1 = 7 | | | 01820 |
| | ISCR2 = 8 | | | 01830 |
| | IDT = 0 | | | 01840 |
| | IRT=0 | | | 01850 |
| | IRM = 0 | | | 01860 |
| | LIN=0 | | | 01870 |
| | IPD = 0 | | | 01880 |

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| | IPR = 0 | 01890 |
| | IPV = 0 | 01900 |
| | IPB=0 | 01910 |
| | MRT=0 | 01920 |
| | DO 90 I=1,500 | 01930 |
| 90 | RTV(I) = 0.0 | 01940 |
| 100 | NGP = 0 | 01950 |
| | X1=0. | 01960 |
| | Y1=0. | 01970 |
| | READ(ISI,499) IRT,(WORD(I),I=1,15) | 01980 |
| | 499 FORMAT(I5,15A5) | 01990 |
| | NBC = 1 | 02000 |
| | IBC = 0 | 02010 |
| | CHAP = 0.0 | 02020 |
| | C | 02030 |
| | C===== READ IN PARAMETER DATA. | 02040 |
| | C | 02050 |
| | READ (ISI,500) SHAP, BONC, AA, BB, CC, THIC, YONG, GNU, DEL | 02060 |
| 500 | FORMAT (1X,A4,1X,A4,7E10.0) | 02070 |
| | IF (AA.EQ. 0.0) GO TO 1000 | 02080 |
| | IF((THIC.EQ.0.).OR.(YONG.EQ.0.).OR.(DEL.EQ.0.)) GO TO 902 | 02090 |
| | IF (BONC .EQ. HING) IBC = 1 | 02100 |
| | IF (BONC .EQ. CLMP) IBC = 2 | 02110 |
| | IF (BONC .EQ. BOTH) IBC = 1 | 02120 |
| | IF (BONC .EQ. BOTH) NBC = 2 | 02130 |
| | IF (IBC .EQ. 0) GO TO 900 | 02140 |
| | IF (SHAP .EQ. ELIP) CHAP = 1.0 | 02150 |
| | IF (SHAP .EQ. RECT) CHAP = 2.0 | 02160 |
| | IF (SHAP .EQ. TRAP) CHAP = 3.0 | 02170 |
| | IF (CHAP .EQ. 0.0) GO TO 901 | 02180 |
| | 0 READ (ISI,501) NPAN, NSCL, NSPC, NPRS, NOPRT, IMAN, ILGD, | 02190 |
| | 1 TREL, NBET, NPSI, NPAI, NTHE, NSEX, CPRSS | 02200 |
| 501 | FORMAT (4I5, 5X,9I5,E10.0) | 02210 |
| | IF(NPAN.EQ.1) CPRSS=0. | 02220 |
| | READ (ISI,502) (SCAL(I), I=1,NSCL) | 02230 |
| | IF (NPAN .LT. 2) GO TO 102 | 02240 |
| | READ (ISI,502) (SPAC(I), I=1,NSPC) | 02250 |
| 502 | FORMAT (8E10.0) | 02260 |
| 102 | READ (ISI,502) (PRES(I), I=1,NPRS) | 02270 |
| | READ (ISI,502) (BETA(I), I=1,NBET) | 02280 |
| | READ (ISI,502) (PSIA(I), I=1,NPSI) | 02290 |
| | READ (ISI,502) (PAIA(I), I=1,NPAI) | 02300 |
| | READ (ISI,502) (THEA(I), I=1,NTHE) | 02310 |
| | READ (ISI,502) (ZSEXT(I), I=1,NSEX) | 02320 |
| | NRFI = 2*NPAN + 1 | 02330 |
| | READ (ISI,502) (RI(I), I=1,NRFI) | 02340 |
| | FR= (YONG*(THIC**3))/(12.0*(1.0-(GNU**2))) | 02350 |

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| | IF(MRT.NE.0) GO TO 103 | 02360 |
| | IF(NOPRT.EQ.0) REWIND ISCR1 | 02370 |
| | IF(NOPRT.EQ.0) REWIND ISCR2 | 02380 |
| | IF(NOPRT.EQ.0) REWIND IS9 | 02390 |
| | IF(NOPRT.EQ.0) MRT=1 | 02400 |
| C | | 02410 |
| C===== | MAIN DO-LOOP ON NUMBER OF BOUNDARY CONDITIONS. | 02420 |
| C | | 02430 |
| 103 | DO 126 LP1=1,NBC | 02440 |
| | IF (LP1 .EQ. 2) IBC=2 | 02450 |
| | DO 126 LP2=1,NSCL | 02460 |
| | MIBP=0 | 02470 |
| | SKAL = SCAL(LP2) | 02480 |
| | IF(SKAL.EQ.0.) GO TO 903 | 02490 |
| | DIMA = AA*SCAL(LP2) | 02500 |
| | DIMB = BB*SCAL(LP2) | 02510 |
| | DIMC = CC*SCAL(LP2) | 02520 |
| | ICHAP = CHAP | 02530 |
| | DO 104 IS = 1,33 | 02540 |
| | DO 104 JS = 1,21 | 02550 |
| | X(IS,JS) = 1.E-6 | 02560 |
| | W(IS,JS) = 0.0 | 02570 |
| | 104 DWX(IS,JS) = 0.0 | 02580 |
| C | | 02590 |
| C===== | SELECT PLANFORM TO BE SOLVED. | 02600 |
| C | | 02610 |
| | GO TO (106,108,110), ICHAP | 02620 |
| 106 | CALL ELIPSE | 02630 |
| | GO TO 112 | 02640 |
| 108 | CALL RECTNG | 02650 |
| | IF(ISHR.EQ.1) CALL SHRDEF | 02660 |
| | GO TO 112 | 02670 |
| 110 | CALL TRPZOD | 02680 |
| 112 | IF(ICHAP.EQ.3) GO TO 202 | 02690 |
| | IF((DIMA/2.).GT.(32.*DEL)) GO TO 1060 | 02691 |
| | IF((DIMB/2.).GT.(20.*DEL)) GO TO 1065 | 02692 |
| 202 | IF(NSPC.EQ.0) SPAC(1)=STAR | 02693 |
| | IF(NSPC.EQ.0) NSPC=1 | 02700 |
| | DO 126 LP3=1,NSPC | 02710 |
| | SPAD = SPAC(LP3) | 02720 |
| 113 | DO 126 LP4 = 1,NPRS | 02730 |
| | LP5 = LP4 | 02740 |
| | ILRG = 0 | 02750 |
| | IRT = IRT + 1 | 02760 |
| | PRSS = PRES(LP4) | 02770 |
| | IF((ICHAP.NE.3).OR.(N2.NE.1)) GO TO 111 | 02780 |
| | DO 799 K=1,21 | 02790 |

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| | DO 799 L=1,33 | 02800 |
| | W(K,L)=W(K,L)*(CPRSS-PRSS) | 02810 |
| 799 | DWX(K,L)=DWX(K,L)*PRSS | 02820 |
| C | CALCULATE REFRACTIVE INDEXES FOR PRESSURE USED. | 02830 |
| 111 | DON = ((2.926E-4)/(1.0 + (3.665E-3)*(21.0)))/14.7 | 02840 |
| | RIC = 1.0 + DON*ABS(PRSS) | 02850 |
| | IF (NPAN .EQ. 1) RI(1) = RIC | 02860 |
| | IF (NPAN .EQ. 2) RI(1) = 1.0 + DON*ABS(CPRSS) | 02870 |
| | IF (NPAN .EQ. 2) RI(3) = RIC | 02880 |
| | WRITE(ISO,1050) IPR,IPB | 02890 |
| | WRITE(ISO,123) (PRES(I),I=1,NPRS),CPRSS | 02900 |
| | WRITE(ISO,121) (RI(I),I=1,NRFI) | 02910 |
| 123 | FORMAT(1H , 21HPRESSURE LEVELS ARE 6E15.4) | 02920 |
| 121 | FORMAT(1H , 23HREFRACTIVE INDICES ARE 6E16.8) | 02930 |
| | IDT = IDT + 1 | 02940 |
| | CALL DEFRES (IRT, NOPRT) | 02950 |
| | CALL RTVLST (IRT, LIN, IPV) | 02960 |
| | IF (IMAN .EQ. 0) GO TO 114 | 02970 |
| | CALL MAXMIN (IRT) | 02980 |
| 114 | IF (ILGD .EQ. 0) GO TO 116 | 02990 |
| | CALL LRGDEF | 03000 |
| | ILRG = 1 | 03010 |
| | CALL DEFRES (IRT, NOPRT) | 03020 |
| C | | 03030 |
| C===== | PERFORM RAY TRACE ON DEFLECTED SHAPE FOUND ABOVE. | 03040 |
| C | | 03050 |
| 116 | DO 125 LQ1 = 1,NSEX | 03060 |
| | DO 125 LQ2 = 1, NBET | 03070 |
| | DO 125 LQ3 = 1, NPSI | 03080 |
| | DO 125 LQ4 = 1, NPAI | 03090 |
| | DO 125 LP6 = 1,NTHE | 03100 |
| | DO 118 I=1,8 | 03110 |
| | NMP(I) = 0 | 03120 |
| | AVG(I) = 0.0 | 03130 |
| | AVS(I) = 0.0 | 03140 |
| | AMN(I) = 0.0 | 03150 |
| 118 | STD(I) = 0.0 | 03160 |
| | LOCP = 1 | 03170 |
| | DO 120 I=1,180 | 03180 |
| 120 | RES(I) = 0.0 | 03190 |
| | DO 124 LP7 = 1,NGP | 03200 |
| | K1 = JPN(LP7) | 03210 |
| | CALL PACWRD (K1,K2, 2) | 03220 |
| | XS = X(K1,K2) | 03230 |
| | EJ=K1-1 | 03240 |
| | YS=DEL*EJ | 03250 |
| | ZS = 0.0 | 03260 |

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|-----|---|-------|
| | XQQ=XS/(2.*DEL) | 03270 |
| | IX=XQQ | 03280 |
| | XU=IX | 03290 |
| | RE=XQQ-XU | 03300 |
| | IF(RE.NE.0.) GO TO 124 | 03310 |
| | YQQ=YS/(2.*DEL) | 03320 |
| | IY=YQQ | 03330 |
| | YV=IY | 03340 |
| | RE=YQQ-YV | 03350 |
| | IF(RE.NE.0.) GO TO 124 | 03360 |
| | ZSEX = ZSEXT(LQ1) | 03370 |
| | PLANA = BETA(LQ2) | 03380 |
| | RAYAN = PSIA(LQ3) | 03390 |
| | PAIAN = PAIA(LQ4) | 03400 |
| | THEAN = THEA(LP6) | 03410 |
| | CALL RAYTWO (XS, YS, ZS, PLANA, RAYAN, PAIAN, THEAN, ZSEX) | 03420 |
| 122 | CONTINUE | 03430 |
| C | | 03440 |
| C | THIS SECTION PRINTS THE RAY TRACE DATA AND STORES THE COMPONENT | 03450 |
| C | DATA IN MENRES NEEDED TO CALCULATE THE MEAN AND RMS. | 03460 |
| C | | 03470 |
| | ISEC = 1 | 03480 |
| | CALL MENRMS | 03490 |
| | CALL RESTWO (IRT, NOPRT) | 03500 |
| 124 | CONTINUE | 03510 |
| C | | 03520 |
| C | THIS SECTION CALCULATES THE MEAN AND RMS AND THEN PRINTS THEM | 03530 |
| C | | 03540 |
| | ISEC = 2 | 03550 |
| | CALL MENRMS | 03560 |
| | CALL RESTWO (IRT, NOPRT) | 03570 |
| 125 | CONTINUE | 03580 |
| | IF((ICHAP.NE.3).OR.(N2.NE.1)) GO TO 126 | 03590 |
| | DO 199 K=1,21 | 03600 |
| | DO 199 L=1,33 | 03601 |
| | W(K,L)=W(K,L)/(CPRSS-PRSS) | 03610 |
| 199 | DWX(K,L)=DWX(K,L)/PRSS | 03620 |
| 126 | CONTINUE | 03630 |
| | GO TO 100 | 03640 |
| C | | 03650 |
| C | THIS SECTION PRINTS THE ERROR COMMENTS. | 03660 |
| C | | 03670 |
| 900 | WRITE (ISO,950) BONC | 03680 |
| 950 | 0 FORMAT (1H171H0,37HTHE BOUNDARY CONDITION WORD USED WAS 'A4, | 03690 |
| | 1 25H WHICH IS NOT ACCEPTABLE.) | 03700 |
| | GO TO 2000 | 03710 |
| 901 | WRITE (ISO,951) SHAP | 03720 |

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| 951 | 0 | FORMAT (1H1/1H0/1H0,28HTHE PLANEFORM WORD USED WAS ,A4, | 03730 |
| | 1 | 25H WHICH IS NOT ACCEPTABLE.) | 03740 |
| | | GO TO 2000 | 03750 |
| 902 | | WRITE (ISO,952) | 03760 |
| 952 | 0 | FORMAT (1H0,43HTHE THICKNESS, YOUNGS MODULUS, OR THE GRID , | 03770 |
| | 1 | 19HINCREMENT ARE ZERO.) | 03780 |
| | | GO TO 2000 | 03790 |
| 903 | | WRITE (ISO,953) LP2 | 03800 |
| 953 | | FORMAT (1H0, 6HSCALE(,I1,10H) IS ZERO.) | 03810 |
| | | GO TO 2000 | 03820 |
| 1000 | | LIN = LIN + 100 | 03830 |
| | | CALL RTVLST (IRT, LIN, IPV) | 03840 |
| | | IF(NOPRT.EQ.1) GO TO 1010 | 03850 |
| | | WRITE (ISO,1050) IPR,IPB | 03860 |
| 1050 | 0 | FORMAT (1H1/1H0,9HTHERE ARE,I5,27H PAGES OF RAY TRACE OUTPUT , | 03870 |
| | 1 | 30HON THE MICROFILM TAPE (TAPE 8)/ | 03880 |
| | 2 | 1H0,9HTHERE ARE,I5,27H PAGES OF RAY TRACE OUTPUT , | 03890 |
| | 1 | 30HON THE RETRIEVAL TAPE (TAPE 9)) | 03900 |
| | | INX = 999 | 03910 |
| | | CALL PAGE (IPB, LIN, IS9, INX) | 03920 |
| | | GO TO 1020 | 03930 |
| 1010 | | WRITE (ISO,1051) IPR | 03940 |
| 1051 | 0 | FORMAT (1H1/1H0,9HTHERE ARE,I5,27HPAGES OF RAY TRACE OUTPUT , | 03950 |
| | 1 | 30HON THE SYSOUTPUT TAPE (TAPE 6)) | 03960 |
| 1020 | | WRITE (ISO,1052) | 03970 |
| 1052 | | FORMAT (1H0/1H0,30X,40H***** THE PROBLEM YOU GAVE ME TO DO WAS , | 03980 |
| | 1 | 20HDONE CORRECTLY *****) | 03990 |
| | | CALL CLOCK (TIME) | 04000 |
| | | WRITE (6,9099) TIME | 04010 |
| 9099 | | FORMAT (1H0,25HEND WINDEF TIME = , F10.4) | 04020 |
| 1060 | | WRITE(6,9098) IRT | 04021 |
| 9098 | | FORMAT(1H1,38HTHE PROBLEM DESIGNATED RETRIVAL NUMBER,I4,58H HAS IT | 04022 |
| | | IS AA DIMENSION GREATER THAN THE PROGRAM CAN HANDLE.) | 04023 |
| 1065 | | WRITE(6,9097) IRT | 04024 |
| 9097 | | FORMAT(1H1,38HTHE PROBLEM DESIGNATED RETRIVAL NUMBER,I4,58H HAS IT | 04025 |
| | | IS BB DIMENSION GREATER THAN THE PROGRAM CAN HANDLE.) | 04026 |
| | | GO TO 100 | 04027 |
| 2000 | | STOP | 04030 |
| | | END | 04040 |
| | | \$IBFTC MS23G1 | 04050 |
| | | CELIPSE | 04060 |
| | | SUBROUTINE ELIPSE | 04070 |
| C | | | 04080 |
| C | | THIS SUBROUTINE GENERATES THE TABLE OF GRIDPOINT DEFORMATIONS FOR | 04090 |
| C | | AN ELLIPSE | 04100 |
| C | | | 04110 |
| C | | A = ELLIPSE MAJOR SEMI AXIS | 04120 |

| | | | |
|---|------|--|-------|
| C | B | = ELLIPSE MINOR SEMI AXIS | 04130 |
| C | C | = ELLIPTIC FOCAL DISTANCE | 04140 |
| C | DWX | = DEFLECTION AT POINT I,J OF SECOND PANE | 04150 |
| C | ET | = ELLIPTIC COORDINATE | 04160 |
| C | ETX | = PARTIAL OF ET WRT X | 04170 |
| C | ETY | = PARTIAL OF ET WRT Y | 04180 |
| C | I | = ROW INDEX | 04190 |
| C | J | = COLUM INDEX | 04200 |
| C | K | = GRIDPOINT COUNTER | 04210 |
| C | NGP | = NUMBER OF GRID POINTS | 04220 |
| C | W | = DEFLECTION AT POINT I,J OF FIRST PANE | 04230 |
| C | W1 | = CONSTANT IN DEFLECTION EQUATION | 04240 |
| C | W0 | = CONSTANT IN DEFLECTION EQUATION | 04250 |
| C | WEP | = PARTIAL OF W WRT ET | 04260 |
| C | WZP | = PARTIAL OF W WRT ZI | 04270 |
| C | X | = X COORDINATE ARRAY | 04280 |
| C | XLIM | = X VALUE AT ELLIPTIC BOUNDARY ALONG ANY ABSISSA | 04290 |
| C | ZI | = ELLIPTIC COORDINATE | 04300 |
| C | ZIX | = PARTIAL OF ZI WRT X | 04310 |
| C | ZIY | = PARTIAL OF ZI WRT Y | 04320 |
| C | | ALL OTHER LEFT HAND SIDE VALUES ARE TEMPORARIES | 04330 |
| C | | | 04340 |
| C | | COMMON DUM | 04350 |
| C | | | 04360 |
| | 0 | EQUIVALENCE (DUM(1), CON), (DUM(501), X), | 04370 |
| | 1 | (DUM(1501), W), (DUM(2251), DWX), | 04380 |
| | 2 | (DUM(3001), JPN), (DUM(3501), RTV) | 04390 |
| C | | | 04400 |
| | 0 | EQUIVALENCE (CON(1), DIMA), (CON(2), DIMB), | 04410 |
| | 1 | (CON(3), DIMC), (CON(4), DEL), (CON(5), GNU), | 04420 |
| | 2 | (CON(6), THIC), (CON(7), SPAD), (CON(8), PRSS), | 04430 |
| | 3 | (CON(9), NPAN), (CON(10), ISI), (CON(11), ISO), | 04440 |
| | 4 | (CON(12), IBC), (CON(13), NGP), (CON(14), LP7), | 04450 |
| | 5 | (CON(15), FR), (CON(16), LOCP), (CON(17), IPD), | 04460 |
| | 6 | (CON(18), IPR), (CON(19), CHAP), (CON(20), ISCR1), | 04470 |
| | 7 | (CON(21), ISCR2), (CON(22), SKAL), (CON(23), ISEC), | 04480 |
| | 8 | (CON(24), NPAG), (CON(25), YONG), (CON(26), ILGD), | 04490 |
| | 9 | (CON(27), IREL), (CON(28), LP5), (CON(29), CPRSS) | 04500 |
| C | | | 04510 |
| | 0 | EQUIVALENCE (CON(31), SCAL), (CON(41), SPAC), | 04520 |
| | 1 | (CON(51), PRES), (CON(61), PLNA), (CON(71), RAYA), | 04530 |
| | 2 | (CON(81), PAIA), (CON(91), THEA), (CON(101), RI), | 04540 |
| | 3 | (CON(111), RES), (CON(301), STAT), (CON(351), OIF), | 04550 |
| | 4 | (CON(401),EANDF), (CON(451), RHS) | 04560 |
| C | | | 04570 |
| | 0 | DIMENSION CON(500), X(21,33), W(21,33), | 04580 |
| | 1 | DWX(21,33), JPN(500), RTV(500) | 04590 |

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| | | | |
|--------|---|--|-------|
| C | | | 04600 |
| | A = DIMA/2.0 | | 04610 |
| | B = DIMB/2.0 | | 04620 |
| C | | | 04630 |
| C===== | INITIALIZE INDEXES. | | 04640 |
| C | | | 04650 |
| | IF (A .GT. B) GO TO 201 | | 04660 |
| | TM = B | | 04670 |
| | B = A | | 04680 |
| | A = TM | | 04690 |
| 201 | C = SQRT(A*A - B*B) | | 04700 |
| | XLIM = A | | 04710 |
| | I = 0 | | 04720 |
| | J = 0 | | 04730 |
| | K = 0 | | 04740 |
| | X(1,1) = 0.0 | | 04750 |
| | GO TO (100,104), IBC | | 04760 |
| C | | | 04770 |
| C===== | THIS SECTION CALCULATES THE GRIDPOINT DEFORMATIONS FOR AN ELLIPSE | | 04780 |
| C | WITH SIMPLY SUPPORTED EDGES. | | 04790 |
| C | | | 04800 |
| C | CALCULATE CONSTANTS | | 04810 |
| C | | | 04820 |
| 100 | IF (A .EQ. B) GO TO 102 | | 04830 |
| | X(1,1) = A | | 04840 |
| | ZI = 1.0 | | 04850 |
| | ET = 1.0 | | 04860 |
| | XC = X(1,1) | | 04870 |
| | YC = 0. | | 04880 |
| | CALL ELIPIT (C, XC, YC, ZI, ET, FZP, FEP, GZP, GEP, DET) | | 04890 |
| | A10 = ZI | | 04900 |
| | A20 = 2.0*ZI | | 04910 |
| | A40 = 4.0*ZI | | 04920 |
| | CA20 = COSH(A20) | | 04930 |
| | CA40 = COSH(A40) | | 04940 |
| | CA2S = (COSH(A20))**2 | | 04950 |
| | SA2S = (SINH(A20))**2 | | 04960 |
| | SA2Q = (SINH(A20))**4 | | 04970 |
| | WO = (C**4)/(12.0*128.0*CA2S*CA40*FR) | | 04980 |
| | OMNU = (1.0 - GNU) | | 04990 |
| | W1 = +(8.0*(OMNU)*(3.0*CA2S-2.0)*SA2Q)/(2.0*CA2S-(OMNU)*SA2S) | | 05000 |
| | X(1,1) = 0.0 | | 05010 |
| C | CALCULATE GRIDPOINT DEFORMATIONS. | | 05020 |
| 203 | I = I+1 | | 05030 |
| 101 | J = J+1 | | 05040 |
| | K = K+1 | | 05050 |
| | K1 = I | | 05060 |

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-----
K2 = J                                05070
CALL PACWRD (K1,K2,1)                  05080
JPN(K) = K1                             05090
ZI = 1.0                                 05100
ET = 1.0                                 05110
XC = X(I,J)                             05120
EJ=I-1                                  05130
YC=DEL*EJ                               05140
CALL ELIPIT (C, XC, YC,                ZI, ET, FZP, FEP, GZP, GEP, DET) 05150
ZI2 = 2.0*ZI                             05160
ZI4 = 4.0*ZI                             05170
ET2 = 2.0*ET                             05180
ET4 = 4.0*ET                             05190
TE1 = (3.0*CA20*CA40 - 4.0*CA40*COSH(ZI2) + CA20*COSH(ZI4)) 05200
TE2 = (3.0*CA20*CA40 - 4.0*CA40* COS(ET2) + CA20* COS(ET4)) 05210
TE3 = (COSH(ZI2) - CA20)                 05220
TE4 = (CA20 - COS(ET2))                  05230
W(I,J) = WO*(TE1*TE2 - W1*TE3*TE4)      05240
IF(NPAN.EQ.2) DWX(I,J)=W(I,J)           05250
0 WZP = WO*(TE2*(-8.0*CA40*SINH(ZI2) + 4.0*CA20*SINH(ZI4)) 05260
1   -W1*TE4*(2.0*SINH(ZI2)))            05270
0 WEP = WO*(TE1*(+8.0*CA40* SIN(ET2) - 4.0*CA20* SIN(ET4)) 05280
1   -W1*TE3*(2.0* SIN(ET2)))           05290
ZIX =-GEP/DET                            05300
ETX = GZP/DET                            05310
ZIY = FEP/DET                            05320
ETY = FZP/DET                            05330
X(I,J+1) = X(I,J) + DEL                  05340
IF (X(I,J+1) .LE. XLIM) GO TO 101       05350
X(I,J+1) = 0.0                           05360
J = 0                                     05370
X(I+1,J+1) = 0.0                         05380
EJ=I                                      05390
DWY=DEL*EJ                               05400
IF (DWY .GT. B) GO TO 800                05410
XLIM = A*SQRT (1.0 - (DWY**2/(B*B)))     05420
IF (DWY .LE. B) GO TO 203                05430
GO TO 800                                 05440
C                                         05450
C===== THIS SECTION SOLVES THE SIMPLY SUPPORTED EDGE WHEN A = B (CIRCLE) 05460
C                                         05470
102 TE1 = 1.0/(64.0*FR)                   05480
TE2 = ((5.0+GNU)/(1.0+GNU))*(A*A)       05490
I = 0                                     05500
J = 0                                     05510
X(1,1) = 0.0                             05520
XLIM = A                                  05530

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| | | |
|-----|---|-------|
| 205 | I = I+1 | 05540 |
| 103 | J = J+1 | 05550 |
| | K = K+1 | 05560 |
| | K1 = I | 05570 |
| | K2 = J | 05580 |
| | CALL PACWRD (K1,K2,1) | 05590 |
| | JPN(K) = K1 | 05600 |
| | X2 = X(I,J)*X(I,J) | 05610 |
| | EJ=I-1 | 05620 |
| | Y2=DEL*DEL*EJ*EJ | 05630 |
| | TE3 = (A*A - X2 -Y2) | 05640 |
| | TE4= (TE2 - X2 - Y2) | 05650 |
| | W(I,J) = TE1*TE3*TE4 | 05660 |
| | IF(NPAN.EQ.2) DWX(I,J)=W(I,J) | 05670 |
| | X(I,J+1) = X(I,J) + DEL | 05680 |
| | EJ=I | 05690 |
| | DWY=DEL*EJ | 05700 |
| | IF (X(I,J+1) .LE. XLIM) GO TO 103 | 05710 |
| | X(I,J+1) = 0.0 | 05720 |
| | J = 0 | 05730 |
| | X(I+1,J+1) = 0.0 | 05740 |
| | EJ=I | 05750 |
| | DWY=DEL*EJ | 05760 |
| | IF (DWY .GT. B) GO TO 800 | 05770 |
| | XLIM = A*SQRT (1.0 - (DWY**2/(B*B))) | 05780 |
| | IF (DWY .LE. B) GO TO 205 | 05790 |
| | GO TO 800 | 05800 |
| | C | 05810 |
| | C==== THIS SECTION CALCULATES THE GRIDPOINT DEFORMATIONS FOR AN | 05820 |
| | C ELLIPSE WITH CLAMPED EDGES. | 05830 |
| | C | 05840 |
| 104 | TEM = (24.0/(A**4)) + (24.0/(B**4)) + (16.0/(A*A*B*B)) | 05850 |
| | WO = 1.0/(FR*TEM) | 05860 |
| 207 | I = I+1 | 05870 |
| 105 | J = J+1 | 05880 |
| | K = K+1 | 05890 |
| | K1 = I | 05900 |
| | K2 = J | 05910 |
| | CALL PACWRD (K1,K2,1) | 05920 |
| | JPN(K) = K1 | 05930 |
| | EJ=I-1 | 05940 |
| | DWY=DEL*EJ | 05950 |
| | TEM = (1.0 - (X(I,J)*X(I,J)/(A*A)) - (DWY*DWY/(B*B))) | 05960 |
| | W(I,J) = WO*(TEM**2) | 05970 |
| | IF(NPAN.EQ.2) DWX(I,J)=W(I,J) | 05980 |
| | X(I,J+1) = X(I,J) + DEL | 05990 |
| | IF (X(I,J+1) .LE. XLIM) GO TO 105 | 06000 |

| | | |
|-----|---|-------|
| | X(I,J+1) = 0.0 | 06010 |
| | J = 0 | 06020 |
| | X(I+1,J+1) = 0.0 | 06030 |
| | EJ=I | 06040 |
| | DWY=DEL*EJ | 06050 |
| | IF (DWY .GT. B) GO TO 800 | 06060 |
| | XLIM = A*SQRT (1.0 - (DWY**2/(B*B))) | 06070 |
| | IF (DWY .LE. B) GO TO 207 | 06080 |
| 800 | NGP = K | 06090 |
| | RETURN | 06100 |
| | END | 06110 |
| | \$IBFTC MS23G2 | 06120 |
| | CELIPIT | 06130 |
| | SUBROUTINE ELIPIT (C, X, Y, XI, ET, FXP, FEP, GXP, GEP, DET) | 06140 |
| C | | 06150 |
| C | THIS SUBROUTINE DETERMINS THE ELLIPTIC COORDINATES XI AND ET, | 06160 |
| C | CORRESPONDING TO THE CARTESIAN COORDINATES X AND Y. | 06170 |
| C | | 06180 |
| C | ITERATION IS BY THE NEWTON-RHAPSON METHOD OF SUCCESSIVE APPROX. | 06190 |
| C | | 06200 |
| C | C = ELLIPTIC FOCAL DISTANCE | 06210 |
| C | DET = DETERMINENT | 06220 |
| C | ET = ET COORDINATE VALUE IN ELLIPTICAL SYSTEM | 06230 |
| C | FEP = PARTIAL OF FIO WRT ET | 06240 |
| C | FIO = FUNCTION F | 06250 |
| C | FXP = PARTIAL OF FIO WRT XI | 06260 |
| C | GEP = PARTIAL OF GIO WRT ET | 06270 |
| C | GIO = FUNCTION G | 06280 |
| C | GXP = PARTIAL OF GIO WRT XI | 06290 |
| C | IDON = 1 INDICATES ITERATION IS COMPLETE | 06300 |
| C | X = X COORDINATE VALUE IN RETANGULAR SYSTEM | 06310 |
| C | XI = XI COORDINATE VALUE IN ELLIPTICAL SYSTEM | 06320 |
| C | Y = Y COORDINATE VALUE IN RETANGULAR SYSTEM | 06330 |
| C | ALL OTHER LEFT HAND VALUES ARE TEMPORARIES | 06340 |
| C | | 06350 |
| | IDON = 0 | 06360 |
| 100 | IF (Y .NE. 0.0) GO TO 103 | 06370 |
| | IF (X .GT. C) GO TO 101 | 06380 |
| | XI1 = 0.0 | 06390 |
| | ET1 = ACOS(X/C) | 06400 |
| | GO TO 108 | 06410 |
| 101 | XI = 1.0 | 06420 |
| | ET = 0.0 | 06430 |
| 102 | FIO = X - C*COSH(XI)*COS(ET) | 06440 |
| | FXP = - C*SINH(XI)*COS(ET) | 06450 |
| | XI1 = XI - FIO/FXP | 06460 |
| | ET1 = ET | 06470 |

| | | |
|-----|--|-------|
| | IF ((ABS(XI1 - XI)) .LE. 0.0000001) GO TO 108 | 06480 |
| | XI = XI1 | 06490 |
| | GO TO 102 | 06500 |
| 103 | IF (X .NE. 0.0) GO TO 105 | 06510 |
| | ET = 90.0*0.017453292519 | 06520 |
| | XI = 0.0 | 06530 |
| 104 | GIO = Y - C*SINH(XI)*SIN(ET) | 06540 |
| | GXP = - C*COSH(XI)*SIN(ET) | 06550 |
| | XI1 = XI - GIO/GXP | 06560 |
| | ET1 = ET | 06570 |
| | IF ((ABS(XI1 - XI)) .LE. 0.0000001) GO TO 108 | 06580 |
| | XI = XI1 | 06590 |
| | GO TO 104 | 06600 |
| 105 | FIO = X - C*COSH(XI)*COS(ET) | 06610 |
| | GIO = Y - C*SINH(XI)*SIN(ET) | 06620 |
| 106 | FXP = - C*SINH(XI)*COS(ET) | 06630 |
| | FEP = + C*COSH(XI)*SIN(ET) | 06640 |
| | GXP = - C*COSH(XI)*SIN(ET) | 06650 |
| | GEP = - C*SINH(XI)*COS(ET) | 06660 |
| | DET = (FXP*GEP - FEP*GXP) | 06670 |
| | IF (IDON .EQ. 1) GO TO 800 | 06680 |
| | XI1 = XI - (1.0/DET)*(GEP*FIO - FEP*GIO) | 06690 |
| | ET1 = ET + (1.0/DET)*(GXP*FIO - FXP*GIO) | 06700 |
| | IF ((ABS(XI1 - XI)) .LE. 0.0000001) GO TO 107 | 06710 |
| | XI = XI1 | 06720 |
| | ET = ET1 | 06730 |
| | GO TO 105 | 06740 |
| 107 | IF ((ABS(ET1 - ET)) .LE. 0.0000001) GO TO 108 | 06750 |
| | XI = XI1 | 06760 |
| | ET = ET1 | 06770 |
| | GO TO 105 | 06780 |
| 108 | XI = XI1 | 06790 |
| | ET = ET1 | 06800 |
| | IDON =1 | 06810 |
| | GO TO 105 | 06820 |
| 800 | RETURN | 06830 |
| | END | 06840 |
| | SIBFTC MS23G3 | 06850 |
| | CRECTAG | 06860 |
| | C | 06870 |
| | SUBROUTINE RECTNG | 06880 |
| | C | 06890 |
| | C THIS SUBROUTINE GENERATES THE TABLE OF GRIDPOINT DEFORMATIONS | 06900 |
| | C FOR A RECTANGULAR PLATE WITH DIMENSIONS A BY B AND RIGIDITY D | 06910 |
| | C | 06920 |
| | C A = PLATE LENGTH | 06930 |
| | C ALPHAM = DEFLECTION COEFFICIENT | 06940 |

| | | | |
|---|-----------------------------------|---|-------|
| C | ALPHAN | = DEFLECTION COEFFICIENT | 06950 |
| C | ASPECT | = SQUARE OF ASPECT RATIO | 06960 |
| C | B | = PLATE WIDTH | 06970 |
| C | BETAM | = MOMENT COEFFICIENT | 06980 |
| C | BETAN | = MOMENT COEFFICIENT | 06990 |
| C | D | = PLATE STIFFNESS | 07000 |
| C | DWX | = DEFLECTION AT POINT I,J OF SECOND PANE | 07010 |
| C | DWXMOE | = SLOPE IN X DIRECTION FOR MOMENTS APPLIED ALONG ONE EDGE | 07020 |
| C | DWXMOF | = SLOPE IN X DIRECTION FOR MOMENTS APPLIED ALONG OTHER EDGE | 07030 |
| C | DWXSIM | = SLOPE IN X DIRECTION FOR SIMPLY SUPPORTED EDGE | 07040 |
| C | DWYMOE | = SLOPE IN Y DIRECTION FOR MOMENTS APPLIED ALONG ONE EDGE | 07050 |
| C | DWYMOF | = SLOPE IN Y DIRECTION FOR MOMENTS APPLIED ALONG OTHER EDGE | 07060 |
| C | DWYSIM | = SLOPE IN Y DIRECTION FOR SIMPLY SUPPORTED EDGE | 07070 |
| C | EM | = COUNT ON NUMBER OF TERMS | 07080 |
| C | EN | = COUNT ON NUMBER OF TERMS | 07090 |
| C | I | = ROW INDEX | 07100 |
| C | IBC | = BOUNDARY CONDITION SWITCH | 07110 |
| C | ILIM | = NUMBER OF EQUATIONS USED TO DETERMINE REDUNDANT MOMENTS | 07120 |
| C | J | = COLUMN INDEX | 07130 |
| C | K | = GRIDPOINT COUNTER | 07140 |
| C | MN | = NUMBER OF SIMULTANEOUS EQUATIONS | 07150 |
| C | MOMENT | = COEFFICIENTS OF LHS OF EQUATIONS | 07160 |
| C | NGP | = NUMBER OF GRIDPOINTS | 07170 |
| C | NM | = COLUMNS IN RHS OF EQUATIONS | 07180 |
| C | RHS | = RHS OF SET OF SIMULTANEOUS EQUATIONS | 07190 |
| C | W | = DEFLECTION AT POINT I,J OF FIRST PANE | 07200 |
| C | WMOE | = DEFLECTION FOR MOMENTS APPLIED ALONG ONE EDGE | 07210 |
| C | WMOF | = DEFLECTION FOR MOMENTS APPLIED ALONG OTHER EDGE | 07220 |
| C | WSIM | = DEFLECTION FOR SIMPLY SUPPORTED EDGE | 07230 |
| C | X | = X COORDINATE ARRAY | 07240 |
| C | | | 07250 |
| C | COMMON DUM | | 07260 |
| C | | | 07270 |
| C | DOUBLE PRECISION RHS,EANDF,MOMENT | | 07280 |
| C | | | 07290 |
| 0 | EQUIVALENCE | (DUM(1), CON), (DUM(501), X), | 07300 |
| 1 | | (DUM(1501), W), (DUM(2251), DWX), | 07310 |
| 2 | | (DUM(3001), JPN), (DUM(3501), RTV), | 07320 |
| 3 | (DUM(4001),MOMENT) | | 07330 |
| C | | | 07340 |
| 0 | EQUIVALENCE | (CON(1), DIMA), (CON(2), DIMB), | 07350 |
| 1 | (CON(3), DIMC), | (CON(4), DEL), (CON(5), GNU), | 07360 |
| 2 | (CON(6), THIC), | (CON(7), SPAD), (CON(8), PRSS), | 07370 |
| 3 | (CON(9), NPA), | (CON(10), ISI), (CON(11), ISO), | 07380 |
| 4 | (CON(12), IBC), | (CON(13), NGP), (CON(14), LP7), | 07390 |
| 5 | (CON(15), FR), | (CON(16), LOCP), (CON(17), IPD), | 07400 |
| 6 | (CON(18), IPR), | (CON(19), CHAP), (CON(20), ISCR1), | 07410 |

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7 (CON( 21),ISCR2), (CON( 22), SKAL), (CON( 23), ISEC), 07420
8 (CON( 24), NPAG), (CON( 25), YONG), (CON( 26), ILGD), 07430
9 (CON( 27), IREL), (CON( 28), LP5), (CON( 29), CPRSS) 07440
C 07450
0 EQUIVALENCE (CON( 31), SCAL), (CON( 41), SPAC), 07460
1 (CON( 51), PRES), (CON( 61), PLNA), (CON( 71), RAYA), 07470
2 (CON( 81), PAIA), (CON( 91), THEA), (CON(101), RI), 07480
3 (CON(111), RES), (CON(301), STAT), (CON(351), OIF), 07490
4 (CON(401), RHS) 07500
C 07510
0 DIMENSION CON( 500), X(21,33), W(21,33), 07520
1 DWX(21,33), JPN( 500), RTV( 500) 07530
C 07540
DIMENSION EANDF(32),MOMENT(32,32),RHS(32) 07550
C 07560
EQUIVALENCE (RHS,EANDF) 07570
C 07580
C===== THIS SECTION SETS UP INITIAL CONSTANTS 07590
C 07600
D = FR 07610
A = DIMA 07620
B = DIMB 07630
ILIM = 28 07640
IULIM = ILIM/2 07650
ILLIM = ILIM/2 + 1 07660
NTERMS = ILIM - 3 07670
TERMS = NTERMS 07680
10 I = 0 07690
J = 0 07700
K = 0 07710
X(1,1) = 0.0 07720
PI = 3.1415926535 07730
CNST1 = 4.0*(A**4)/(D*(PI**5)) 07740
CNST2 = 4.0*(A**3)/(D*(PI**4)) 07750
CNST3 = A*A/(2.0*D*PI*PI) 07760
CNST4 = A/(2.0*D*PI) 07770
CNST5 = B*B/(2.0*D*PI*PI) 07780
CNST6 = B/(2.0*D*PI) 07790
IF (IBC .EQ. 1) GO TO 100 07800
C 07810
C===== THIS SECTION CALCULATES THE MOMENT COEFFICIENTS FOR CLAMPED PLATE 07820
C 07830
50 DO 55 JK=1,ILIM 07840
DO 55 L=1,ILLIM 07850
55 MOMENT (JK,L) = 0.0 07860
EN = -1.0 07870
DO 60 II=1,IULIM 07880

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| | | |
|----|---|-------|
| | EN = EN - 2.0 | 07890 |
| | ALPHAN = EN*PI*B/(2.0*A) | 07900 |
| | CNST7 = 8.0*EN*A/(PI*B) | 07910 |
| | CNST8 = 4.0*A*A/((EN**4)*(PI**3)) | 07920 |
| | ASPECT = A*A/(B*B) | 07930 |
| | III = II | 07940 |
| | IF (ALPHAN .LT. 88.0) GO TO 57 | 07950 |
| | MOMENT(II,III) = 1.0/EN | 07960 |
| | RHS(II) = -CNST8 | 07970 |
| | GO TO 58 | 07980 |
| 57 | 0 MOMENT(II,III) = (TANH(ALPHAN)+ALPHAN/ 1 COSH(ALPHAN)/COSH(ALPHAN)) / EN | 07990 |
| | RHS(II) = CNST8*(ALPHAN/ COSH(ALPHAN)/COSH(ALPHAN) -TANH(ALPHAN)) | 08000 |
| 58 | EM = -1.0 | 08010 |
| | DO 60 JJ=ILLIM,ILIM | 08020 |
| | EM = EM + 2.0 | 08030 |
| | 0 MOMENT(II,JJ) = CNST7*(1.0/((EM**3)*(EN*EN/(EM*EM)+ASPECT) 1 *(EN*EN/(EM*EM)+ASPECT))) | 08040 |
| | 60 CONTINUE | 08050 |
| | 70 EN = -1.0 | 08060 |
| | DO 80 II=ILLIM,ILIM | 08070 |
| | EN = EN + 2.0 | 08080 |
| | BETAN = EN*PI*A/(2.0*B) | 08090 |
| | CNST9 = 8.0*B*EN/(PI*A) | 08100 |
| | CNST10 = 4.0*B*B/((EN**4)*(PI**3)) | 08110 |
| | ASPECT = B*B/(A*A) | 08120 |
| | III = II | 08130 |
| | IF (BETAN .LT. 88.0) GO TO 73 | 08140 |
| | MOMENT(II,III) = 1.0/EN | 08150 |
| | RHS(II) = -CNST10 | 08160 |
| | GO TO 75 | 08170 |
| | 73 0 MOMENT(II,III) = (TANH(BETAN)+BETAN/ 1 COSH(BETAN)/COSH(BETAN)) / EN | 08180 |
| | RHS(II) = CNST10*(BETAN/ COSH(BETAN)/COSH(BETAN) -TANH(BETAN)) | 08190 |
| | 75 EM = -1.0 | 08200 |
| | DO 80 JJ=1,IULIM | 08210 |
| | EM = EM + 2.0 | 08220 |
| | 0 MOMENT(II,JJ) = CNST9*(1.0/((EM**3)*(EN*EN/(EM*EM)+ASPECT) 1 *(EN*EN/(EM*EM)+ASPECT))) | 08230 |
| | 80 CONTINUE | 08240 |
| | MN = ILIM | 08250 |
| | NM = 1 | 08260 |
| | CALL SEQ3 (MOMENT,RHS,MN,NM) | 08270 |
| | | 08280 |
| | | 08290 |
| | | 08300 |
| | | 08310 |
| | C==== THIS SECTION GENERATES DEFORMATIONS FOR HINGED EDGES | 08320 |
| | | 08330 |
| | | 08340 |
| | 100 I = I + 1 | 08350 |

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| | | |
|-----|--|-------|
| 105 | J = J+1 | 08360 |
| | K = K+1 | 08370 |
| | K1 = I | 08380 |
| | K2 = J | 08390 |
| | CALL PACWRD (K1,K2,1) | 08400 |
| | JPN(K) = K1 | 08410 |
| | W(I,J) = 0.0 | 08420 |
| | IF(NPAN.EQ.2) DWX(I,J)=W(I,J) | 08430 |
| | EM = -1.0 | 08440 |
| 110 | EM = EM + 2.0 | 08450 |
| | EJ=I-1 | 08460 |
| | DWY=DEL*EJ | 08470 |
| | CNSTA = EM*PI/A | 08480 |
| | ALPHAM = CNSTA*B/2.0 | 08490 |
| | MMM = EM | 08500 |
| | CNST11 = -1.0 | 08510 |
| | IF (((MMM-1)/2-((MMM-1)/4)*2) .EQ. 0) CNST11=1.0 | 08520 |
| | CNST11 = CNST11/(EM**5) | 08530 |
| | CNST12 = EM*CNST11 | 08540 |
| | CNST13 = COSH(ALPHAM) | 08550 |
| | CNST14 = (2.0+ALPHAM*TANH(ALPHAM))/(2.0*CNST13) | 08560 |
| 0 | WSIM = CNST1*CNST11*(1.0-CNST14*COSH(CNSTA*DWY) | 08570 |
| 1 | +CNSTA*DWY *SINH(CNSTA*DWY) / (2.0*CNST13))* | 08580 |
| 2 | COS(CNSTA*X(I,J)) | 08590 |
| | IF (IBC .EQ. 2) GO TO 200 | 08600 |
| | W(I,J) = W(I,J) + WSIM | 08610 |
| | IF(NPAN.EQ.2) DWX(I,J)=W(I,J) | 08620 |
| | IF (EM .LE. TERMS) GO TO 110 | 08630 |
| | X(I,J+1) = X(I,J) + DEL | 08640 |
| | IF (X(I,J+1) .LE. (A/2.0)) GO TO 105 | 08650 |
| | X(I,J+1) = 0.0 | 08660 |
| | J = 0 | 08670 |
| | X(I+1,J+1) = 0.0 | 08680 |
| | EJ=I | 08690 |
| | DWY=DEL*EJ | 08700 |
| | IF (DWY .LE. (B/2.0)) GO TO 100 | 08710 |
| | GO TO 300 | 08720 |
| | C | 08730 |
| | C===== THIS SECTION GENERATES DEFORMATIONS FOR CLAMPED EDGES | 08740 |
| | C | 08750 |
| | C | 08760 |
| 200 | CNSTB = EM*PI/B | 08770 |
| | BETAM = CNSTB*A/2.0 | 08780 |
| | MMM = EM | 08790 |
| | CNST15 = -1.0 | 08800 |
| | IF (((MMM-1)/2-((MMM-1)/4)*2) .EQ. 0) CNST15=1.0 | 08810 |
| | CNST15 = CNST15/(EM*EM) | 08820 |

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      CNST16 = EM*CNST15 ----- 08830
      CNST17 = COSH(BETAM) ----- 08840
      CNST18 = ALPHAM*TANH(ALPHAM)/CNST13 ----- 08850
      CNST19 = BETAM*TANH(BETAM)/CNST17 ----- 08860
      EMM = EM/2.0 + 0.5 ----- 08870
      M = EMM ----- 08880
      EJ=I-1 ----- 08890
      DWY=DEL*EJ ----- 08900
      0 WMOE = -CNST3*CNST15*EANDF(M)*(CNSTA*DWY *SINH(CNSTA*DWY)/ ----- 08910
      1 CNST13 -CNST18*COSH(CNSTA*DWY)) *COS(CNSTA*X(I,J)) ----- 08920
      EEE = IULIM ----- 08930
      EMM = EM/2.0 + EEE + 0.5 ----- 08940
      M = EMM ----- 08950
      0 WMOF = -CNST5*CNST15*EANDF(M)*(CNSTB*X(I,J)*SINH(CNSTB*X(I,J)))/ ----- 08960
      1 CNST17 -CNST19*COSH(CNSTB*X(I,J))*COS(CNSTB*DWY) ----- 08970
      W(I,J) = W(I,J) + WSIM + WMOE + WMOF ----- 08980
      IF(NPAN.EQ.2) DWX(I,J)=W(I,J) ----- 08990
      IF (EM .LE. TERMS) GO TO 110 ----- 09000
      X(I,J+1) = X(I,J) + DEL ----- 09010
      IF (X(I,J+1) .LE. (A/2.0)) GO TO 105 ----- 09020
      X(I,J+1) = 0.0 ----- 09030
      J = 0 ----- 09040
      X(I+1,J+1) = 0.0 ----- 09050
      DWY=DEL*EJ ----- 09060
      IF (DWY .LE. (B/2.0)) GO TO 100 ----- 09070
      300 NGP = K ----- 09080
      800 RETURN ----- 09090
      END ----- 09100
$IBFTC MS23G4 ----- 09110
CSEQS ----- 09120
C ----- 09130
      SUBROUTINE SEQS (A,B,N,M) ----- 09140
C ----- 09150
C MATRIX INVERSION WITH ACCOMPANYING SOLUTION OF LINEAR EQUATIONS ----- 09160
C ----- 09170
C ----- 09180
      COMMON DUM ----- 09190
      0 EQUIVALENCE (DUM(1),CON),(DUM(501),X),(DUM(1001),Y) ----- 09200
      1,(DUM(1501),W),(DUM(2001),DWX),(DUM(2501),DWY),(DUM(3001),JPN) ----- 09210
      2 ,(DUM(3501),RTV) ----- 09220
      DOUBLE PRECISION A,B,AMAX,PIVOT,SWAP,T ----- 09230
      DIMENSION IPIVOT(32),A(32,32), INDEX(32,2),PIVOT(32),B(32,2) ----- 09240
      EQUIVALENCE (IROW,JROW),(AMAX,T,SWAP),(ICOLUM,JCOLUM) ----- 09250
C ----- 09260
C=====INITIALIZATION ----- 09270
C ----- 09280
      10 DETERM=1.0 ----- 09290

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15 DO 20 J=1,N
20 IPIVOT(J)=0
30 DO 550 I=1,N
C
C====SEARCH FOR PIVOT ELEMENT
C
40 AMAX=0.0
45 DO 105 J=1,N
50 IF (IPIVOT(J)-1) 60, 105, 60
60 DO 100 K=1,N
70 IF (IPIVOT(K)-1) 80, 100, 740
80 IF(DABS(AMAX)-DABS(A(J,K)))85,100,100
85 IROW=J
90 ICOLUM=K
95 AMAX=A(J,K)
100 CONTINUE
105 CONTINUE
IF (AMAX) 128,107,128
107 PRINT 108
108 FORMAT (22H MATRIX IS SINGULAR. )
NCE = 1
GO TO 740
128 IPIVOT(ICOLUM) =IPIVOT(ICOLUM)+1
C
C====INTERCHANGE ROWS TO PUT PIVOT ELEMENT ON DIAGONAL
C
130 IF (IROW-ICOLUM) 140, 260, 140
140 DETERM=-DETERM
150 DO 200 L=1,N
160 SWAP=A(IROW,L)
170 A(IROW,L)=A(ICOLUM,L)
200 A(ICOLUM,L)=SWAP
205 IF(M) 260, 260, 210
210 DO 250 L=1, M
220 SWAP=B(IROW,L)
230 B(IROW,L)=B(ICOLUM ,L)
250 B(ICOLUM,L)=SWAP
260 INDEX(I,1)=IROW
270 INDEX(I,2)=ICOLUM
310 PIVOT(I)=A(ICOLUM,ICOLUM)
320 CONTINUE
C
C====DIVIDE PIVOT ROW BY PIVOT ELEMEN.
C
330 A(ICOLUM,ICOLUM)=10.0D-1
340 DO 350 L=1,N
350 A(ICOLUM,L)=A(ICOLUM,L)/PIVOT(I)

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| | 355 IF(M) 380, 380, 360 | 09770 |
| | 360 DO 370 L=1,M | 09780 |
| | 370 B(ICOLUM,L)=B(ICOLUM,L)/PIVOT(I) | 09790 |
| | C | 09800 |
| | C=====REDUCE NON-PIVOT ROWS | 09810 |
| | C | 09820 |
| | 380 DO 550 L1=1,N | 09830 |
| | 390 IF(L1-ICOLUM) 400, 550, 400 | 09840 |
| | 400 T=A(L1,ICOLUM) | 09850 |
| | 420 A(L1,ICOLUM)=0.0 | 09860 |
| | 430 DO 450 L=1,N | 09870 |
| | 450 A(L1,L)=A(L1,L)-A(ICOLUM,L)*T | 09880 |
| | 455 IF(M) 550, 550, 460 | 09890 |
| | 460 DO 500 L=1,M | 09900 |
| | 500 B(L1,L)=B(L1,L)-B(ICOLUM,L)*T | 09910 |
| | 550 CONTINUE | 09920 |
| | C | 09930 |
| | C=====INTERCHANGE COLUMNS | 09940 |
| | C | 09950 |
| | 600 DO 710 I=1,N | 09960 |
| | 610 L=N+1-I | 09970 |
| | 620 IF (INDEX(L,1)-INDEX(L,2)) 630, 710, 630 | 09980 |
| 159 | 630 JROW= INDEX(L,1) | 09990 |
| | 640 JCOLUM=INDEX(L,2) | 10000 |
| | 650 DO 705 K=1,N | 10010 |
| | 660 SWAP=A(K,JROW) | 10020 |
| | 670 A(K,JROW)=A(K,JCOLUM) | 10030 |
| | 700 A(K,JCOLUM)=SWAP | 10040 |
| | 705 CONTINUE | 10050 |
| | 710 CONTINUE | 10060 |
| | 740 RETURN | 10070 |
| | END | 10080 |
| | \$IBFTC MS23G5 | 10090 |
| | CTRPZOD | 10100 |
| | SUBROUTINE TRPZOD | 10110 |
| C | THIS SUBROUTINE READS IN THE TRAPEZOIDAL DEFORMATION DATA FROM | 10120 |
| C | PUNCHED CARDS. THE CODES ARE BROKEN DOWN AND REASSEMBLED IN THE | 10130 |
| C | FORMAT NECESSARY FOR THE RAY TRACE PROGRAMS. | 10140 |
| C | | 10150 |
| C | DWX = SLOPE IN X DIR. AT POINT LOC | 10160 |
| C | DWY = SLOPE IN Y DIR. AT POINT LOC | 10170 |
| C | ELM = ELEMENT VALVE AT LOC | 10180 |
| C | IBY = =1 INDICATES POINT IS OUTSIDE PLANFORM BOUNDARY | 10190 |
| C | ICOL = COLUMN NUMBER | 10200 |
| C | IDIR = DEGREE OF FREEDOM 1=X, 2=Y, 3=Z, 4=TX, 5= TY, 6=TZ | 10210 |
| C | ILD = LOAD NUMBER OUTPUT BY SAMIS (COLUMN CODE) | 10220 |
| C | IROW = ROW NUMBER | 10230 |

| | | | | | | | | | |
|-----|------------|--------------------|---|-------------------------------|-------------------|--------------|--------------|--|-------|
| C | ITEM | = | TEMPORARY | | | | | | 10240 |
| C | JLD | = | LOAD NUMBER DESIRED. THE LOAD NUMBER IS A PART OF THE | | | | | | 10250 |
| C | | | ELEMENT CODE GENERATED BY SAMIS. | | | | | | 10260 |
| C | LOC | = | COORDINATE LOCATION CODE | | | | | | 10270 |
| C | M | = | GRIDPOINT COUNTER | | | | | | 10280 |
| C | NCRD | = | NO. OF ELEMENT DATA CARDS TO BE READ IN. | | | | | | 10290 |
| C | NGP | = | NUMBER OF GRIDPOINTS | | | | | | 10300 |
| C | SCLFAC | = | SCALE FACTOR TO MULTIPLY DEFLECTIONS BY | | | | | | 10310 |
| C | W | = | DEFLECTION AT POINT LOC | | | | | | 10320 |
| C | X | = | X COORDINATE ARRAY | | | | | | 10330 |
| C | XS | = | X COORDINATE AT POINT LOC | | | | | | 10340 |
| C | YS | = | Y COORDINATE AT POINT LOC | | | | | | 10350 |
| C | | | | | | | | | 10360 |
| C | COMMON DUM | | | | | | | | 10370 |
| C | | | | | | | | | 10380 |
| | 0 | EQUIVALENCE | (DUM(1), CON), | | (DUM(501), X), | | | | 10390 |
| | 1 | | (DUM(1501), W), | | (DUM(2251), DWX), | | | | 10400 |
| | 2 | | (DUM(3001), JPN), | | (DUM(3501), RTV) | | | | 10410 |
| C | | | | | | | | | 10420 |
| | 0 | EQUIVALENCE | (CON(1), DIMA), | | (CON(2), DIMB), | | | | 10430 |
| | 1 | (CON(3), DIMC), | (CON(4), DEL), | | (CON(5), GNU), | | | | 10440 |
| | 2 | (CON(6), THIC), | (CON(7), SPAD), | | (CON(8), PRSS), | | | | 10450 |
| | 3 | (CON(9), NPAN), | (CON(10), ISI), | | (CON(11), ISO), | | | | 10460 |
| | 4 | (CON(12), IBC), | (CON(13), NGP), | | (CON(14), LP7), | | | | 10470 |
| | 5 | (CON(15), FR), | (CON(16), LOCP), | | (CON(17), IPD), | | | | 10480 |
| | 6 | (CON(18), IPR), | (CON(19), CHAP), | | (CON(20), ISCR1), | | | | 10490 |
| | 7 | (CON(21), ISCR2), | (CON(22), SKAL), | | (CON(23), ISEC), | | | | 10500 |
| | 8 | (CON(24), NPAG), | (CON(25), YONG), | | (CON(26), ILGD), | | | | 10510 |
| | 9 | (CON(27), IREL), | (CON(28), LP5), | | (CON(29), CPRSS) | | | | 10520 |
| C | | | | | | | | | 10530 |
| | 0 | EQUIVALENCE | (CON(31), SCAL), | | (CON(41), SPAC), | | | | 10540 |
| | 1 | (CON(51), PRES), | (CON(61), PLNA), | | (CON(71), RAYA), | | | | 10550 |
| | 2 | (CON(81), PAIA), | (CON(91), THEA), | | (CON(101), RI), | | | | 10560 |
| | 3 | (CON(111), RES), | (CON(291), STAT), | | (CON(351), OIF), | | | | 10570 |
| | 4 | (OIF(1),IDX), | (OIF(2),IDY), | | (OIF(3),X1), | (OIF(4),Y1), | (OIF(11),N2) | | 10580 |
| C | | | | | | | | | 10590 |
| | 0. | DIMENSION | CON(500), | X(21,33), | | W(21,33), | | | 10600 |
| | 1 | DWX(21,33), | | JPN(500), | OIF(12) | | | | 10610 |
| C | | | | | | | | | 10620 |
| | | DIMENSION | LOC(3), | ILD(3), | ELM(3) | | | | 10630 |
| C | | | | | | | | | 10640 |
| | | READ | (ISI,500) | JLD,NCRD,SCLFAC,X1,Y1,IDX,IDY | | | | | 10650 |
| 500 | | FORMAT | (2I5,3E10.0,2I5) | | | | | | 10660 |
| | | WRITE | (ISO,503) | SCLFAC | | | | | 10670 |
| 503 | | FORMAT | (1H1, 42HSCALE FACTOR FOR TRAPEZOID DEFLECTIONS IS | | | | | | 10680 |
| 1 | | E16.4,1H.) | | | | | | | 10690 |
| | | WRITE | (ISO,505) | X1,Y1 | | | | | 10700 |

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|------|--------|---|-------|
| | 505 | FORMAT (1H , 31HINTERPOLATION CENTER IS AT X1= E12.4, 6H, Y1= | 10710 |
| | | 1 E12.4,1H.) | 10720 |
| | | WRITE (ISO,507)IDX,IDY | 10730 |
| | 507 | FORMAT (1H , 35HCENTER OF INTERPOLATION SQUARES IS I5, | 10740 |
| | | 1 17H X INTERVALS AND I5, 25H Y INTERVALS FROM ORIGIN.) | 10750 |
| | C | X1,Y1 - COORDINATES OF TRANSLATED ORIGIN | 10760 |
| | C | IDX= NO. OF INTERVALS IN X FOR INTERPOLATION CENTER | 10770 |
| | C | IDY= NO. OF INTERVALS IN Y FOR INTERPOLATION CENTER | 10780 |
| | C | IF JLD IS MINUS, CARD DATA FOR WINDOW IN ACTUAL CONFIGURATION IS GIVEN. | 10790 |
| | C | IF NCRD IS MINUS, CARD DATA IS GIVEN FOR ONLY 1 OF 2 PANES AND BOTH | 10800 |
| | C | ARE THE SAME. | 10810 |
| | | N1=1 | 10820 |
| | | N2=1 | 10830 |
| | | IF(NCRD)2,6,6 | 10840 |
| | 2 | N1=2 | 10850 |
| | | NCRD=-NCRD | 10860 |
| | 6 | IR=21 | 10870 |
| | | IC=33 | 10880 |
| | | IF(JLD) 10,15,15 | 10890 |
| | 10 | N2=2 | 10900 |
| | | JLD=-JLD | 10910 |
| | | IR=20 | 10920 |
| | | IC=20 | 10930 |
| 161, | 15 | M=0 | 10940 |
| | | DO 104 I=1,NCRD | 10950 |
| | | READ (IST,501) (LOC(J), ILD(J), ELM(J), J=1,3) | 10960 |
| | 501 | FORMAT (3(I6,I6,012)) | 10970 |
| | C | | 10980 |
| | C===== | TEST TO SEE IF DATA IS ACCEPTABLE | 10990 |
| | | DO 104 J=1,3 | 11000 |
| | | IF (ILD(J) .NE. JLD) GO TO 104 | 11010 |
| | | IF (LOC(J) .LE. 0) GO TO 104 | 11020 |
| | | IROW = LOC(J)/1000 | 11030 |
| | | ITEM = LOC(J) - IROW*1000 | 11040 |
| | | ICOL = ITEM/10 | 11050 |
| | | IDIR = ITEM - ICOL*10 | 11060 |
| | | IF ((IDIR.EQ.1) .OR. (IDIR.EQ.2) .OR. (IDIR.EQ.6)) GO TO 104 | 11070 |
| | | IF((ICOL.GT.IC).OR.(IROW.GT.IR)) GO TO 20 | 11080 |
| | | XS = ICOL - 1 | 11090 |
| | | YS = IROW - 1 | 11100 |
| | | GO TO 30 | 11110 |
| | 20 | XS=ICOL-1-IC | 11120 |
| | | YS=IROW-1-IR | 11130 |
| | 30 | IBY = 0 | 11140 |
| | | XS=XS*DEL | 11150 |
| | | YS=YS*DEL | 11160 |
| | | CALL BONDY (XS, YS, IBY) | 11170 |

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| | IF (IBY .EQ. 1) GO TO 104 | 11180 |
| | K1 = IROW | 11190 |
| | K2 = ICOL | 11200 |
| | CALL PACWRD (K1,K2,1) | 11210 |
| | IF((IROW.LE.IR).AND.(ICOL.LE.IG)) GO TO 32 | 11220 |
| | IF((IROW.GT.IR).AND.(ICOL.GT.IG)) GO TO 40 | 11230 |
| | GO TO 104 | 11240 |
| 32 | K = IROW | 11250 |
| | L = ICOL | 11260 |
| | X(K,L) = ICOL - 1 | 11270 |
| | X(K,L)=X(K,L)*DEL | 11280 |
| | C | 11290 |
| | C===== STORE ACCEPTABLE DATA | 11300 |
| | IF((IDIR.EQ.3).AND.(N2.EQ.1)) W(K,L)=ELM(J)*SCLFAC | 11310 |
| | IF((IDIR.EQ.3).AND.(N2.EQ.2)) DWX(K,L)=ELM(J)*SCLFAC | 11320 |
| | IF (IDIR .EQ. 3) M = M+1 | 11330 |
| | IF (IDIR .EQ. 3) JPN(M) = K1 | 11340 |
| | GO TO (104,34),N1 | 11350 |
| 34 | DWX(K,L)=W(K,L) | 11360 |
| | GO TO 104 | 11370 |
| 40 | IF(NPAN-2)104,44,104 | 11390 |
| 44 | K=IROW-IR | 11400 |
| | L=ICOL-IC | 11410 |
| | IF((IDIR.EQ.3).AND.(N2.EQ.1)) DWX(K,L)=ELM(J)*SCLFAC | 11420 |
| | IF((IDIR.EQ.3).AND.(N2.EQ.2)) W(K,L)=ELM(J)*SCLFAC | 11430 |
| 104 | CONTINUE | 11440 |
| | NGP = M | 11450 |
| 800 | RETURN | 11460 |
| | END | 11470 |
| | \$IBFTC MS23G6 | 11480 |
| | CLRGDEF | 11490 |
| | SUBROUTINE LRGDEF | 11500 |
| | C | 11510 |
| | C THIS PROGRAM USES EQUATIONS DERIVED FROM AN ENERGY METHOD | 11520 |
| | C DEVELOPED IN TIMOSHENKOS THEORY OF PLATES AND SHELLS, P. 419 TO | 11530 |
| | C 424 TO FIND THE APPROXIMATE LARGE DEFLECTION SOLUTION FOR A | 11540 |
| | C RECTANGULAR PLATE. | 11550 |
| | C | 11560 |
| | C A = HALF RECTANGLE LENGTH | 11570 |
| | C A1 = CONSTANTS IN CUBIC EQUATION | 11580 |
| | C B = HALF RECTANGLE WIDTH | 11590 |
| | C C1 = CONSTANTS IN CUBIC EQUATION | 11600 |
| | C CON1 = CONSTANTS IN LARGE DEFLECTION EQUATION | 11610 |
| | C CON2 = CONSTANTS IN LARGE DEFLECTION EQUATION | 11620 |
| | C CON3 = CONSTANTS IN LARGE DEFLECTION EQUATION | 11630 |
| | C CON4 = CONSTANTS IN LARGE DEFLECTION EQUATION | 11640 |
| | C CON5 = CONSTANTS IN LARGE DEFLECTION EQUATION | 11650 |

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|---|-----|--|---|-------|
| C | D1 | = | CONSTANTS IN CUBIC EQUATION | 11660 |
| C | DUX | = | LARGE DEFLECTION THEORY DEFLECTION FOR FIRST PANE | 11670 |
| C | Q | = | CONSTANTS IN SOLUTION OF CUBIC EQUATION | 11680 |
| C | QR | = | CONSTANTS IN SOLUTION OF CUBIC EQUATION | 11690 |
| C | R | = | CONSTANTS IN SOLUTION OF CUBIC EQUATION | 11700 |
| C | S1 | = | CONSTANTS IN SOLUTION OF CUBIC EQUATION | 11710 |
| C | S2 | = | CONSTANTS IN SOLUTION OF CUBIC EQUATION | 11720 |
| C | SQR | = | CONSTANTS IN SOLUTION OF CUBIC EQUATION | 11730 |
| C | TM | = | CONSTANTS IN SOLUTION OF CUBIC EQUATION | 11740 |
| C | TP | = | CONSTANTS IN SOLUTION OF CUBIC EQUATION | 11750 |
| C | U | = | LARGE DEFLECTION THEORY DEFLECTION FOR SECOND PANE | 11760 |
| C | WO | = | CONSTANTS IN SOLUTION OF CUBIC EQUATION | 11770 |
| C | | | | 11780 |
| | | | DOUBLE PRECISION PI,CON1,CON2,CON3,CON4,CON5,A1,C1,Q,R,QR,SQR,TP, | 11790 |
| | 1 | | S1,TM,S2,WO,Q1,Q2,QC | 11800 |
| C | | | | 11810 |
| | | | COMMON DUM | 11820 |
| C | | | | 11830 |
| | 0 | EQUIVALENCE | (DUM(1), CON), (DUM(501), X), | 11840 |
| | 1 | | (DUM(1501), W), (DUM(2001), DWX), | 11850 |
| | 2 | | (DUM(3001), JPN), (DUM(3501), RTV), | 11860 |
| | 3 | (DUM(4001), U), | (DUM(4751), DUX), (DUM(6501), T), | 11870 |
| | 4 | (DUM(5501), R), | (DUM(6001), S), (DUM(7251), DIX) | 11880 |
| C | | | | 11890 |
| | 0 | EQUIVALENCE | (CON(1), DIMA), (CON(2), DIMB), | 11900 |
| | 1 | (CON(3), DIMC), | (CON(4), DEL), (CON(5), GNU), | 11910 |
| | 2 | (CON(6), THIC), | (CON(7), SPAD), (CON(8), PRSS), | 11920 |
| | 3 | (CON(9), NPAN), | (CON(10), ISI), (CON(11), ISO), | 11930 |
| | 4 | (CON(12), IBC), | (CON(13), NGP), (CON(14), LP7), | 11940 |
| | 5 | (CON(15), FR), | (CON(16), LOCP), (CON(17), IPD), | 11950 |
| | 6 | (CON(18), IPR), | (CON(19), CHAP), (CON(20), ISCR1), | 11960 |
| | 7 | (CON(21), ISCR2), | (CON(22), SKAL), (CON(23), ISEC), | 11970 |
| | 8 | (CON(24), NPAG), | (CON(25), YONG), (CON(26), ILGD), | 11980 |
| | 9 | (CON(27), IREL), | (CON(28), LP5), (CON(29), CPRSS) | 11990 |
| C | | | | 12000 |
| | 0 | EQUIVALENCE | (CON(31), SCAL), (CON(41), SPAC), | 12010 |
| | 1 | (CON(51), PRES), | (CON(61), PLNA), (CON(71), RAYA), | 12020 |
| | 2 | (CON(81), PAIA), | (CON(91), THEA), (CON(101), RI), | 12030 |
| | 3 | (CON(111), RES), | (CON(291), STAT), (CON(351), OIF), | 12040 |
| | 4 | (CON(401),EANDF), | (CON(451), RHS) | 12050 |
| C | | | | 12060 |
| | | | EQUIVALENCE (RTV,BI),(OIF(1),NDX),(OIF(2),NDY),(X1,OIF(3)), | 12070 |
| | 1 | (Y1,OIF(4)),(OIF(5),CONST1),(OIF(6),CONST2),(OIF(7),CONST3), | | 12080 |
| | 2 | (OIF(8),CONST4),(OIF(9),CONST5),(OIF(10),CONST6) | | 12090 |
| C | | | | 12100 |
| | 0 | DIMENSION | CON(500), X(21,33), U(21,33), W(21,33), | 12110 |
| | 1 | DWX(21,33), | DUX(21,33), JPN(500), RIV(500), OIF(12) | 12120 |

| | | | |
|-----|---|---|-------|
| | C | | 12130 |
| | | IF (CHAP.NE.2) GO TO 900 | 12140 |
| | | NTIMES=0 | 12150 |
| | | III=1 | 12160 |
| | | IF (NPAN.EQ.2) III=2 | 12170 |
| 100 | | DO 700 II=1,III | 12180 |
| | | II=II | 12190 |
| | | NTIMES=NTIMES+1 | 12200 |
| | | PRSSS=PRSS | 12210 |
| | | IF (NTIMES.EQ.2) PRSSS=-(PRSS-CPRSS) | 12220 |
| | | DO 102 I=1,21 | 12230 |
| | | DO 102 J=1,33 | 12240 |
| 102 | | U(I,J)=W(I,J)*PRSSS | 12250 |
| | | PI = 3.14159265358979323846 | 12260 |
| | | A = DIMA/2.0 | 12270 |
| | | B = DIMB/2.0 | 12280 |
| | C | CONSTANTS IN LARGE DEFLECTION EQUATION. | 12290 |
| | | CON1 = 480.0*A*B/(YONG*THIC*PI**4) | 12300 |
| | | CON2 = (PI**2/16.0)*(9.0*B/(A**3) + 2.0/(A*B) + 9.0*A/(B**3)) | 12310 |
| 0 | | CON3 = (PI**2/3.0)*(16.0*B/(A**2) + 1.0/A + 1.0/B + 16.0*A/ | 12320 |
| | | 1 (B**2))**2 | 12330 |
| | | CON4 = (35.0*(PI**2)*B/A + 35.0*(PI**2)*A/B + 640.0/9.0) | 12340 |
| | | CON5 = CON1/(CON2 - (2.0/3.0)*(CON3/CON4)) | 12350 |
| | C | CONSTANTS IN CUBIC EQUATION | 12360 |
| | | A1 = 1.0/CON5 | 12370 |
| | | C1=PRSSS/(ABS(U(1,1))*3.) | 12380 |
| | | D1 = -PRSSS | 12390 |
| | C | SOLUTION OF CUBIC EQUATION. | 12400 |
| | | Q = A1*C1 | 12410 |
| | | R = -0.5*(A1**2)*D1 | 12420 |
| | | INEG = 0 | 12430 |
| | | QR = Q**3 + R**2 | 12440 |
| | | SQR = DSQRT(QR) | 12450 |
| | | TP = R + SQR | 12460 |
| | | IF (TP .GT. 0.0) GO TO 106 | 12470 |
| | | INEG = 1 | 12480 |
| 106 | | S1 = ABS(TP)**(1.0/3.0) | 12490 |
| | | IF (INEG .NE. 1) GO TO 108 | 12500 |
| | | S1 = -S1 | 12510 |
| | | INEG = 0 | 12520 |
| 108 | | TM = R - SQR | 12530 |
| | | IF (TM .GT. 0.0) GO TO 110 | 12540 |
| | | INEG = 1 | 12550 |
| 110 | | S2 = ABS(TM)**(1.0/3.0) | 12560 |
| | | IF (INEG .NE. 1) GO TO 112 | 12570 |
| | | S2 = -S2 | 12580 |
| 112 | | INEG = 0 | 12590 |

| | | |
|---------|---|-------|
| | WO = (S1 + S2)/A1 | 12600 |
| C | DETERMINATION OF SMALL DEFLECTION THEORY AND LARGE DEFLECTION | 12610 |
| C | THEORY PRESSURES. | 12620 |
| | Q2 = (WO**3)/CON5 | 12630 |
| | Q1 = PRSSS - Q2 | 12640 |
| | QC = Q2*CON5 | 12650 |
| | IF (QC .GT. 0.0) GO TO 114 | 12660 |
| | INEG = 1 | 12670 |
| 114 | CQC = ABS(QC)**(1.0/3.0) | 12680 |
| | IF (INEG .NE. 1) GO TO 116 | 12690 |
| | CQC = -CQC | 12700 |
| C | THIS SECTION DETERMINES THE DEFLECTION AND SLOPES. | 12710 |
| 116 | IF(NTIMES.EQ.1) GO TO 103 | 12720 |
| | CONST4=Q1 | 12730 |
| | CONST5=PRSSS | 12740 |
| | CONST6=CQC | 12750 |
| | GO TO 105 | 12760 |
| 103 | CONST1=Q1 | 12770 |
| | CONST2=PRSSS | 12780 |
| | CONST3=CQC | 12790 |
| 105 | DO 104 I=1,NGP | 12800 |
| | K1 = JPN(I) | 12810 |
| | CALL PACWRD (K1,K2,2) | 12820 |
| | CX = PI*X(K1,K2)/(2.0*A) | 12830 |
| | EJ=K1-1 | 12840 |
| | YY=DEL*EJ | 12850 |
| | GY=PI*YY/(2.*B) | 12860 |
| | TE1 = U(K1,K2)*(ABS(Q1/PRSSS)) | 12870 |
| | TE2 = CQC*COS(CX)*COS(CY) | 12880 |
| 104 | U(K1,K2) = (TE1 + TE2)/2.0 | 12890 |
| | IF(NTIMES.EQ.2) GO TO 700 | 12900 |
| | DO 120 I=1,21 | 12910 |
| | DO 120 J=1,33 | 12920 |
| 120 | DUX(I,J)=U(I,J) | 12930 |
| 700 | CONTINUE | 12940 |
| 800 | RETURN | 12950 |
| 900 | WRITE(ISO,500) | 12960 |
| 500 | FORMAT('HI,99HINPUT ERROR. LARGE DEFLECTION REQUIRED FOR PLANFORM | 12970 |
| | 10THER THAN RECTANGLE.) | 12980 |
| | STOP | 12990 |
| | END | 13000 |
| \$IBFTC | MS23G7 | 13010 |
| C | DEFRES | 13020 |
| | SUBROUTINE DEFRES (IDT,NOPRT) | 13030 |
| C | | 13040 |
| C | THIS SUBROUTINE PRINTS OUT THE PLATE DEFLECTION DATA. | 13050 |
| C | | 13060 |

| | | | |
|---|---------------|---|-------|
| C | CONC | = BOUNDARY CONDITION | 13070 |
| C | DTX | = TEMPORARY ARRAY FOR SLOPE IN X DIR. | 13080 |
| C | DTY | = TEMPORARY ARRAY FOR SLOPE IN Y DIR. | 13090 |
| C | R | = TEMPORARY ARRAY FOR X COORDINATES | 13100 |
| C | S | = TEMPORARY ARRAY FOR Y COORDINATES | 13110 |
| C | T | = TEMPORARY ARRAY FOR DEFLECTION | 13120 |
| C | | | 13130 |
| C | COMMON DUM | | 13140 |
| C | | | 13150 |
| | 0 EQUIVALENCE | (DUM(1), CON), (DUM(501), X), | 13160 |
| | 1 | (DUM(1501), W), (DUM(2251), DWX), | 13170 |
| | 2 | (DUM(3001), JPN), (DUM(3501), RTV), | 13180 |
| | 3 | (DUM(4001), U), (DUM(4751), DUX), | 13190 |
| | 4 | (DUM(5501), R), (DUM(6001), S), | 13200 |
| | 5 | (DUM(6501), T), (DUM(7251), DTX) | 13210 |
| C | | | 13220 |
| | 0 EQUIVALENCE | (CON(1), DIMA), (CON(2), DIMB), | 13230 |
| | 1 | (CON(3), DIMC), (CON(4), DEL), (CON(5), GNU), | 13240 |
| | 2 | (CON(6), THIC), (CON(7), SPAD), (CON(8), PRSS), | 13250 |
| | 3 | (CON(9), NPAN), (CON(10), ISI), (CON(11), ISO), | 13260 |
| | 4 | (CON(12), IBC), (CON(13), NGP), (CON(14), LP7), | 13270 |
| | 5 | (CON(15), FR), (CON(16), LOCP), (CON(17), IPD), | 13280 |
| | 6 | (CON(18), IPR), (CON(19), CHAP), (CON(20), ISCR1), | 13290 |
| | 7 | (CON(21), ISCR2), (CON(22), SKAL), (CON(23), ISEC), | 13300 |
| | 8 | (CON(24), NPAG), (CON(25), YONG), (CON(26), ILRG), | 13310 |
| | 9 | (CON(27), IREL), (CON(28), LP5), (CON(29), CPRSS) | 13320 |
| C | | | 13330 |
| | 0 EQUIVALENCE | (CON(31), SCAL), (CON(41), SPAC), | 13340 |
| | 1 | (CON(51), PRES), (CON(61), PLNA), (CON(71), RAYA), | 13350 |
| | 2 | (CON(81), PAIA), (CON(91), THEA), (CON(101), RI), | 13360 |
| | 3 | (CON(111), RES), (CON(301), STAT), (CON(351), OIF), | 13370 |
| | 4 | (CON(401), EANDF), (CON(451), RHS) | 13380 |
| C | | | 13390 |
| C | | | 13400 |
| | 0 DIMENSION | CON(500), X(21,33), W(21,33), DWX(21,33), | 13410 |
| | 1 | JPN(500), R(500), S(500), T(500), DTX(750), | 13420 |
| | 3 | RTV(500), U(21,33), DUX(21,33) | 13430 |
| C | | | 13440 |
| | 0 DIMENSION | RT30(3), RT31(3), RT32(3), RT36(2), RT37(2), RT38(2), | 13450 |
| | 1 | RT39(2) | 13460 |
| C | | | 13470 |
| | 0 DATA | RT30(1)/13HELLIPSE A=/, RT31(1)/13HRECTANGLE A=/, | 13480 |
| | 1 | RT32(1)/13HTRAPEZOID A=/, RT33/4H B=/, RT34/4H C=/, | 13490 |
| | 2 | RT35/6HSCALE=7, RT36(1)/10HTHICKNESS=7, | 13500 |
| | 3 | RT37(1)/9H PANES=/, RT38(1)/11H SPACING=/, | 13510 |
| | 4 | RT39(1)/12H PRESSURE=/ | 13520 |
| C | | | 13530 |

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DATA HING/6HHINGED/, CH/1H /, CLMP/6HCLAMPE/, CC/1HD/ 13540
C 13550
C==== THIS SECTION MULTIPLIES THE UNITIZED DEFORMATIONS BY THE PRESSURE 13560
C LOAD. 13570
C 13580
IS7 = ISO 13590
IF (NOPRT .EQ. 0) IS7 = ISCRJ 13600
DO 101 I=1,NGP 13610
K1 = JPN(I) 13620
CALL PACWRD (K1,K2,2) 13630
EJ=K1-1 13640
R(I) = X(K1,K2) 13650
S(I) = DEL*EJ 13660
IF(ILRG.EQ.1) GO TO 100 13670
IF(CHAP.EQ.3.) GO TO 99 13680
T(I) = W(K1,K2)*(CPRSS-PRSS) 13690
DTX(I) = DWX(K1,K2)*PRSS 13700
GO TO 101 13710
99 T(I)=W(K1,K2) 13720
DTX(I)=DWX(K1,K2) 13730
GO TO 101 13740
100 T(I) = DUX(K1,K2) 13750
DTX(I) = U(K1,K2) 13760
101 CONTINUE 13770
C 13780
C==== THIS SECTION PRINTS THE TITLE AND HEADING INFORMATION. 13790
C 13800
CALL PAGE (IPD, LINE, IS7, IDT) 13810
IF (ILRG .EQ. 0) GO TO 607 13820
WRITE (IS7,529) 13830
529 0 FORMAT (1H0, 38X,38HW I N D O W D E F O R M A T I O N , 13840
1 7HD A T A/1H ,49X,23H(LARGE DEFLECTION DATA)/1H ) 13850
GO TO 608 13860
607 WRITE (IS7,500) 13870
500 0 FORMAT (1H0/1H ,38X,38HW I N D O W D E F O R M A T I O N , 13880
1 7HD A T A/1H ) 13890
608 ICHAP = CHAP 13900
IF (IBC .NE. 1) GO TO 302 13910
CONC = HING 13920
CF = CH 13930
302 IF (IBC .NE. 2) GO TO 303 13940
CONC = CLMP 13950
CF = CC 13960
303 GO TO (102,103,104), ICHAP 13970
102 0 WRITE (IS7,501) (RT30(I),I=1,3), DIMA, RT33, DIMB, 13980
1 RT35, SKAL, (RT36(I),I=1,2), THIC, (RT37(I),I=1,2), NPAN, 13990
2 (RT38(I),I=1,2), SPAD, (RT39(I),I=1,2), PRSS, CONC, CF 14000

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| | | | |
|-----|---|---|-------|
| 501 | 0 | FORMAT (1H0,2A6,A1,F5.2,A4,F5.2,14X,A6,F4.2,3X,A6,A4,F5.2,A6,A3, | 14010 |
| | 1 | I1,A6,A5,F3.1,2A6,F5.1,3X,A6,A1) | 14020 |
| | | GO TO 105 | 14030 |
| 103 | 0 | WRITE (IS7,501) (RT31(I),I=1,3), DIMA, RT33, DIMB, | 14040 |
| | 1 | RT35, SKAL, (RT36(I),I=1,2), THIC, (RT37(I),I=1,2), NPAN, | 14050 |
| | 2 | (RT38(I),I=1,2), SPAD, (RT39(I),I=1,2), PRSS, CONC, CF | 14060 |
| | | GO TO 105 | 14070 |
| 104 | 0 | WRITE (IS7,518) (RT32(I),I=1,3), DIMA, RT33, DIMB, RT34, DIMC, | 14080 |
| | 1 | RT35, SKAL, (RT36(I),I=1,2), THIC, (RT37(I),I=1,2), NPAN, | 14090 |
| | 2 | (RT38(I),I=1,2), SPAD, (RT39(I),I=1,2), PRSS, CONC, CF | 14100 |
| 518 | 0 | FORMAT (1H0,2A6,A1,F5.2,A4,F5.2,A4,F5.2,5X,A6,F4.2,3X,A6,A4,F5.2, | 14110 |
| | 1 | A6,A3,I1,A6,A5,F3.1,2A6,F5.1,3X,A6,A1) | 14120 |
| 105 | | WRITE (IS7,505) | 14130 |
| 505 | 0 | FORMAT (1H0/1H ,1X,11HCOORDINATES,18X,12HDEFORMATIONS,14X, | 14140 |
| | 1 | 11HCOORDINATES,18X,12HDEFORMATIONS/1H0, | 14150 |
| | 2 | 44H X Y DEFL. PANE 1 DEFL. PANE 2 ,11X, | 14160 |
| | 3 | 44H X Y DEFL. PANE 1 DEFL. PANE 2) | 14170 |
| | | LINE = LINE + 11 | 14180 |
| | | JRM = NGP-2*(NGP/2) | 14190 |
| | | DO 114 K=1,NGP,2 | 14200 |
| | | IF (LINE - 45) 112,107,107 | 14210 |
| 107 | | CALL PAGE (IPD, LINE, IS7, IDT) | 14220 |
| | | WRITE (IS7,500) | 14230 |
| | | GO TO (108,109,110), ICHAP | 14240 |
| 108 | 0 | WRITE (IS7,501) (RT30(I),I=1,3), DIMA, RT33, DIMB, | 14250 |
| | 1 | RT35, SKAL, (RT36(I),I=1,2), THIC, (RT37(I),I=1,2), NPAN, | 14260 |
| | 2 | (RT38(I),I=1,2), SPAD, (RT39(I),I=1,2), PRSS, CONC, CF | 14270 |
| | | GO TO 111 | 14280 |
| 109 | 0 | WRITE (IS7,501) (RT31(I),I=1,3), DIMA, RT33, DIMB, | 14290 |
| | 1 | RT35, SKAL, (RT36(I),I=1,2), THIC, (RT37(I),I=1,2), NPAN, | 14300 |
| | 2 | (RT38(I),I=1,2), SPAD, (RT39(I),I=1,2), PRSS, CONC, CF | 14310 |
| | | GO TO 111 | 14320 |
| 110 | 0 | WRITE (IS7,518) (RT32(I),I=1,3), DIMA, RT33, DIMB, RT34, DIMC, | 14330 |
| | 1 | RT35, SKAL, (RT36(I),I=1,2), THIC, (RT37(I),I=1,2), NPAN, | 14340 |
| | 2 | (RT38(I),I=1,2), SPAD, (RT39(I),I=1,2), PRSS, CONC, CF | 14350 |
| 111 | | WRITE (IS7,505) | 14360 |
| | | LINE = LINE + 11 | 14370 |
| 112 | | IF ((JRM.EQ.1).AND.(K.EQ.NGP)) GO TO 113 | 14380 |
| | | J = K+1 | 14390 |
| | 0 | WRITE (IS7,506) R(K), S(K), T(K), DTX(K), | 14400 |
| | 1 | R(J), S(J), T(J), DTX(J) | 14410 |
| 506 | 0 | FORMAT (1H ,F5.2,F7.2,2(2X,E13.6),13X, | 14420 |
| | 1 | F5.2,F7.2,2(2X,E13.6)) | 14430 |
| | | GO TO 114 | 14440 |
| 113 | | WRITE (IS7,506) R(K), S(K), T(K), DTX(K) | 14450 |
| 114 | | LINE = LINE + 1 | 14460 |
| 800 | | RETURN | 14470 |

| | | | | |
|--|--|--|--|-------|
| | END | | | 14480 |
| | \$IBFTC MS23G8 | | | 14490 |
| | CRAYTWO | | | 14500 |
| | SUBROUTINE RAYTWO (XP, YP, ZS, BETA, PSI, PAI, THETA, ZSEXT) | | | 14510 |
| | C | | | 14520 |
| | C PRSS = FIRST WINDOW PRESSURE FACTOR TO SCALE DEFORMATIONS | | | 14530 |
| | C PRSF = 2ND WINDOW PRESSURE FACTOR TO SCALE DEFORMATIONS | | | 14540 |
| | C BETA = ANGLE IN XY PLANE BETWEEN Y AXIS AND PLANE OF TWO RAYS | | | 14550 |
| | C PSI = ANGLE BETWEEN Z AXIS AND PLANE CONTAINING 2 RAYS | | | 14560 |
| | C PAI = ANGLE IN RAY PLANE BETWEEN XY PLANE AND PRIMARY RAY | | | 14570 |
| | C THETA = ANGLE IN THE RAY PLANE BETWEEN PRIMARY AND SECONDARY RAY | | | 14580 |
| | C ZSEXT = DISTANCE OF SEXTANT FROM INSIDE OF WINDOW | | | 14590 |
| | C RES(IJ+ 1) = XP X COORD. OF PRIMARY ENTERING RAY | | | 14600 |
| | C RES(IJ+ 11) = YP Y COORD. OF PRIMARY ENTERING RAY | | | 14610 |
| | C RES(IJ+ 21) = XP X COORD. OF PRIMARY LEAVING RAY | | | 14620 |
| | C RES(IJ+ 31) = YP Y COORD. OF PRIMARY LEAVING RAY | | | 14630 |
| | C RES(IJ+ 41) = XS X COORD. OF SECONDARY ENTERING RAY | | | 14640 |
| | C RES(IJ+ 51) = YS Y COORD. OF SECONDARY ENTERING RAY | | | 14650 |
| | C RES(IJ+ 61) = XS X COORD. OF SECONDARY LEAVING RAY | | | 14660 |
| | C RES(IJ+ 71) = YS Y COORD. OF SECONDARY LEAVING RAY | | | 14670 |
| | C RES(IJ+ 81) = ZSEXT | | | 14680 |
| | C RES(IJ+ 91) = BETA | | | 14690 |
| | C RES(IJ+101) = PSI | | | 14700 |
| | C RES(IJ+111) = PAI | | | 14710 |
| | C RES(IJ+121) = THETA | | | 14720 |
| | C RES(IJ+131) = SAI | | | 14730 |
| | C RES(IJ+141) = ERROR | | | 14740 |
| | C RES(IJ+151) = BLANK | | | 14750 |
| | C RES(IJ+161) = BLANK | | | 14760 |
| | C RES(IJ+171) = BLANK | | | 14770 |
| | C | | | 14780 |
| | COMMON DUM | | | 14790 |
| | C | | | 14800 |
| | 0 EQUIVALENCE (DUM(1), CON), (DUM(501), X), | | | 14810 |
| | 1 (DUM(1001), Y), (DUM(1501), W), (DUM(2001), DWX), | | | 14820 |
| | 2 (DUM(2501), DWY), (DUM(3001), JPN), (DUM(3501), RTV) | | | 14830 |
| | C | | | 14840 |
| | 0 EQUIVALENCE (CON(1), DIMA), (CON(2), DIMB), | | | 14850 |
| | 1 (CON(3), DIMC), (CON(4), DEL), (CON(5), GNU), | | | 14860 |
| | 2 (CON(6), THIC), (CON(7), SPAD), (CON(8), PRSS), | | | 14870 |
| | 3 (CON(9), NPAN), (CON(10), ISI), (CON(11), ISO), | | | 14880 |
| | 4 (CON(12), IBC), (CON(13), NGP), (CON(14), LP7), | | | 14890 |
| | 5 (CON(15), FR), (CON(16), LOCP), (CON(17), IPD), | | | 14900 |
| | 6 (CON(18), IPR), (CON(19), CHAP), (CON(20), ISCR1), | | | 14910 |
| | 7 (CON(21), ISCR2), (CON(22), SKAL), (CON(23), ISEC), | | | 14920 |
| | 8 (CON(24), NPAG), (CON(25), YONG), (CON(26), ILGD), | | | 14930 |
| | 9 (CON(27), IREL), (CON(28), LP5), (CON(29), CPRSS) | | | 14940 |

| | | | | |
|-----|---|-------|---|-------|
| | C | | | 14950 |
| | | 0 | EQUIVALENCE (CON(31), SCAL), (CON(41), SPAC), | 14960 |
| | | 1 | (CON(51), PRES), (CON(61), PLNA), (CON(71), RAYA), | 14970 |
| | | 2 | (CON(81), PAIA), (CON(91), THEA), (CON(101), RI), | 14980 |
| | | 3 | (CON(111), RES), (CON(301), STAT), (CON(351), OIF), | 14990 |
| | | 4 | (CON(401),EANDF), (CON(451), RHS) | 15000 |
| | C | | | 15010 |
| | | | DIMENSION CON(500), X(22,22), Y(22,22), W(22,22), DWX(22,22), | 15020 |
| | | 1 | DWY(22,22), RES(180) | 15030 |
| | C | | | 15040 |
| | | | DIMENSION CI(3), DELTAP(4), CN(3), RI(5), CR(3), D(3), EE(3) | 15050 |
| | C | | | 15060 |
| | | | DIMENSION E(3), SN1(3), SN2(3), S1(3), S2(3), PNS(3), V(3) | 15070 |
| | C | | | 15080 |
| | | | IJ = LP7-1 | 15090 |
| | | | IF (NPAN .EQ. 2) PRSS = -(PRSS-CPRSS) | 15100 |
| | | | RES(1) = XP | 15110 |
| | | | RES(2) = YP | 15120 |
| | | | D(1) = THIC | 15130 |
| | | | D(2) = D(1) + SPAD | 15140 |
| | | | D(3) = D(2) + THIC | 15150 |
| | | | N = NPAN*2 | 15160 |
| | | | DO 100 I=1,N | 15170 |
| 170 | | 100 | DELTAP(I) = 1.0 | 15180 |
| | | | RAD = 0.017453292519 | 15190 |
| | | | DEG = 1.0/RAD | 15200 |
| | | | SEC = 206264.8064 | 15210 |
| | | | PI = 3.141592653 | 15220 |
| | | | RES(9) = ZSEXT | 15230 |
| | | | RES(10) = BETA | 15240 |
| | | | RES(11) = PSI | 15250 |
| | | | RES(12) = THETA | 15260 |
| | | | RES(13) = PAI | 15270 |
| | | | RES(14)=PAI+THETA | 15280 |
| | | | BETA = BETA*RAD | 15290 |
| | | | PSI = PSI *RAD | 15300 |
| | | | PAI = PAI * RAD | 15310 |
| | | | THETA= THETA*RAD | 15320 |
| | | | S1(1) = COS(BETA)*COS(PAI) - SIN(BETA)*SIN(PSI)*SIN(PAI) | 15330 |
| | | | S1(2) = SIN(BETA)*COS(PAI) + COS(BETA)*SIN(PSI)*SIN(PAI) | 15340 |
| | | | S1(3) = COS(PSI) *SIN(PAI) | 15350 |
| | | | G = -ZSEXT -0.716 | 15360 |
| | | 310 0 | A = (0.1703 + 0.335/COS(64.0*RAD + ABS(THETA/2.0)))/ | 15370 |
| | | 1 | (TAN(64.0*RAD + ABS(THETA/2.0)) - TAN(-52.0*RAD)) | 15380 |
| | | | B = A*TAN(-52.0*RAD) + 0.1703 | 15390 |
| | | | IF(THETA.EQ.0.) GO TO 20 | 15400 |
| | | | C = (-3.274 - B + A*TAN(ABS(THETA)))/TAN(ABS(THETA)) | 15410 |

| | | |
|-----|--|-------|
| | G = C-ZSEXT = 3.407 | 15420 |
| 20 | E(1) = XP + G*S1(1) | 15430 |
| | E(2) = YP + G*S1(2) | 15440 |
| | E(3) = G*S1(3) | 15450 |
| | DO 304 I=1,3 | 15460 |
| 304 | V(I) = E(I) | 15470 |
| | IBY = 0 | 15480 |
| | CALL BONDY (XP, YP, IBY) | 15490 |
| | IF (IBY.EQ.1) GO TO 800 | 15500 |
| | CALL TRACE (S1,V,XP,YP,RI,N,D,DELTAP,SN1,ISO,PRSS,CPRSS) | 15510 |
| | RES(3) = XP | 15520 |
| | RES(4) = YP | 15530 |
| | CALL BONDY (XP, YP, IBY) | 15540 |
| | IF (IBY .EQ. 1) GO TO 801 | 15550 |
| | SAI = PAI + THETA | 15560 |
| | S2(1) = COS(BETA)*COS(SAI) - SIN(BETA)*SIN(PSI)*SIN(SAI) | 15570 |
| | S2(2) = SIN(BETA)*COS(SAI) + COS(BETA)*SIN(PSI)*SIN(SAI) | 15580 |
| | S2(3) = COS(PSI) *SIN(SAI) | 15590 |
| | IF (THETA .NE. 0.0) GO TO 330 | 15600 |
| | AA = A - 4.123 | 15610 |
| | BB = 3.274 - B | 15620 |
| | 0 DX = S1(1)*AA - BB*(COS(BETA)*SIN(PAI) + SIN(BETA)*SIN(PSI)* | 15630 |
| | 1 COS(PAI)) | 15640 |
| | 0 DY = S1(2)*AA + BB*(COS(BETA)*SIN(PSI)*COS(PAI) - SIN(BETA)* | 15650 |
| | 1 SIN(PAI)) | 15660 |
| | DZ = S1(3)*AA + COS(PSI)*COS(PAI)*BB | 15670 |
| | EE(1) = E(1) + DX | 15680 |
| | EE(2) = E(2) + DY | 15690 |
| | EE(3) = E(3) + DZ | 15700 |
| | DO 350 I=1,3 | 15710 |
| 350 | E(I) = EE(I) | 15720 |
| | 330 XS = E(1) - E(3)*S2(1)/S2(3) | 15730 |
| | YS = E(2) - E(3)*S2(2)/S2(3) | 15740 |
| | RES(5) = XS | 15750 |
| | RES(6) = YS | 15760 |
| | CALL BONDY (XS, YS, IBY) | 15770 |
| | IF (IBY .EQ. 1) GO TO 802 | 15780 |
| | IF (NPAN .EQ. 2) PRSS = -TPRSS-CPRSS) | 15790 |
| | CALL TRACE (S2,E,XS,YS,RI,N,D,DELTAP,SN2,ISO,PRSS,CPRSS) | 15800 |
| | RES(7) = XS | 15810 |
| | RES(8) = YS | 15820 |
| | CALL BONDY (XS, YS, IBY) | 15830 |
| | IF (IBY .EQ. 1) GO TO 803 | 15840 |
| | CALL CROPOD (SN1, SN2, PNS, APNS) | 15850 |
| | THETAN = ASIN(APNS) | 15860 |
| | ERROR = (THETAN - THETA)*SEC | 15870 |
| | SAI = SAI/RAD | 15880 |

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RES( 15) = ERROR 15890
GO TO 900 15900
800 RES(3)=1.E+9 15910
RES(4)=1.E+9 15920
801 RES(5)=1.E+9 15930
RES(6)=1.E+9 15940
802 RES(7)=1.E+9 15950
RES(8)=1.E+9 15960
IF(NPAN.EQ.2) PRSS=-(PRSS-CPRSS) 15961
803 RES(15)=1.E+13 15970
900 RETURN 15980
END 15990
$IBFTC MS23G9 16000
CTRACE 16010
SUBROUTINE TRACE (CS,E,X,Y,RI,N,D,DELTAP,CR,ISO,PRSS,CPRSS) 16020
C 16030
C THIS SUBROUTINE TRACES THE RAY THRU THE WINDOW 16040
C 16050
0 DIMENSION CS(3), E(3), CI(3), CN(3), CR(3), DELTAP( 4), RI( 5), 16060
1 D(3) 16070
C 16080
ZP = 0.0 16090
K = 1 16100
DO 110 I=1,3 16110
110 CI(I) = CS(I) 16120
115 CALL ITERAT (X, Y, K, DELTAP, CI, DELZ, OWX, OWY) 16130
ZP = ZP + DELZ 16140
CALL NORMAL (OWX, OWY, K, DELTAP, CN) 16150
QRI = RI(K+1)/RI(K) 16160
CALL REFRCI (CI, CN, QRI, CR, ISO) 16170
IF (N=K) 800,800,120 16180
120 E(1) = X 16190
E(2) = Y 16200
E(3) = ZP - D(K) 16210
DO 125 I=1,3 16220
125 CI(I) = CR(I) 16230
X = E(1) - E(3)*CI(1)/CI(3) 16240
Y = E(2) - E(3)*CI(2)/CI(3) 16250
ZP = D(K) 16260
K = K+1 16270
IF (K .EQ. 3) PRSS = -(PRSS-CPRSS) 16280
GO TO 115 16290
800 RETURN 16300
END 16310
$IBFTC MS23H0 16320
CITERAT 16330
SUBROUTINE ITERAT (XP, YP, K, DELTAP, CI, DELZ, OWX, OWY) 16340
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C-----16350
C THIS SUBROUTINE PERFORMS THE ITERATION TO FIND THE POINT XP,YP ON 16360
C THE DEFORMED SURFACE. 16370
C 16380
COMMON DUM 16390
EQUIVALENCE (DUM(1),CON),(CON(1),DIMA),(CON(2),DIMB) 16400
C 16410
DIMENSION CI(3), DELTAP(10) 16420
C 16430
J = 1 16440
DELTA = 0.0 16450
101 CALL INCOTB (XP, YP, OWF, OWX, OWY,K) 16460
DELZ = OWF*DELTAP(K) 16470
A = (DELZ - DELTAA*CI(3))*CI(3) 16480
IF (ABS(A) - 1.0E-06) 800,800,102 16490
102 DELTAA = DELTAA + A 16500
XP = XP + A*CI(1) 16510
YP = YP + A*CI(2) 16520
DIMA=2.*DIMA 16530
DIMB=2.*DIMB 16540
IBY=0 16550
CALL BONDY(XP,YP,IBY) 16560
DIMA=DIMA/2. 16570
DIMB=DIMB/2. 16580
IF (IBY.EQ.1) GO TO 800 16590
J = J+1 16600
IF (J-25) 101,800,800 16610
800 RETURN 16620
END 16630
$IBFTC MS23H1 16640
CINCOTB 16650
SUBROUTINE INCOTB (XP, YP, OWF, OWX, OWY, IPG) 16660
C 16670
C THIS SUBROUTINE GENERATES THE TABLE OF INTERPOLATION COEFFICIENTS 16680
C 16690
DOUBLE PRECISION A,BR,A1,A2,A3,A4 16700
C 16710
COMMON DUM 16720
C 16730
0 EQUIVALENCE (DUM( 1), CON), (DUM( 501), X), 16740
1 (DUM(1501), W), (DUM(2251), DWX), 16750
2 (DUM(3001), JPN), (DUM(3501), RTV), 16760
3 (DUM(4001), BR), (DUM(6100), B) 16770
C 16780
0 EQUIVALENCE (CON( 1), DIMA), (CON( 2), DIMB), 16790
1 (CON( 3), DIMC), (CON( 4), DEL), (CON( 5), GNU), 16800
2 (CON( 6), THIC), (CON( 7), SPAD), (CON( 8), PRSS), 16810

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| | | | | |
|-----|--|--|-----------------------|-------|
| | 3 (CON(9), NPAN), | (CON(10), ISI), | (CON(11), ISO), | 16820 |
| | 4 (CON(12), IBC), | (CON(13), NGP), | (CON(14), LP7), | 16830 |
| | 5 (CON(15), FR), | (CON(16), LOCP), | (CON(17), IPD), | 16840 |
| | 6 (CON(18), IPR), | (CON(19), CHAP), | (CON(20), ISCR1), | 16850 |
| | 7 (CON(21), ISCR2), | (CON(22), SKAL), | (CON(23), ISEC), | 16860 |
| | 8 (CON(24), NPAG), | (CON(25), YONG), | (CON(26), ILGD), | 16870 |
| | 9 (CON(27), IREL), | (CON(28), LP5), | (CON(29), CPRSS) | 16880 |
| C | | | | 16890 |
| | 0 EQUIVALENCE | (CON(31), SCAL), | (CON(41), SPAC), | 16900 |
| | 1 (CON(51), PRES), | (CON(61), PLNA), | (CON(71), RAYA), | 16910 |
| | 2 (CON(81), PAIA), | (CON(91), THEA), | (CON(101), RI), | 16920 |
| | 3 (CON(111), RES), | (CON(301), STAT), | (CON(351), OIF), | 16930 |
| | 4 (CON(401), EANDF), | (CON(451), RHS) | | 16940 |
| C | | | | 16950 |
| | 0 EQUIVALENCE | (RTV, BI), (OIF(1), NDX), (OIF(2), NDY), (X1, OIF(3)), | | 16960 |
| | 1 (Y1, OIF(4)), (OIF(5), CONST1), (OIF(6), CONST2), (OIF(7), CONST3), | | | 16970 |
| | 2 (OIF(8), CONST4), (OIF(9), CONST5), (OIF(10), CONST6), (OIF(12), MIBP) | | | 16980 |
| C | | | | 16990 |
| | DIMENSION | CON(500), X(21,33), OIF(10), | W(21,33), DWX(21,33), | 17000 |
| C | | | | 17010 |
| | DIMENSION | A(25), BR(32,32), B(36,25), A1(25,2), A2(25,2), | | 17020 |
| 1 | JPN(500), RTV(500), A3(25,2), A4(32,2), WC(36,2) | | | 17030 |
| C | | | | 17040 |
| | DATA | PI/3.14159265/ | | 17050 |
| C | | | | 17060 |
| | JUMP=5 | | | 17070 |
| | IF(MIBP) 304, 304, 400 | | | 17080 |
| 304 | ICHAP = CHAP | | | 17090 |
| | JUMP=1 | | | 17100 |
| | X1P=X1 | | | 17110 |
| | Y1P=Y1 | | | 17120 |
| | GO TO (20,40,60), ICHAP | | | 17130 |
| 20 | IDX=5 | | | 17140 |
| | IDY=5 | | | 17150 |
| | GO TO 309 | | | 17160 |
| 40 | IDX=DIMA | | | 17170 |
| | IDX=IDX/2 | | | 17180 |
| | IDY=DIMB | | | 17190 |
| | IDY=IDY/2 | | | 17200 |
| 305 | IF(IDX.LT.5) IDX=5 | | | 17210 |
| | IF(IDY.LT.5) IDY=5 | | | 17220 |
| | GO TO 309 | | | 17230 |
| 60 | IDX=NDX | | | 17240 |
| | IDY=NDY | | | 17250 |
| | IF(IDX.LT.5) GO TO 306 | | | 17260 |
| | IF(IDY.LT.5) GO TO 306 | | | 17270 |
| | GO TO 311 | | | 17280 |

| | | |
|------|---|-------|
| 306 | WRITE (ISO,307) IDX, IDY | 17290 |
| 307 | FORMAT (1H0, 80H INTERPOLATION FAILS. GRID HAS LESS THAN SIX NODES 1 IN THE X OR Y DIRECTION. IDX=,I2,6H. IDY=,I2,1H.) | 17300 |
| | STOP | 17310 |
| | | 17320 |
| 309 | IF (IDX.GT.10) IDX=IDX/2 | 17321 |
| | IF (IDY.GT.10) IDY=IDY/2 | 17322 |
| 311 | CONTINUE | 17330 |
| | DTX=IDX | 17340 |
| | DTX=DTX*DEL | 17350 |
| | DTY=IDY | 17360 |
| | DTY=DTY*DEL | 17370 |
| | DO 300 I1=1,4 | 17380 |
| | GO TO (310,318,314,322), I1 | 17390 |
| 310 | I3=IDY+1 | 17400 |
| | I2=I3-5 | 17410 |
| | J3=IDX+1 | 17420 |
| | J2=J3-5 | 17430 |
| | GO TO 308 | 17440 |
| 314 | I2=IDY+1 | 17450 |
| | I3=I2+5 | 17460 |
| | J3=IDX+1 | 17470 |
| | J2=J3-5 | 17480 |
| | GO TO 308 | 17490 |
| 318 | I3=IDY+1 | 17500 |
| | I2=I3-5 | 17510 |
| | J2=IDX+1 | 17520 |
| | J3=J2+5 | 17530 |
| | GO TO 308 | 17540 |
| 322 | I2=IDY+1 | 17550 |
| | I3=I2+5 | 17560 |
| | J2=IDX+1 | 17570 |
| | J3=J2+5 | 17580 |
| 308 | CONTINUE | 17590 |
| | AA=DIMA/2. | 17600 |
| | BB=DIMB/2. | 17610 |
| | DO 200 I=1,36 | 17620 |
| | DO 200 J=1,25 | 17630 |
| 200 | B(I,J) = 0.0 | 17640 |
| | K = 0 | 17650 |
| | DO 202 J=J2,J3 | 17660 |
| | EJ=J | 17670 |
| | DO 202 I=I2,I3 | 17680 |
| | K = K+1 | 17690 |
| | EI=I | 17700 |
| | U=DEL*(EJ-1.)-X1P | 17710 |
| | V=DEL*(EI-1.)-Y1P | 17720 |
| 8040 | B(K, I) = (U**4)*(V**4) | 17730 |

| | | |
|-----|---|-------|
| | B(K, 2) = (U**4)*(V**3) | 17740 |
| | B(K, 3) = (U**3)*(V**4) | 17750 |
| | B(K, 4) = (U**4)*(V**2) | 17760 |
| | B(K, 5) = (U**3)*(V**3) | 17770 |
| | B(K, 6) = (U**2)*(V**4) | 17780 |
| | B(K, 7) = (U**4)*(V) | 17790 |
| | B(K, 8) = (U**3)*(V**2) | 17800 |
| | B(K, 9) = (U**2)*(V**3) | 17810 |
| | B(K,10) = (U)*(V**4) | 17820 |
| | B(K,11) = (U**4) | 17830 |
| | B(K,12) = (U**3)*(V) | 17840 |
| | B(K,13) = (U**2)*(V**2) | 17850 |
| | B(K,14) = (U)*(V**3) | 17860 |
| | B(K,15) = (V**4) | 17870 |
| | B(K,16) = (U**3) | 17880 |
| | B(K,17) = (U**2)*(V) | 17890 |
| | B(K,18) = (U)*(V**2) | 17900 |
| | B(K,19) = (V**3) | 17910 |
| | B(K,20) = (U**2) | 17920 |
| | B(K,21) = (U)*(V) | 17930 |
| | B(K,22) = (V**2) | 17940 |
| | B(K,23) = (U) | 17950 |
| | B(K,24) = (V) | 17960 |
| | B(K,25) = 1.0 | 17970 |
| | WC(K,1)=W(I,J) | 17980 |
| | WC(K,2)=DWX(I,J) | 17990 |
| | IF(ILRG.NE.1) GO TO 201 | 18000 |
| | WC(K,1)=0.5*(W(I,J)*CONST2*(ABS(CONST1/CONST2))+CONST3*COS(PI*U/ | 18010 |
| | 1 (AA*2.))*COS(PI*V/(BB*2.))) | 18020 |
| | IF(NPAN.EQ.2) WC(K,2)=0.5*(W(I,J)*CONST5*(ABS(CONST4/CONST5))+ | 18030 |
| | 1 CONST6*COS(PI*U/(AA*2.))*COS(PI*V/(BB*2.))) | 18040 |
| | 201 IF(ABS(X(I,J)-X1P-U)-1.0E-7)202,202,206 | 18050 |
| | 206 DO 210 LM=1,25 | 18060 |
| | 210 B(K,LM)=0. | 18070 |
| | 202 CONTINUE | 18080 |
| | DO 240 K=1,2 | 18090 |
| | DO 240 I=1,25 | 18100 |
| | A4(I,K)=0. | 18110 |
| | DO 240 J=1,36 | 18120 |
| | 240 A4(I,K)=A4(I,K)+B(J,I)*WC(J,K) | 18130 |
| | C | 18140 |
| | C==== THIS SECTION MULTIPLIES THE COEFFICIENT MATRIX BY ITS TRANSPOSE | 18150 |
| | C | 18160 |
| | DO 124 I=1,25 | 18170 |
| | DO 124 J=1,25 | 18180 |
| 122 | BR(I,J) = 0.0 | 18190 |
| | DO 124 K=1,36 | 18200 |

| | | |
|--------|--|-------|
| 124 | BR(I,J) = BR(I,J) + B(K,I)*B(K,J) | 18210 |
| C | | 18220 |
| C===== | THIS SECTION INVERTS THE INTERMEDIATE MATRIX. | 18230 |
| C===== | THIS SECTION CALCULATES THE COEFFICIENTS. | 18240 |
| C | | 18250 |
| | NR = 25 | 18260 |
| | NC = 2 | 18270 |
| | CALL SEQS (BR,A4,NR,NC) | 18280 |
| | DO 280 I=1,25 | 18290 |
| | GO TO (260,264,268,300),I1 | 18300 |
| 260 | A1(I,1)=A4(I,1) | 18310 |
| | A1(I,2)=A4(I,2) | 18320 |
| | GO TO 280 | 18330 |
| 264 | A2(I,1)=A4(I,1) | 18340 |
| | A2(I,2)=A4(I,2) | 18350 |
| | GO TO 280 | 18360 |
| 268 | A3(I,1)=A4(I,1) | 18370 |
| | A3(I,2)=A4(I,2) | 18380 |
| | GO TO 280 | 18390 |
| 280 | CONTINUE | 18400 |
| 300 | CONTINUE | 18410 |
| C | | 18420 |
| C===== | THIS SECTION INTERPOLATES TO OBTAIN THE DEFLECTION AND SLOPES AT | 18430 |
| C | THE POINT XP, YP. | 18440 |
| C | | 18450 |
| 400 | J=1 | 18460 |
| | IF(L.GE.3) J=2 | 18470 |
| | IF(JUMP.EQ.5) GO TO 504 | 18480 |
| 410 | GO TO (420,522,526,534,504),JUMP | 18490 |
| 420 | SXP=XP | 18500 |
| | SYP=YP | 18510 |
| | XP=DTX | 18520 |
| | YP=DTY | 18530 |
| | GO TO 512 | 18540 |
| 504 | IF(ABS(XP)-DTX)510,510,518 | 18550 |
| 510 | IF(ABS(YP)-DTY)512,512,526 | 18560 |
| 512 | DO 514 K=1,25 | 18570 |
| 514 | A(K)=A1(K,J) | 18580 |
| | GO TO 540 | 18590 |
| 518 | IF(ABS(YP)-DTY) 522,522,534 | 18600 |
| 522 | DO 524 K=1,25 | 18610 |
| 524 | A(K)=A2(K,J) | 18620 |
| | GO TO 540 | 18630 |
| 526 | DO 530 K=1,25 | 18640 |
| 530 | A(K)=A3(K,J) | 18650 |
| | GO TO 540 | 18660 |
| 534 | DO 538 K=1,25 | 18670 |

| | | |
|-----|---|-------|
| 538 | A(K)=A4(K,J) | 18680 |
| 540 | CONTINUE | 18690 |
| | XP=XP-X1P | 18700 |
| | YP=YP-Y1P | 18710 |
| 0 | OWA = A(1)*(XP**4)*(YP**4) + A(2)*(XP**4)*(YP**3) | 18720 |
| 1 | + A(3)*(XP**3)*(YP**4) + A(4)*(XP**4)*(YP**2) | 18730 |
| 2 | + A(5)*(XP**3)*(YP**3) + A(6)*(XP**2)*(YP**4) | 18740 |
| 3 | + A(7)*(XP**4)*(YP) + A(8)*(XP**3)*(YP**2) | 18750 |
| 4 | + A(9)*(XP**2)*(YP**3) + A(10)*(XP)*(YP**4) | 18760 |
| 5 | + A(11)*(XP**4) + A(12)*(XP**3)*(YP) | 18770 |
| 6 | + A(13)*(XP**2)*(YP**2) + A(14)*(XP)*(YP**3) | 18780 |
| 7 | + A(15)* (YP**4) + A(16)*(XP**3) | 18790 |
| 8 | + A(17)*(XP**2)*(YP) + A(18)*(XP)*(YP**2) | 18800 |
| 9 | + A(19)* (YP**3) + A(20)*(XP**2) | 18810 |
| 0 | OWB = A(21)*(XP)*(YP) + A(22)* (YP**2) | 18820 |
| 1 | + A(23)*(XP) + A(24)* (YP) | 18830 |
| 2 | + A(25) | 18840 |
| | OWF = OWA + OWB | 18850 |
| 0 | OWX = 4.0*A(1)*(XP**3)*(YP**4) + 4.0*A(2)*(XP**3)*(YP**3) | 18860 |
| 1 | + 3.0*A(3)*(XP**2)*(YP**4) + 4.0*A(4)*(XP**3)*(YP**2) | 18870 |
| 2 | + 3.0*A(5)*(XP**2)*(YP**3) + 2.0*A(6)*(XP)*(YP**4) | 18880 |
| 3 | + 4.0*A(7)*(XP**3)*(YP) + 3.0*A(8)*(XP**2)*(YP**2) | 18890 |
| 4 | + 2.0*A(9)*(XP)*(YP**3) + A(10)* (YP**4) | 18900 |
| 5 | + 4.0*A(11)*(XP**3) + 3.0*A(12)*(XP**2)*(YP) | 18910 |
| 6 | + 2.0*A(13)*(XP)*(YP**2) + A(14)* (YP**3) | 18920 |
| 7 | + 3.0*A(16)*(XP**2) + 2.0*A(17)*(XP)*(YP) | 18930 |
| 8 | + A(18)* (YP**2) + 2.0*A(20)*(XP) | 18940 |
| 9 | + A(21)* (YP) + A(23) | 18950 |
| 0 | OWY = 4.0*A(1)*(XP**4)*(YP**3) + 3.0*A(2)*(XP**4)*(YP**2) | 18960 |
| 1 | + 4.0*A(3)*(XP**3)*(YP**3) + 2.0*A(4)*(XP**4)*(YP) | 18970 |
| 2 | + 3.0*A(5)*(XP**3)*(YP**2) + 4.0*A(6)*(XP**2)*(YP**3) | 18980 |
| 3 | + A(7)*(XP**4) + 2.0*A(8)*(XP**3)*(YP) | 18990 |
| 4 | + 3.0*A(9)*(XP**2)*(YP**2) + 4.0*A(10)*(XP)*(YP**3) | 19000 |
| 5 | + A(12)*(XP**3) + 2.0*A(13)*(XP**2)*(YP) | 19010 |
| 6 | + 3.0*A(14)*(XP)*(YP**2) + 4.0*A(15)* (YP**3) | 19020 |
| 7 | + A(17)*(XP**2) + 2.0*A(18)*(XP)*(YP) | 19030 |
| 8 | + 3.0*A(19)* (YP**2) + A(21)*(XP) | 19040 |
| 9 | + 2.0*A(22)* (YP) + A(24) | 19050 |
| | XP=XP+X1P | 19060 |
| | YP=YP+Y1P | 19070 |
| | JUMP=JUMP+1 | 19080 |
| | GO TO(580,574,580,580,576,600),JUMP | 19090 |
| 574 | WRITE (ISO,575) | 19100 |
| 575 | FORMAT ('IHI') | 19110 |
| | GO TO 580 | 19120 |
| 576 | XP=SXP | 19130 |
| | YP=SYP | 19140 |

| | | | |
|-----|-----|---|-------|
| | 580 | WRITE (ISO,581) OWF,OWX,OWY | 19150 |
| | | 581 FORMAT (1H, 39H TEST INTERPOLATION VALUES AT CENTER = ,E16.6, | 19160 |
| | | 1 1H,, E16.6,1H,, E16.6) | 19170 |
| | | GO TO 410 | 19180 |
| | 600 | MIBP=1 | 19190 |
| | | IF((ICHAP.EQ.3).OR.(ILRG.EQ.1)) GO TO 800 | 19200 |
| | | OWF=OWF*PRSS | 19210 |
| | | OWX=OWX*PRSS | 19220 |
| | | OWY=OWY*PRSS | 19230 |
| | 800 | RETURN | 19240 |
| | | END | 19250 |
| | | \$IBFTC MS23H2 | 19260 |
| | | CNORMAL | 19270 |
| | | SUBROUTINE NORMAL (OWX, OWY, K, DELTAP, CN) | 19280 |
| | C | | 19290 |
| | C | THIS SUBROUTINE FINDS THE NORMAL TO THE SURFACE. | 19300 |
| | C | | 19310 |
| | | DIMENSION CN(3), DELTAP(6) | 19320 |
| | C | | 19330 |
| | | AMAG = SQRT ((OWX**2 + OWY**2)*(DELTAP(K)**2) + 1.0) | 19340 |
| | | CN(1) = (-DELTAP(K)*OWX)/AMAG | 19350 |
| | | CN(2) = (-DELTAP(K)*OWY)/AMAG | 19360 |
| | | CN(3) = 1.0/AMAG | 19370 |
| 179 | 800 | RETURN | 19380 |
| | | END | 19390 |
| | | \$IBFTC MS23H3 | 19400 |
| | | CREFRCI | 19410 |
| | | SUBROUTINE REFRCI (CI, CN, QRI, CR, ISO) | 19420 |
| | C | | 19430 |
| | C | THIS SUBROUTINE CALCULATES NEW DIRECTION OF RAY UPON ENTERING | 19440 |
| | C | NEW MEDIA. | 19450 |
| | C | | 19460 |
| | | DIMENSION CI(3), CN(3), CR(3) | 19470 |
| | C | | 19480 |
| | | DOTP = 0.0 | 19490 |
| | | DO 101 I=1,3 | 19500 |
| | 101 | DOTP = DOTP + CI(I)*CN(I) | 19510 |
| | | ROOT = QRI**2 -1.0 + DOTP**2 | 19520 |
| | | IF (ROOT) 103,105,105 | 19530 |
| | 103 | ROUT = 0.0 | 19540 |
| | | WRITE (ISO,500) ROOT | 19550 |
| | 500 | FORMAT (1H0,6HROOT= ,E16.8/) | 19560 |
| | | GO TO 107 | 19570 |
| | 105 | ROUT = SQRT (ROOT) | 19580 |
| | 107 | DO 109 I=1,3 | 19590 |
| | 109 | CR(I) = (CI(I) + (ROUT-DOTP)*CN(I))/QRI | 19600 |
| | 800 | RETURN | 19610 |

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      END
$IBFTC MS23H4
CCROPOD
      SUBROUTINE CROPOD (VA, VB, VPROD, AVPROD)
C
C   THIS SUBROUTINE FIND THE CROSS PRODUCT OF TWO VECTORS
C
      DIMENSION VA(3), VB(3), VPROD(3)
C
      VPROD(1) = VA(2)*VB(3) - VA(3)*VB(2)
      VPROD(2) = VA(3)*VB(1) - VA(1)*VB(3)
      VPROD(3) = VA(1)*VB(2) - VA(2)*VB(1)
      AVPROD = SQRT(VPROD(1)**2 + VPROD(2)**2 + VPROD(3)**2)
      800 RETURN
      END
$IBFTC MS23H5
CRESTWO
      SUBROUTINE RESTWO (IRT, NOPRT)
C
C   THIS SUBROUTINE PRINTS THE RESULTS OBTAINED BY THE RAYTRA PROG.
C
      COMMON DUM
C
      0 EQUIVALENCE (DUM( 1), CON), (DUM( 501), X),
      1 (DUM(1001), Y), (DUM(1501), W), (DUM(2001), DWX),
      2 (DUM(2501), DWY), (DUM(3001), JPN), (DUM(3501), RTV)
C
      0 EQUIVALENCE (CON( 1), DIMA), (CON( 2), DIMB),
      1 (CON( 3), DIMC), (CON( 4), DEL), (CON( 5), GNU),
      2 (CON( 6), THIC), (CON( 7), SPAD), (CON( 8), PRSS),
      3 (CON( 9), NPAN), (CON(10), ISI), (CON(11), ISO),
      4 (CON(12), IBC), (CON(13), NGP), (CON(14), LP7),
      5 (CON(15), FR), (CON(16), LOCP), (CON(17), IPD),
      6 (CON(18), IPR), (CON(19), CHAP), (CON(20), ISCR1),
      7 (CON(21), ISCR2), (CON(22), SKAL), (CON(23), ISEC),
      8 (CON(24), NPAG), (CON(25), YONG), (CON(26), ILGD),
      9 (CON(27), IREL), (CON(28), LP5), (CON(29), CPRSS)
C
      0 EQUIVALENCE (CON(31), SCAL), (CON(41), SPAC),
      1 (CON(51), PRES), (CON(61), PLNA), (CON(71), RAYA),
      2 (CON(81), PAIA), (CON(91), THEA), (CON(101), RI),
      3 (CON(111), RES), (CON(291), STAT), (CON(351), OIF),
      4 (CON(401), EANDF), (CON(451), RHS), (CON( 30), IRM)
C
      0 EQUIVALENCE (STAT( 1), NMP), (STAT( 9), AVG),
      1 (STAT(25), AVS), (STAT(41), AMN), (STAT(49), STD)
C

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0 DIMENSION RT10(3), RT20(6), RT30(3), RT36(2), RT37(2), ..... 20090
1 RT38(2), RT39(2), RT31(3), RT32(3), RES(180), PLNA( 8), AMN( 8), 20100
2 STD( 8), NMP( 8) 20110
C 20120
DATA RT20(1)/36HT W O R A Y T R A C E D A T A / 20130
0 DATA RT30(1)/13HELLIPSE A=/, RT31(1)/13HRECTANGLE A=/, 20140
1 RT32(1)/13HTRAPEZOID A=/, RT33/4H B=/, RT34/4H C=/, 20150
2 RT35/6HSCALE=/, RT36(1)/10HTHICKNESS=/, 20160
3 RT37(1)/9H PANES=/, RT38(1)/11H SPACING=/, 20170
4 RT39(1)/12H PRESSURE=/ 20180
0 DATA RT40/6HZSEXT=/, RT41/4H IN./, 20190
1 RT42/5HBETA=/, RT43/5H DEG./, 20200
2 RT44/4HPSI=/, RT45/5H DEG./, 20210
3 RT46/6HTHETA=/, RT47/5H DEG./, 20220
4 RT48/4HPAI=/, RT49/5H DEG./, 20230
5 RT50/4HSAI=/, RT51/5H DEG./ 20240
DATA HING/6HHINGED/, CH/1H /, CLMP/6HCLAMPE/, CC/1HD/ 20250
0 DATA RT60/6HXP IN /, RT61/6HYP IN /, 20260
1 RT62/6HXP OUT/, RT63/6HYP OUT/, RT64/6HXS IN /, RT65/6HYS IN /, 20270
2 RT66/6HXS OUT/, RT67/6HYS OUT/, RT68/6HERROR /, RT69/6H(SEC) / 20280
C 20290
C INITIALIZE INDEXES. 20300
C 20310
187 IS10=10 20320
IS8 = ISO 20330
IS9=ISCR2+1 20340
IF(NOPRT.EQ.0) IS8=iSCR2 20350
IF(NOPRT.EQ.0) IS9=IS8+1 20360
ICHAP = CHAP 20370
GO TO (100,110), ISEC 20380
100 GO TO (101,106), LOCP 20390
101 LOCP = 2 20400
C 20410
C THIS SECTION PRINTS THE RAY TRACE RESULTS 20420
C 20430
CALL PAGE (IPR, LINE, IS8, IRT) 20440
WRITE (IS8,500) RT20 20450
500 FORMAT (1H0,46X,6A6) 20460
IF (IBC .NE. 1) GO TO 302 20470
CONC = HING 20480
CF = CH 20490
302 IF (IBC .NE. 2) GO TO 303 20500
CONC = CLMP 20510
CF = CC 20520
303 GO TO (102, 103, 104), ICHAP 20530
102 0 WRITE (IS8,501) (RT30(I),I=1,3), DIMA, RT33, DIMB, 20540
1 RT35, SKAL, (RT36(I),I=1,2), THIC, (RT37(I),I=1,2), NPAN, 20550

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| | | | |
|-----|-----|---|-------|
| | 2 | (RT38(I),I=1,2), SPAD, (RT39(I),I=1,2), PRSS, CONC, CF | 20560 |
| 501 | 0 | FORMAT (1H0,2A6,A1,F5.2,A4,F5.2,14X,A6,F4.2,3X,A6,A4,F5.2,A6,A3, | 20570 |
| | 1 | I1,A6,A5,F3.1,2A6,F5.1,3X,A6,A1) | 20580 |
| | | GO TO 105 | 20590 |
| 103 | 0 | WRITE (IS8,501) (RT31(I),I=1,3), DIMA, RT33, DIMB, | 20600 |
| | 1 | RT35, SKAL, (RT36(I),I=1,2), THIC, (RT37(I),I=1,2), NPAN, | 20610 |
| | 2 | (RT38(I),I=1,2), SPAD, (RT39(I),I=1,2), PRSS, CONC, CF | 20620 |
| | | GO TO 105 | 20630 |
| 104 | 0 | WRITE (IS8,518) (RT32(I),I=1,3), DIMA, RT33, DIMB, RT34, DIMC, | 20640 |
| | 1 | RT35, SKAL, (RT36(I),I=1,2), THIC, (RT37(I),I=1,2), NPAN, | 20650 |
| | 2 | (RT38(I),I=1,2), SPAD, (RT39(I),I=1,2), PRSS, CONC, CF | 20660 |
| 518 | 0 | FORMAT (1H0,2A6,A1,F5.2,A4,F5.2,A4,F5.2,5X,A6,F4.2,3X,A6,A4,F5.2, | 20670 |
| | 1 | A6,A3,I1,A6,A5,F3.1,2A6,F5.1,3X,A6,A1) | 20680 |
| 105 | 0 | WRITE (IS8,502) RT40, RES(9), RT41, RT42, RES(10), RT43, | 20690 |
| | 1 | RT44, RES(11), RT45, RT46, RES(12), RT47, RT48, RES(13), RT49, | 20700 |
| | 2 | RT50, RES(14), RT51 | 20710 |
| 502 | 0 | FORMAT (1H0/1H ,A6,F7.3,A4,3X,A5,F8.2,A5,3X,A4,F8.2,A5,3X, | 20720 |
| | 1 | A6,F8.2,A5,3X,A4,F8.2,A5,3X,A4,F8.2,A5) | 20730 |
| | 0 | WRITE (IS8,503) RT60, RT61, RT62, RT63, RT64, RT65, RT66, RT67, | 20740 |
| | 1 | RT68, RT69 | 20750 |
| 503 | 0 | FORMAT (1H0,2X,A6,5X,A6,5X,A6,5X,A6,7X,A6,5X,A6,5X,A6,5X,A6,5X, | 20760 |
| | 1 | A6,1X,A5) | 20770 |
| 182 | 106 | IF(LINE.EQ.35) LOCP=1 | 20780 |
| | 108 | 0 WRITE (IS8,504) RES(1), RES(2), RES(3), RES(4), RES(5), | 20790 |
| | | 1 RES(6), RES(7), RES(8), RES(15) | 20800 |
| | 504 | 0 FORMAT (1H ,F8.4,3X,F8.4,3X,F8.4,3X,F8.4,5X,F8.4,3X,F8.4,3X, | 20810 |
| | | 1 F8.4,3X,F8.4,5X,F12.5) | 20820 |
| | | LINE = LINE + 1 | 20830 |
| | | GO TO 800 | 20840 |
| | C | | 20850 |
| | C | THIS SECTION PRINTS OUT THE MEAN AND RMS SUMMATION DATA, | 20860 |
| | C | | 20870 |
| | 110 | III = 0 | 20880 |
| | | CALL PAGE (IRM, LYN, ISO, IRT) | 20890 |
| | | WRITE (ISO,500) RT20 | 20900 |
| | | WRITE (ISO,510) | 20910 |
| | 510 | FORMAT (1H0,39X,43MEAN AND RMS SUMMATION) | 20920 |
| | | GO TO (112,114,116), ICHAP | 20930 |
| | 112 | 0 WRITE (IS8,501) (RT30(I),I=1,3), DIMA, RT33, DIMB, | 20940 |
| | | 1 RT35, SKAL, (RT36(I),I=1,2), THIC, (RT37(I),I=1,2), NPAN, | 20950 |
| | | 2 (RT38(I),I=1,2), SPAD, (RT39(I),I=1,2), PRSS, CONC, CF | 20960 |
| | | GO TO 118 | 20970 |
| | 114 | 0 WRITE (IS8,501) (RT31(I),I=1,3), DIMA, RT33, DIMB, | 20980 |
| | | 1 RT35, SKAL, (RT36(I),I=1,2), THIC, (RT37(I),I=1,2), NPAN, | 20990 |
| | | 2 (RT38(I),I=1,2), SPAD, (RT39(I),I=1,2), PRSS, CONC, CF | 21000 |
| | | GO TO 118 | 21010 |
| | 116 | 0 WRITE (IS8,518) (RT32(I),I=1,3), DIMA, RT33, DIMB, RT34, DIMC, | 21020 |

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1 RT35, SKAL, (RT36(I), I=1,2), THIC, (RT37(I), I=1,2), NPAN, 21030
2 (RT38(I), I=1,2), SPAD, (RT39(I), I=1,2), PRSS, CONC, CF 21040
118 0 WRITE (IS8,502) RT40, RES( 9), RT41, RT42, RES( 10), RT43, 21050
1 RT44, RES( 11), RT45, RT46, RES( 12), RT47, RT48, RES( 13), RT49, 21060
2 RT50, RES( 14), RT51 21070
WRITE (ISO, 513) 21080
513 FORMAT (1H0,47H MEAN RMS NO. POINTS) 21090
0 WRITE (ISO,512) ( AMN(I), STD(I), NMP(I), I=1,NPAG) 21100
512 FORMAT (1H0, 13X,E11.4,2X,E11.4,6X,I3) 21110
800 RETURN 21120
END 21130
$IBFTC MS23H6 21140
CMENRMS 21150
SUBROUTINE MENRMS 21160
C 21170
DOUBLE PRECISION AVG, AVS, VAL, CON2 21180
C 21190
COMMON DUM 21200
C 21210
0 EQUIVALENCE (DUM( 1), CON), (DUM( 501), X), 21220
1 (DUM(1001), Y), (DUM(1501), W), (DUM(2001), DWX), 21230
2 (DUM(2501), DWY), (DUM(3001), JPN), (DUM(3501), RTV) 21240
C 21250
0 EQUIVALENCE (CON( 1), DIMA), (CON( 2), DIMB), 21260
1 (CON( 3), DIMC), (CON( 4), DEL), (CON( 5), GNU), 21270
2 (CON( 6), THIC), (CON( 7), SPAD), (CON( 8), PRSS), 21280
3 (CON( 9), NPAN), (CON( 10), ISI), (CON( 11), ISO), 21290
4 (CON( 12), IBC), (CON( 13), NGP), (CON( 14), LP7), 21300
5 (CON( 15), FR), (CON( 16), LOCP), (CON( 17), IPD), 21310
6 (CON( 18), IPR), (CON( 19), CHAP), (CON( 20), ISCR1), 21320
7 (CON( 21), ISCR2), (CON( 22), SKAL), (CON( 23), ISEC), 21330
8 (CON( 24), NPAG), (CON( 25), YONG), (CON( 26), ILGD), 21340
9 (CON( 27), IREL), (CON( 28), LP5), (CON( 29), CPRSS) 21350
C 21360
0 EQUIVALENCE (CON( 31), SCAL), (CON( 41), SPAC), 21370
1 (CON( 51), PRES), (CON( 61), PLNA), (CON( 71), RAYA), 21390
2 (CON( 81), PAIA), (CON( 91), THEA), (CON(101), RI), 21400
3 (CON(111), RES), (CON(291), STAT), (CON(351), OIF), 21410
4 (CON(401), EANDF), (CON(451), RHS) 21420
C 21430
0 EQUIVALENCE (STAT( 1), NMP), (STAT( 9), AVG), 21440
1 (STAT(25), AVS), (STAT(41), AMN), (STAT(49), STD), 21450
2 (OIF(11), N2) 21460
C 21470
DIMENSION NMP( 8), AVG( 8), AVS( 8), AMN( 8), STD( 8), RES(180) 21480
C 21490
C XS = XIN 21500

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| | | |
|--------|---|-------|
| C | YS = YIN | 21510 |
| C | XP = XOUT | 21520 |
| C | YP = YOUT | 21530 |
| C | | 21540 |
| | XXX=1. | 21550 |
| | IF(N2.EQ.2) XXX=0. | 21560 |
| | ISW = 1 | 21570 |
| | GO TO (100,111), ISEC | 21580 |
| 100 | IJ = LP7 - 1 | 21590 |
| | I = 1 | 21600 |
| | XS = RES(1) | 21610 |
| | YS = RES(2) | 21620 |
| | XP = RES(3) | 21630 |
| | YP = RES(4) | 21640 |
| | ICHAP = CHAP | 21650 |
| 101 | GO TO (102,103,104), ICHAP | 21660 |
| C | | 21670 |
| C===== | IS POINT MORE THAN 1 INCH INSIDE ELLIPSE BOUNDARY | 21680 |
| 102 | A = DIMA/2.0 | 21690 |
| | B = DIMB/2.0 | 21700 |
| | IF (XS .GT. A) GO TO 109 | 21710 |
| | IF (YS .GT. B) GO TO 109 | 21720 |
| | XLIM = A*SQRT(1.0-(YS**2/(B*B))) | 21730 |
| | YLIM = B*SQRT(1.0-(XS**2/(A*A))) | 21740 |
| | IF (XS .GT. (XLIM-1.0)) GO TO 109 | 21750 |
| | IF (YS .GT. (YLIM-1.0)) GO TO 109 | 21760 |
| | IF (XP .GT. A) GO TO 109 | 21770 |
| | IF (YP .GT. B) GO TO 109 | 21780 |
| | XLIM = A*SQRT(1.0-(YP**2/(B*B))) | 21790 |
| | YLIM = B*SQRT(1.0-(XP**2/(A*A))) | 21800 |
| | IF (XP .GT. (XLIM-1.0)) GO TO 109 | 21810 |
| | IF (YP .GT. (YLIM-1.0)) GO TO 109 | 21820 |
| | GO TO 108 | 21830 |
| C | | 21840 |
| C===== | IS POINT MORE THAN 1 INCH INSIDE RECTANGLE BOUNDARY | 21850 |
| 103 | A = DIMA/2.0 | 21860 |
| | B = DIMB/2.0 | 21870 |
| | IF (XS .GT. (A-1.0)) GO TO 109 | 21880 |
| | IF (YS .GT. (B-1.0)) GO TO 109 | 21890 |
| | IF (XP .GT. (A-1.0)) GO TO 109 | 21900 |
| | IF (YP .GT. (B-1.0)) GO TO 109 | 21910 |
| | GO TO 108 | 21920 |
| C | | 21930 |
| C===== | IS POINT MORE THAN 1 INCH INSIDE TRAPEZOID BOUNDARY | 21940 |
| 104 | A = DIMA/2.0 | 21950 |
| | B = DIMB | 21960 |
| | C = DIMC/2.0 | 21970 |

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| | | |
|-----|--|-------|
| | IF (N2.EQ.1) GO TO 117 | 21980 |
| | IF ((XS.LT.0.) .OR. (YS.LT.0.)) GO TO 109 | 21990 |
| | IF ((XP.LT.0.) .OR. (YP.LT.0.)) GO TO 109 | 22000 |
| 117 | IF (YS .GT. B) GO TO 109 | 22010 |
| | XLIM = C + ((A-C)/B)*(B-YS) | 22020 |
| | YLIM = B | 22030 |
| | IF (XS .LE. C) GO TO 105 | 22040 |
| | IF (XS .GT. A) GO TO 109 | 22050 |
| | IF ((A-C) .NE. 0.0) GO TO 115 | 22060 |
| | YLIM = B | 22070 |
| | GO TO 105 | 22080 |
| 115 | YLIM = (B/(A-C))*(A-XS) | 22090 |
| 105 | IF (XS .GT. (XLIM-XXX)) GO TO 109 | 22100 |
| | IF (YS .GT. (YLIM-XXX)) GO TO 109 | 22110 |
| | IF (IREL .EQ. 1) GO TO 106 | 22120 |
| | IF (YS .LT. XXX) GO TO 109 | 22130 |
| | IF (YP .GT. B) GO TO 109 | 22140 |
| 106 | XLIM = C + ((A-C)/B)*(B-YP) | 22150 |
| | YLIM = B | 22160 |
| | IF (XP .LE. C) GO TO 107 | 22170 |
| | IF (XP .GT. A) GO TO 109 | 22180 |
| | IF ((A-C) .NE. 0.0) GO TO 116 | 22190 |
| | YLIM = B | 22200 |
| | GO TO 107 | 22210 |
| 116 | YLIM = (B/(A-C))*(A-XP) | 22220 |
| 107 | IF (XP .GT. (XLIM-XXX)) GO TO 109 | 22230 |
| | IF (YP .GT. (YLIM-XXX)) GO TO 109 | 22240 |
| | IF (IREL .EQ. 1) GO TO 108 | 22250 |
| | IF (YP .LT. XXX) GO TO 109 | 22260 |
| 108 | IF (ISW .EQ. 2) GO TO 110 | 22270 |
| | XS = RES(5) | 22280 |
| | YS = RES(6) | 22290 |
| | XP = RES(7) | 22300 |
| | YP = RES(8) | 22310 |
| | ISW = 2 | 22320 |
| | GO TO 101 | 22330 |
| 109 | GO TO 799 | 22340 |
| | C | 22350 |
| | C===== STORE COMPONENTS NEEDED FOR MEAN AND RMS | 22360 |
| 110 | NMP(I) = NMP(I) + 1 | 22370 |
| | RES1 = RES(15) | 22380 |
| | RES2 = RES1*RES1 | 22390 |
| | AVG(I) = AVG(I) + RES1 | 22400 |
| | AVS(I) = AVS(I) + RES2 | 22410 |
| | GO TO 800 | 22420 |
| | C | 22430 |
| | C===== THIS SECTION CALCULATES THE MEAN (AMN) AND RMS (STD). | 22440 |

| | | | | |
|-----|--|-----------------------|--|-------|
| | | | | 22450 |
| 111 | AMP = NMP(I) | | | 22460 |
| | IF (AMP .EQ. 0.0) GO TO 114 | | | 22470 |
| | AMN(I) = AVG(I)/AMP | | | 22480 |
| | VAL = (AVS(I) - AVG(I))*AVG(I)/AMP | | | 22490 |
| | IF (VAL .GT. 0.0) GO TO 112 | | | 22500 |
| | VAL = ABS(VAL) | | | 22510 |
| 112 | STD(I) = SQRT(VAL)/(SQRT(AMP-1.0)) | | | 22520 |
| | SMN = AMN(I)*(1.0E-6) | | | 22530 |
| | IF (STD(I) .LT. SMN) STD(I) = 0.0 | | | 22540 |
| | GO TO 800 | | | 22550 |
| 114 | STD(I) = 0.0 | | | 22560 |
| | AMN(I) = 0.0 | | | 22570 |
| | GO TO 800 | | | 22580 |
| 799 | RES(15)=1.E+13 | | | 22590 |
| 800 | RETURN | | | 22600 |
| | END | | | 22610 |
| | \$IBETC MS23H7 | | | 22611 |
| | GMAXMIN | | | 22620 |
| | SUBROUTINE MAXMIN(IRT) | | | 22630 |
| C | | | | 22640 |
| C | THIS SUBROUTINE CALCULATES THE MAXIMUM AND MINIMUM SLOPES AT A | | | 22650 |
| C | POINT. | | | 22660 |
| C | | | | 22670 |
| | COMMON DUM | | | 22680 |
| C | | | | 22690 |
| | 0 EQUIVALENCE (DUM(1), CON), (DUM(501), X), | | | 22700 |
| | 1 (DUM(1501), W), (DUM(2251), DWX), | | | 22710 |
| | 2 (DUM(3001), JPN), (DUM(3501), RTV) | | | 22720 |
| C | | | | 22730 |
| | 0 EQUIVALENCE (CON(1), DIMA), (CON(2), DIMB), | | | 22740 |
| | 1 (CON(3), DIMC), (CON(4), DEL), (CON(5), GNU), | | | 22750 |
| | 2 (CON(6), THIC), (CON(7), SPAD), (CON(8), PRSS), | | | 22760 |
| | 3 (CON(9), NPAN), (CON(10), ISI), (CON(11), ISO), | | | 22770 |
| | 4 (CON(12), IBC), (CON(13), NGP), (CON(14), LP7), | | | 22780 |
| | 5 (CON(15), FR), (CON(16), LOCP), (CON(17), IPD), | | | 22790 |
| | 6 (CON(18), IPR), (CON(19), CHAP), (CON(20), ISCR1), | | | 22800 |
| | 7 (CON(21), ISCR2), (CON(22), SKAL), (CON(23), ISEC), | | | 22810 |
| | 8 (CON(24), NPAG), (CON(25), YONG), (CON(26), ILGD), | | | 22820 |
| | 9 (CON(27), IREL), (CON(28), LP5), (CON(29), CPRSS) | | | 22830 |
| C | | | | 22840 |
| | 0 EQUIVALENCE (CON(31), SCAL), (CON(41), SPAC), | | | 22850 |
| | 1 (CON(51), PRES), (CON(61), PLNA), (CON(71), RAYA), | | | 22860 |
| | 2 (CON(81), PAIA), (CON(91), THEA), (CON(101), RI), | | | 22870 |
| | 3 (CON(111), RES), (CON(301), STAT), (CON(351), OIF), | | | 22880 |
| | 4 (CON(401), EANDF), (CON(451), RHS) | | | 22890 |
| C | | | | 22900 |
| | DIMENSION CON(500), X(21,33), | W(21,33), DWX(21,33), | | 22910 |

| | | | |
|---|-----|---|-------|
| C | 1 | JPN(500),RTV(500),OIF(12) | 22920 |
| | 0 | DIMENSION RT30(3), RT31(3), RT32(3), RT36(2), RT37(2), RT38(2), | 22930 |
| | 1 | RT39(2) | 22940 |
| C | 0 | DATA RT30(1)/13HELLIPSE A=/, RT31(1)/13HRECTANGLE A=/, | 22950 |
| | 1 | RT32(1)/13HTRAPEZOID A=/, RT33/4H B=/, RT34/4H C=/; | 22960 |
| | 2 | RT35/6HSCALE=/, RT36(1)/10HTHICKNESS=/, | 22970 |
| | 3 | RT37(1)/9H PANES=/, RT38(1)/11H SPACING=/, | 22980 |
| | 4 | RT39(1)/12H PRESSURE=/ DATA HING/6HHINGED/, CH/1H /, CLMP/6HCLAMPE/, CC/1HD/ | 22990 |
| | | | 23000 |
| C | | | 23010 |
| | | RAD = 0.017453292519 | 23020 |
| | | IDT=IRT | 23030 |
| | | LINE=0 | 23040 |
| | | | 23050 |
| C | | | 23060 |
| | | | 23070 |
| C | | C==== THIS SECTION GENERATES A POINT IN THE MIDDLE OF A GRID AND THEN | 23080 |
| C | | DETERMINES IF THE GRID EXISTS. | 23090 |
| C | | | 23100 |
| | | DO 120 K=1,NGP | 23110 |
| | | IPG=2 | 23120 |
| | | K1 = JPN(K) | 23130 |
| | | CALL PACWRD (K1, K2, 2) | 23140 |
| | | XP = X(K1,K2) + DEL/2.0 | 23150 |
| | | EJ=K1-1 | 23160 |
| | | YP=DEL*EJ+DEL/2.0 | 23170 |
| | | CALL INCOTB (XP, YP, OWF, OWX, OWY, IPG) | 23180 |
| | | IF(IPG.EQ.1) GO TO 120 | 23190 |
| | | R = 0.0001 | 23200 |
| | | SMX = 0.0 | 23210 |
| | | DO 114 J=1,181,2 | 23220 |
| | | RJ = J-1 | 23230 |
| | | THE = RJ*RAD | 23240 |
| | | XL = XP + R*COS(THE) | 23250 |
| | | YL = YP + R*SIN(THE) | 23260 |
| | | CALL INCOTB(XL,YL,OWG,OWX,OWY,IPG) | 23270 |
| | | OWR = (ABS(OWF) - ABS(OWG))/R | 23280 |
| | | OWS = ABS(OWR) | 23290 |
| | | IF(J.EQ.1) SMN=OWR | 23300 |
| | | IF(J.EQ.1) SMX=OWR | 23310 |
| | | THF = THE/RAD | 23320 |
| | | IF (OWS .LT. ABS(SMX)) GO TO 112 | 23330 |
| | | SMX = OWR | 23340 |
| | | AMX = THE/RAD | 23350 |
| | 112 | IF (OWS .GT. ABS(SMN)) GO TO 114 | 23360 |
| | | SMN = OWR | 23370 |
| | | AMN = THE/RAD | 23380 |
| | 114 | CONTINUE | 23390 |
| | | IF(K.EQ.1) GO TO 115 | 23400 |

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| | | |
|-------|---|-------|
| | IF (LINE-45) 115,115,115 | 23410 |
| 115 | CALL PAGE (IPD, LINE, ISO, IDT) | 23420 |
| | WRITE (ISO,500) | 23430 |
| 500 0 | FORMAT (1H0/1H ,3X,40HW I N D O W D E F O R M A T I O N S - , | 23440 |
| 1 | 49H D E F L E C T I O N , M A X I M U M A N D , | 23450 |
| 2 | 25HM I N I M U M S L O P E / 1 H) | 23460 |
| | ICHAP = CHAP | 23470 |
| | IF (IBC .NE. 1) GO TO 302 | 23480 |
| | CONC = HING | 23490 |
| | CF = CH | 23500 |
| 302 | IF (IBC .NE. 2) GO TO 303 | 23510 |
| | CONC = CLMP | 23520 |
| | CF = CC | 23530 |
| 303 | GO TO (102,103,104), ICHAP | 23540 |
| 102 0 | WRITE (ISO,501) (RT30(I),I=1,3), DIMA, RT33, DIMB, | 23550 |
| 1 | RT35, SKAL, (RT36(I),I=1,2), THIC, (RT37(I),I=1,2), NPAN, | 23560 |
| 2 | (RT38(I),I=1,2), SPAD, (RT39(I),I=1,2), PRSS, CONC, CF | 23570 |
| 501 0 | FORMAT (1H0,2A6,A1,F5.2,A4,F5.2,14X,A6,F4.2,3X,A6,A4,F5.2,A6,A3, | 23580 |
| 1 | I1,A6,A5,F3.1,2A6,F5.1,3X,A6,A1) | 23590 |
| | GO TO 105 | 23600 |
| 103 0 | WRITE (ISO,501) (RT31(I),I=1,3), DIMA, RT33, DIMB, | 23610 |
| 1 | RT35, SKAL, (RT36(I),I=1,2), THIC, (RT37(I),I=1,2), NPAN, | 23620 |
| 2 | (RT38(I),I=1,2), SPAD, (RT39(I),I=1,2), PRSS, CONC, CF | 23630 |
| | GO TO 105 | 23640 |
| 104 0 | WRITE (ISO,518) (RT32(I),I=1,3), DIMA, RT33, DIMB, RT34, DIMC, | 23650 |
| 1 | RT35, SKAL, (RT36(I),I=1,2), THIC, (RT37(I),I=1,2), NPAN, | 23660 |
| 2 | (RT38(I),I=1,2), SPAD, (RT39(I),I=1,2), PRSS, CONC, CF | 23670 |
| 518 0 | FORMAT (1H0,2A6,A1,F5.2,A4,F5.2,A4,F5.2,5X,A6,F4.2,3X,A6,A4,F5.2, | 23680 |
| 1 | A6,A3,I1,A6,A5,F3.1,2A6,F5.1,3X,A6,A1) | 23690 |
| 105 | WRITE (ISO,505) | 23700 |
| 505 0 | FORMAT (1H0/1H ,43H(ANGLE IS IN DEGREES MEASURED WITH RESPECT , | 23710 |
| 1 | 23HTO THE POSITIVE X-AXIS)/1H0,12H COORDINATES,26X,8HMAXIMUM , | 23720 |
| 2 | 5HSLOPE,10X,14HMINIMUM SLOPE/1H ,3H X,7X,1HY,8X,10HDEFLECTION, | 23730 |
| 3 | 8X,15HSLOPE ANGLE,8X,15HSLOPE ANGLE) | 23740 |
| 116 | WRITE (ISO,506) XP, YP, OWF, SMX, AMX, SMN, AMN | 23750 |
| 506 | FORMAT (1H ,F5.2,3X,F5.2,4X,E12.5,2(4X,E12.5,3X,F4.0)) | 23760 |
| 170 | CONTINUE | 23770 |
| 800 | RETURN | 23770 |
| | END | 23770 |
| | \$IBFTC MS23H8 | 23780 |
| | CRTVLST | 23790 |
| | SUBROUTINE RTVLST (IRT, LIN, IPV) | 23800 |
| C | | 23810 |
| C | III = SWITCH TO BYPASS RETRIEVAL PAGING PRINTOUT | 23820 |
| C | IPV = PAGE COUNTER FOR RETRIEVAL INDEX PRINTOUT | 23830 |
| C | ISO = SYSTEM OUTPUT TAPE | 23840 |
| C | JT1 = RETRIEVAL NUMBER | 23850 |

| | | | | |
|---|--|---|-------------------|-------|
| C | JT7 = NUMBER OF PANES | | | 23860 |
| C | JT10 = BOUNDARY COORDINATE SWITCH | | | 23870 |
| C | LIN = RETRIEVAL INDEX OUTPUT LINE COUNTER | | | 23880 |
| C | RT2 = PLANFORM SELECTION SWITCH | | | 23890 |
| C | RT3 = BASE LENGTH OF PLANFORM | | | 23900 |
| C | RT4 = WIDTH OF PLANFORM | | | 23910 |
| C | RT5 = UPPER X DIMENSION OF TRAPEZOID | | | 23920 |
| C | RT6 = GLASS THICKNESS | | | 23930 |
| C | RT8 = SPACING BETWEEN PANES | | | 23940 |
| C | RT9 = INTERSTITIAL PRESSURE | | | 23950 |
| C | | | | 23960 |
| C | COMMON DUM | | | 23970 |
| C | | | | 23980 |
| | 0 EQUIVALENCE | (DUM(1), CON), | (DUM(501), X), | 23990 |
| | 1 (DUM(1001), Y), | (DUM(1501), W), | (DUM(2001), DWX), | 24000 |
| | 2 (DUM(2501), DWY), | (DUM(3001), JPN), | (DUM(3501), RTV) | 24010 |
| C | | | | 24020 |
| | 0 EQUIVALENCE | (CON(1), DIMA), | (CON(2), DIMB), | 24030 |
| | 1 (CON(3), DIMC), | (CON(4), DEL), | (CON(5), GNU), | 24040 |
| | 2 (CON(6), THIC), | (CON(7), SPAD), | (CON(8), PRSS), | 24050 |
| | 3 (CON(9), NPAN), | (CON(10), ISI), | (CON(11), ISO), | 24060 |
| | 4 (CON(12), IBC), | (CON(13), NGP), | (CON(14), LP7), | 24070 |
| | 5 (CON(15), FR), | (CON(16), LOCP), | (CON(17), IPD), | 24080 |
| | 6 (CON(18), IPR), | (CON(19), CHAP), | (CON(20), ISCR1), | 24090 |
| | 7 (CON(21), ISCR2), | (CON(22), SKAL), | (CON(23), ISEC), | 24100 |
| | 8 (CON(24), NPAG), | (CON(25), YONG), | (CON(26), ILGD), | 24110 |
| | 9 (CON(27), IREL), | (CON(28), LP5), | (CON(29), CPRSS) | 24120 |
| C | | | | 24130 |
| | 0 EQUIVALENCE | (CON(31), SCAL), | (CON(41), SPAC), | 24140 |
| | 1 (CON(51), PRES), | (CON(61), PLNA), | (CON(71), RAYA), | 24150 |
| | 2 (CON(81), PAIA), | (CON(91), THEA), | (CON(101), RI), | 24160 |
| | 3 (CON(111), RES), | (CON(301), STAT), | (CON(351), OIF), | 24170 |
| | 4 (CON(401), EANDF), | (CON(451), RHS) | | 24180 |
| C | | | | 24190 |
| | 0 EQUIVALENCE | (RTV(1), JT1), | (RTV(51), RT2), | 24200 |
| | 1 (RTV(101), RT3), | (RTV(151), RT4), | (RTV(201), RT5), | 24210 |
| | 2 (RTV(251), RT6), | (RTV(301), JT7), | (RTV(351), RT8), | 24220 |
| | 3 (RTV(401), RT9), | (RTV(451), JT10), | (RTV(501), RT11) | 24230 |
| C | | | | 24240 |
| | 0 DIMENSION | CON(500), X(22,22), Y(22,22), W(22,22), | | 24250 |
| | 1 DWX(22,22), DWY(22,22), JPN(500), RTV(500), | | | 24260 |
| | 3 RES(180), RT30(2), RT31(2), RT32(2), RT33(2), RT34(2), RI(7), | | | 24270 |
| | 4 SHAP(2), CONC(2), SCAL(8), SPAC(8), PRES(8), PLNA(8), RAYA(8) | | | 24280 |
| C | | | | 24290 |
| | 0 DIMENSION | JT1(50), RT2(50), RT3(50), RT4(50), RT5(50), RT6(50), | | 24300 |
| | 1 JT7(50), RT8(50), RT9(50), JT10(50) | | | 24310 |
| C | | | | 24320 |

| | | | | |
|---|-----|------|---|-------|
| | 0 | DATA | RT30(1)/9HELLIPSE /, RT31(1)/9HRECTANGLE/, | 24330 |
| | 1 | | RT32(1)/9HTRAPEZOID/, RT33(1)/7HHINGED /, | 24340 |
| | 2 | | RT34(1)/7HCLAMPED/, STAR/5H*****/ | 24350 |
| C | | | | 24360 |
| | | | LIN = LIN + 1 | 24370 |
| | | | IF (LIN .LT. 100) GO TO 100 | 24380 |
| | | | LIN = LIN-101 | 24390 |
| | | | GO TO 101 | 24400 |
| | 100 | | JT1(LIN) = IRT | 24410 |
| | | | RT2(LIN) = CHAP | 24420 |
| | | | RT3(LIN) = DIMA | 24430 |
| | | | RT4(LIN) = DIMB | 24440 |
| | | | RT5(LIN) = DIMC | 24450 |
| | | | RT6(LIN) = THIC | 24460 |
| | | | JT7(LIN) = NPAN | 24470 |
| | | | RT8(LIN) = SPAD | 24480 |
| | | | IF (NPAN .EQ. 1) RT8(LIN) = STAR | 24490 |
| | | | RT9(LIN) = PRSS | 24500 |
| | | | JT10(LIN) = IBC | 24510 |
| | | | IF (LIN .LT. 40) GO TO 800 | 24520 |
| | 101 | | III = 0 | 24530 |
| | | | CALL PAGE (IPV, LINE, ISO, III) | 24540 |
| | | | WRITE (ISO, 500) | 24550 |
| | 500 | 0 | FORMAT (1H0,42HRETRIEVAL SHAPE A B C , | 24560 |
| | | 1 | 59HTHICKNESS PANES SPACING PRESSURE FIXITY / | 24570 |
| | | 2 | 7H NUMBER,16X,17HIN. IN. IN.,6X,3HIN.,16X,3HIN.,8X,3HLB., | 24580 |
| | | 3 | 16X/1H) | 24590 |
| | | | DO 114 I=1,LIN | 24600 |
| | | | IF (RT2(I) .NE. 1.0) GO TO 102 | 24610 |
| | | | SHAP(1) = RT30(1) | 24620 |
| | | | SHAP(2) = RT30(2) | 24630 |
| | 102 | | IF (RT2(I) .NE. 2.0) GO TO 104 | 24640 |
| | | | SHAP(1) = RT31(1) | 24650 |
| | | | SHAP(2) = RT31(2) | 24660 |
| | 104 | | IF (RT2(I) .NE. 3.0) GO TO 106 | 24670 |
| | | | SHAP(1) = RT32(1) | 24680 |
| | | | SHAP(2) = RT32(2) | 24690 |
| | 106 | | IF (JT10(I) .NE. 1) GO TO 108 | 24700 |
| | | | CONC(1) = RT33(1) | 24710 |
| | | | CONC(2) = RT33(2) | 24720 |
| | 108 | | IF (JT10(I) .NE. 2) GO TO 112 | 24730 |
| | | | CONC(1) = RT34(1) | 24740 |
| | | | CONC(2) = RT34(2) | 24750 |
| | 112 | | IF (NPAN .EQ. 2) GO TO 113 | 24760 |
| | | 0 | WRITE (ISO,502) JT1(I), (SHAP(J),J=1,2), RT3(I), RT4(I), RT5(I), | 24770 |
| | | 1 | RT6(I), JT7(I), RT8(I), RT9(I), (CONC(J),J=1,2) | 24780 |
| | 502 | 0 | FORMAT (1H ,3X,13,4X,A6,A3,2X,F5.2,2X,F5.2,2X,F5.2,4X,F5.2,7X,I1, | 24790 |

| | | | |
|-----|---|--|-------|
| | 1 | 6X,A5,5X,F5.1,5X,A6,A1,4X) | 24800 |
| | | GO TO 114 | 24810 |
| 113 | 0 | WRITE (ISO,503) JT1(I), (SHAP(J),J=1,2), RT3(I), RT4(I), RT5(I), | 24820 |
| | 1 | RT6(I), JT7(I), RT8(I), RT9(I), (CONC(J),J=1,2) | 24830 |
| 503 | 0 | FORMAT (1H,3X,I3,4X,A6,A3,2X,F5.2,2X,F5.2,2X,F5.2,4X,F5.2,7X,I1, | 24840 |
| | 1 | 6X,F5.2,5X,F5.1,5X,A6,A1) | 24850 |
| 114 | | CONTINUE | 24860 |
| | | LIN = 0 | 24870 |
| 800 | | RETURN | 24880 |
| | | END | 24890 |
| | | \$IRFTC MS23H9 | 24900 |
| | | CBONDRY | 24910 |
| | | SUBROUTINE BONDRY (XP, YP, IBY) | 24920 |
| | C | | 24930 |
| | C | THIS SUBROUTINE TESTS THE X AND Y COORDINATES TO BE SURE THEY | 24940 |
| | C | ARE INSIDE THE BOUNDARY. | 24950 |
| | C | | 24960 |
| | C | A = DEFINED BELOW | 24970 |
| | C | B = DEFINED BELOW | 24980 |
| | C | C = DEFINED BELOW | 24990 |
| | C | CHAP = ICHAP = PLANFORM SELECTION SWITCH | 25000 |
| | C | DIMA = LOWER LENGTH OF PLANFORM | 25010 |
| | C | DIMB = HEIGHT OF PLANFORM | 25020 |
| | C | DIMC = UPPER X DIMENSION OF TRAPEZOID | 25030 |
| | C | IBY = 1 INDICATES POINT IS OUTSIDE PLANFORM BOUNDARY | 25040 |
| | C | XLIM = X VALUE AT PLANFORM BOUNDARY CORRESPONDING TO YP | 25050 |
| | C | XP = X COORDINATE OF POINT BEING CHECKED | 25060 |
| | C | YP = Y COORDINATE OF POINT BEING CHECKED | 25070 |
| | C | | 25080 |
| | | COMMON DUM | 25090 |
| | C | | 25100 |
| | 0 | EQUIVALENCE (DUM(1), CON), (DUM(501), X), | 25110 |
| | 1 | (DUM(1001), Y), (DUM(1501), W), (DUM(2001), DWX), | 25120 |
| | 2 | (DUM(2501), DWY), (DUM(3001), JPN), (DUM(3501), RTV) | 25130 |
| | C | | 25140 |
| | 0 | EQUIVALENCE (CON(1), DIMA), (CON(2), DIMB), | 25150 |
| | 1 | (CON(3), DIMC), (CON(4), DEL), (CON(5), GNU), | 25160 |
| | 2 | (CON(6), THIC), (CON(7), SPAD), (CON(8), PRSS), | 25170 |
| | 3 | (CON(9), NPAN), (CON(10), ISI), (CON(11), ISO), | 25180 |
| | 4 | (CON(12), IBC), (CON(13), NGP), (CON(14), LP7), | 25190 |
| | 5 | (CON(15), FR), (CON(16), LOCP), (CON(17), IPD), | 25200 |
| | 6 | (CON(18), IPR), (CON(19), CHAP), (CON(20), ISCR1), | 25210 |
| | 7 | (CON(21), ISCR2), (CON(22), SKAL), (CON(23), ISEC), | 25220 |
| | 8 | (CON(24), NPAG), (CON(25), YONG), (CON(26), ILGD), | 25230 |
| | 9 | (CON(27), IREL), (CON(28), LP5), (CON(29), CPRSS) | 25240 |
| | C | | 25250 |
| | 0 | EQUIVALENCE (CON(31), SCAL), (CON(41), SPAC), | 25260 |

| | | | | |
|--|---|---|-------------------|-------|
| | 1 (CON(51), PRES), | (CON(61), PLNA), | (CON(71), RAYA), | 25270 |
| | 2 (CON(81), PAIA), | (CON(91), THEA), | (CON(101), RI), | 25280 |
| | 3 (CON(111), RES), | (CON(301), STAT), | (CON(351), OIF), | 25290 |
| | 4 (CON(401),EANDF), | (CON(451), RHS) | | 25300 |
| | C | | | 25310 |
| | 0 DIMENSION | CON(500), X(22,22), Y(22,22), W(22,22), DWX(22,22), | | 25320 |
| | 1 DWY(22,22), JPN(500),RTV(500) | | | 25330 |
| | C | | | 25340 |
| | ICHAP = CHAP | | | 25350 |
| | GO TO (101,102,103), ICHAP | | | 25360 |
| | 101 A = DIMA/2.0 | | | 25370 |
| | B = DIMB/2.0 | | | 25380 |
| | IF (ABS(YP) .GT. B) GO TO 104 | | | 25390 |
| | XLIM = A*SQRT(1.0-(YP**2/(B*B))) | | | 25400 |
| | IF (ABS(XP) .GT. XLIM) GO TO 104 | | | 25410 |
| | GO TO 800 | | | 25420 |
| | 102 A = DIMA/2.0 | | | 25430 |
| | B = DIMB/2.0 | | | 25440 |
| | IF (ABS(YP) .GT. B) GO TO 104 | | | 25450 |
| | IF (ABS(XP) .GT. A) GO TO 104 | | | 25460 |
| | GO TO 800 | | | 25470 |
| | 103 A = DIMA/2.0 | | | 25480 |
| | B = DIMB | | | 25490 |
| | C = DIMC/2.0 | | | 25500 |
| | IF (ABS(YP) .GT. B) GO TO 104 | | | 25510 |
| | XLIM = C + ((A-C)/B)*(B-YP) | | | 25520 |
| | IF (ABS(XP) .GT. XLIM) GO TO 104 | | | 25530 |
| | GO TO 800 | | | 25540 |
| | 104 IBY = 1 | | | 25550 |
| | 800 RETURN | | | 25560 |
| | END | | | 25570 |
| | \$IBFTC MS23JO | | | 25580 |
| | CPACWRD | | | 25590 |
| | SUBROUTINE PACWRD (K1, K2, K3) | | | 25600 |
| | C | | | 25610 |
| | C THIS SUBROUTINE PACKS AND UNPACKS TWO INTEGER WORDS. | | | 25620 |
| | C | | | 25630 |
| | C PACKING K1 = FIRST INTEGER AND RETURNED PACKED WORD | | | 25640 |
| | C K2 = SECOND INTEGER | | | 25650 |
| | C K3 = 1 | | | 25660 |
| | C | | | 25670 |
| | C UNPACKING K1 = PACKED WORD AND RETURNED FIRST INTEGER | | | 25680 |
| | C K2 = SECOND INTEGER | | | 25690 |
| | C K3 = 2 | | | 25700 |
| | C | | | 25710 |
| | GO TO (100, 102), K3 | | | 25720 |
| | 100 K1 = K1*32768 + K2 | | | 25730 |

| | | | | |
|-----|-----|--|--|-------|
| | | GO TO 800 | | 25740 |
| | 102 | K4 = K1/32768 | | 25750 |
| | | K2 = K1 - K4*32768 | | 25760 |
| | | K1 = K4 | | 25770 |
| | 800 | RETURN | | 25780 |
| | | END | | 25790 |
| | | \$IBFTC MS23J1 | | 25800 |
| | | CPAGE | | 25810 |
| | | SUBROUTINE PAGE (IPN, LINE, ISN, INX) | | 25820 |
| | C | THIS SUBROUTINE PRINTS THE TIME AND PAGE NUMBER AT THE PAGE TOP | | 25830 |
| | C | INX = RETRIEVAL NUMBER | | 25840 |
| | C | IPN = PAGE NUMBER | | 25850 |
| | C | ISN = TAPE NUMBER | | 25860 |
| | C | LINE = LINE NUMBER | | 25870 |
| | C | | | 25880 |
| | | DIMENSION RT10(3) | | 25890 |
| | C | | | 25900 |
| | | DATA RT10(1)/18HRETRIEVAL NUMBER =/, RT11/4HPAGE/ | | 25910 |
| | C | | | 25920 |
| | | IPN = IPN + 1 | | 25930 |
| | | IF (INX .EQ. 0) GO TO 100 | | 25940 |
| | | IF (ISN .EQ. 9) GO TO 102 | | 25950 |
| 193 | | WRITE (ISN,500) (RT10(I), I=1,3), INX, RT11, IPN | | 25960 |
| | 500 | FORMAT (1H1,3A6,15,89X,A4,I4) | | 25970 |
| | | GO TO 800 | | 25980 |
| | 102 | WRITE (ISN) (RT10(I), I=1,3), INX, RT11, IPN | | 25990 |
| | | GO TO 800 | | 26000 |
| | 100 | WRITE (ISN, 501) RT11, IPN | | 26010 |
| | 501 | FORMAT (1H1,112X,A4,I4) | | 26020 |
| | 800 | LINE = 1 | | 26030 |
| | | RETURN | | 26040 |
| | | END | | 26050 |
| | | \$IBFTC MS23J2 | | 26060 |
| | | CSHRDEF | | 26070 |
| | | SUBROUTINE SHRDEF | | 26080 |
| | C | | | 26090 |
| | C | ETA = FACTOR TO MODIFY DEFLECTION BY TO OBTAIN SHEAR DEFORMATION | | 26100 |
| | C | | | 26110 |
| | | COMMON DUM | | 26120 |
| | C | | | 26130 |
| | | 0 EQUIVALENCE (DUM(1), CON), (DUM(501), X), | | 26140 |
| | | 1 (DUM(1001), Y), (DUM(1501), W), (DUM(2001), DWX), | | 26150 |
| | | 2 (DUM(2501), DWY), (DUM(3001), JPN), (DUM(3501), RTV) | | 26160 |
| | C | | | 26170 |
| | | 0 EQUIVALENCE (CON(1), DIMA), (CON(2), DIMB), | | 26180 |
| | | 1 (CON(3), DIMC), (CON(4), DEL), (CON(5), GNU), | | 26190 |
| | | 2 (CON(6), THIC), (CON(7), SPAD), (CON(8), PRSS), | | 26200 |

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| | | | | | | | |
|---|---------|---|-------------------|-------------------|-----------|-----------|-------|
| | 3 | (CON(9), NPAN), | (CON(10), ISI), | (CON(11), ISO), | 26210 | | |
| | 4 | (CON(12), IBC), | (CON(13), NGP), | (CON(14), LP7), | 26220 | | |
| | 5 | (CON(15), FR), | (CON(16), LOCP), | (CON(17), IPD), | 26230 | | |
| | 6 | (CON(18), IPR), | (CON(19), CHAP), | (CON(20), ISCR1), | 26240 | | |
| | 7 | (CON(21), ISCR2), | (CON(22), SKAL), | (CON(23), ISEC), | 26250 | | |
| | 8 | (CON(24), NPAG), | (CON(25), YONG), | (CON(26), ILRG), | 26260 | | |
| | 9 | (CON(27), IREL), | (CON(28), LP5), | (CON(29), CPRSS) | 26270 | | |
| C | | | | | 26280 | | |
| | 0 | EQUIVALENCE | (CON(30), IRM), | (CON(31), IPB), | 26290 | | |
| | 1 | (CON(53), SCAL), | (CON(61), SPAC), | (CON(69), PRES), | 26300 | | |
| | 2 | (CON(77), PLNA), | (CON(85), RAYA), | (CON(93), RI), | 26310 | | |
| | 3 | (CON(101), RES), | (CON(315), STAT), | (CON(371), OIF), | 26320 | | |
| | 4 | (CON(401),EANDF), | (CON(451), RHS) | | 26330 | | |
| C | | | | | 26340 | | |
| | 0 | DIMENSION | CON(500), | X(22,22), | Y(22,22), | W(22,22), | 26350 |
| | 1 | DWX(22,22), | DWY(22,22), | JPN(500), | RTV(500) | | 26360 |
| C | | | | | | | 26370 |
| | | PI2 = 3.141592653*3.141592653 | | | | | 26380 |
| | | BET2 = (DIMA/DIMB)**2 | | | | | 26390 |
| | | ETA = PI2*(1.0 + BETA)*(THIC**2)/((DIMA**2)*(1.0 - GNU)*3.0) | | | | | 26400 |
| | | DO 100 I=1,22 | | | | | 26410 |
| | | DO 100 J = 1,22 | | | | | 26420 |
| | 100 | W(I,J) = W(I,J)*ETA | | | | | 26430 |
| | 800 | RETURN | | | | | 26440 |
| | | END | | | | | 26450 |
| | \$IBFTC | MS23J3 | | | | | 26460 |
| | | FUNCTION SINH(ARC) | | | | | 26470 |
| C | | | | | | | 26480 |
| C | | THIS FUNCTION CALCULATES THE DOUBLE PRECISION HYPERBOLIC SINE | | | | | 26490 |
| C | | BUT RETURNS THE SINGLE PRECISION HYPERBOLIC SINE. | | | | | 26500 |
| C | | | | | | | 26510 |
| | | DOUBLE PRECISION ARG,DSINH | | | | | 26520 |
| C | | | | | | | 26530 |
| | | ARG = ARC | | | | | 26540 |
| | | IF(ARC .GT. 88.0) ARG=88.0 | | | | | 26550 |
| | | DSINH = 5.0D-1*(DEXP(ARG)-DEXP(-ARG)) | | | | | 26560 |
| | | SINH = DSINH | | | | | 26570 |
| | | RETURN | | | | | 26580 |
| | | END | | | | | 26590 |
| | \$IBFTC | MS23J4 | | | | | 26600 |
| | | FUNCTION COSH(ARC) | | | | | 26610 |
| C | | | | | | | 26620 |
| C | | THIS FUNCTION CALCULATES THE DOUBLE PRECISION HYPERBOLIC COSINE | | | | | 26630 |
| C | | BUT RETURNS THE SINGLE PRECISION HYPERBOLIC COSINE. | | | | | 26640 |
| C | | | | | | | 26650 |
| | | DOUBLE PRECISION ARG,DCOSH | | | | | 26660 |
| C | | | | | | | 26670 |

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| | | |
|---|---|-------|
| | ARG = ARC | 26680 |
| | IF(ARC .GT. 88.0) ARG=88.0 | 26690 |
| | DCOSH = 5.0D-1*(DEXP(ARG)+DEXP(-ARG)) | 26700 |
| | COSH = DCOSH | 26710 |
| | RETURN | 26720 |
| | END | 26730 |
| | \$IBFTC MS23J5 | 26740 |
| | FUNCTION TANH(ARC) | 26750 |
| C | | 26760 |
| C | THIS FUNCTION CALCULATES THE DOUBLE PRECISION HYPERBOLIC TANGENT | 26770 |
| C | BUT RETURNS THE SINGLE PRECISION HYPERBOLIC TANGENT. | 26780 |
| C | | 26790 |
| | DOUBLE PRECISION ARG,DTANH | 26800 |
| C | | 26810 |
| | ARG = ARC | 26820 |
| | IF(ARC .GT. 88.0) ARG=88.0 | 26830 |
| | DTANH = (DEXP(ARG)-DEXP(-ARG))/(DEXP(ARG)+DEXP(-ARG)) | 26840 |
| | TANH = DTANH | 26850 |
| | RETURN | 26860 |
| | END | 26870 |
| | \$IBFTC MS23H1 | 26880 |
| | CINCOTB | 26890 |
| | SUBROUTINE INCOTB (XP, YP, OWF, OWX, OWY, IPG) | 26900 |
| C | | 26910 |
| C | THIS SUBROUTINE GENERATES THE TABLE OF INTERPOLATION COEFFICIENTS | 26920 |
| C | | 26930 |
| | COMMON DUM | 26940 |
| C | | 26950 |
| | 0 EQUIVALENCE (DUM(1), CON), (DUM(501), X), | 26960 |
| | 1 (DUM(1001), Y), (DUM(1501), W), (DUM(2001), DWX), | 26970 |
| | 2 (DUM(2501), DWY), (DUM(3001), JPN), (DUM(3501), RTV) | 26980 |
| C | | 26990 |
| | 0 EQUIVALENCE (CON(1), DIMA), (CON(2), DIMB), | 27000 |
| | 1 (CON(3), DIMC), (CON(4), DEL), (CON(5), GNU), | 27010 |
| | 2 (CON(6), THIC), (CON(7), SPAD), (CON(8), PRSS), | 27020 |
| | 3 (CON(9), NPAN), (CON(10), ISI), (CON(11), ISO), | 27030 |
| | 4 (CON(12), IBC), (CON(13), NGP), (CON(14), LP7), | 27040 |
| | 5 (CON(15), FR), (CON(16), LOCP), (CON(17), IPD), | 27050 |
| | 6 (CON(18), IPR), (CON(19), CHAP), (CON(20), ISCR1), | 27060 |
| | 7 (CON(21), ISCR2), (CON(22), SKAL), (CON(23), ISEC), | 27070 |
| | 8 (CON(24), NPAG), (CON(25), YONG), (CON(26), ILGD), | 27080 |
| | 9 (CON(27), IREL), (CON(28), LP5), (CON(29), CPRSS) | 27090 |
| C | | 27100 |
| | 0 EQUIVALENCE (CON(31), SCAL), (CON(41), SPAC), | 27110 |
| | 1 (CON(51), PRES), (CON(61), PLNA), (CON(71), RAYA), | 27120 |
| | 2 (CON(81), PAIA), (CON(91), THEA), (CON(101), RI), | 27130 |
| | 3 (CON(111), RES), (CON(301), STAT), (CON(351), OIF), | 27140 |

| | | | | | |
|--|-----|---|------------|------|-------|
| | 4 | (CON(401),EANDF), | (CON(451), | RHS) | 27150 |
| | | | | | 27160 |
| | | DIMENSION CON(500), X(22,22), Y(22,22), W(22,22), DWX(22,22), | | | 27170 |
| | 1 | DWY(22,22), JPN(500), RTV(500) | | | 27180 |
| | | | | | 27190 |
| | 100 | A = DIMA/2.0 | | | 27200 |
| | | B = DIMB/2.0 | | | 27210 |
| | | GO TO (102, 104), IBC | | | 27220 |
| | 102 | TE1 = 1.0/(64.0*FR) | | | 27230 |
| | | TE2 = ((5.0+GNU)/(1.0+GNU))*(A*A) | | | 27240 |
| | | X2 = XP*XP | | | 27250 |
| | | Y2 = YP*YP | | | 27260 |
| | | TE3 = (A*A - X2 - Y2) | | | 27270 |
| | | TE4 = (TE2 - X2 - Y2) | | | 27280 |
| | | OWF = TE1*TE3*TE4*PRSS | | | 27290 |
| | | OWX = -2.0*XP*TE1*(TE3 + TE4)*PRSS | | | 27300 |
| | | OWY = -2.0*YP*TE1*(TE3 + TE4)*PRSS | | | 27310 |
| | | GO TO 800 | | | 27320 |
| | 104 | TEM = (24.0/(A**4)) + (24.0/(B**4)) + (16.0/(A*A*B*B)) | | | 27330 |
| | | WO = 1.0/(FR*TEM) | | | 27340 |
| | | TEM = (1.0 - (XP*XP/(A*A)) - (YP*YP/(B*B))) | | | 27350 |
| | | OWF = WO*(TEM**2)*PRSS | | | 27360 |
| | | OWX = (-4.0*WO*XP*TEM/(A*A))*PRSS | | | 27370 |
| | | OWY = (-4.0*WO*YP*TEM/(B*B))*PRSS | | | 27380 |
| | 800 | RETURN | | | 27390 |
| | | END | | | 27400 |

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\$IRFIC MS23RQ

```
CDATRTV 0000
C 0010
C THIS IS A DATA RETRIEVAL PROGRAM TO RETRIEVE LINE OF SIGHT DATA 0020
C FROM SYMBOLIC TAPE IS9. 0030
C 0040
C 0050
0 DIMENSION RT10(3), RT20(5), RT30(3), RT36(2), RT37(2), 0060
1 RT38(2), RT39(2), RES(200) 0070
C 0080
DATA DUM1/4HX = / 0090
C 0100
C===== INITIALIZE INDEXES, READ RETRIEVAL NUMBER, AND FIRST BLOCKS DATA. 0110
C 0120
ISI = 5 0130
ISO = 6 0140
IS9 = 9 0150
REWIND IS9 0160
READ (IS9) (RT10(I),I=1,3), INX, RT11, IPN 0170
LINX = INX 0180
100 READ (ISI,500) IRTV 0190
500 FORMAT (I5) 0200
IF (IRTV .EQ. 0) GO TO 1000 0210
IF (INX .GT. IRTV) GO TO 900 0220
IF (INX .EQ. IRTV) GO TO 108 0230
IF (INX .EQ. 999) GO TO 902 0240
LINX = INX 0250
C 0260
C===== THIS SECTION READS IN THE DATA TO BE BY-PASSED. 0270
C 0280
102 READ (IS9) (RT10(I),I=1,3), INX 0290
IF (INX .EQ. IRTV) GO TO 105 0300
GO TO 102 0310
105 BACKSPACE IS9 0320
READ (IS9) (RT10(I),I=1,3), INX, RT11, IPN 0330
GO TO 108 0340
C 0350
C===== THIS SECTION READS IN THE TOP SECTION OF DATA TO BE PRINTED. 0360
C 0370
106 READ (IS9) (RT10(I),I=1,3), INX, RT11, IPN 0380
IF (INX .EQ. 999) GO TO 1000 0390
LINX = INX 0400
IF (INX .NE. IRTV) GO TO 100 0410
108 READ (IS9) (RT20(I),I=1,5) 0420
0 READ (IS9) (RT30(I),I=1,3), DIMA, RT33, DIMB, RT34, DIMC, 0430
1 RT35, SKAL, (RT36(I),I=1,2), THIC, (RT37(I),I=1,2), NPAN, 0440
2 (RT38(I),I=1,2), SPAD, (RT39(I), I=1,2), PRSS, CONC, CF 0450
```

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      READ (IS9) RT40, RES(1), RT41, RES(11), RT42, RES(21)
0 READ (IS9)
1 RT50,RT51, (RES(I),I= 31, 38), RT52,RT53, (RES(I),I= 71, 78),
2 RT54,RT55, (RES(I),I= 81, 88), RT56,RT57, (RES(I),I= 91, 98),
3 RT58,RT59, (RES(I),I=101,108), RT60,RT61, (RES(I),I=111,118),
4 RT62,RT63, (RES(I),I=121,128), RT64,RT65, (RES(I),I=131,138),
5 RT66,RT67, (RES(I),I=141,148), RT68,RT69, (RES(I),I=151,158),
6 RT70,RT71, (RES(I),I=161,168), RT72,RT73, (RES(I),I=171,178)
C
C==== THIS SECTION PRINTS THE TOP SECTION OF DATA.
C
      WRITE (ISO,501) (RT10(I), I=1,3), INX, RT11, IPN
501  FORMAT (1H1,3A6,I5,74X,A4,I4)
      WRITE (ISO,502) (RT20(I), I=1,5)
502  FORMAT (1H0,46X,4A6,A3)
0 WRITE (ISO,503) (RT30(I),I=1,3), DIMA, RT33, DIMB, RT34, DIMC,
1      RT35, SKAL, (RT36(I),I=1,2), THIC, (RT37(I),I=1,2), NPAN,
2      (RT38(I),I=1,2), SPAD, (RT39(I),I=1,2), PRSS, CONC , CF
503 0  FORMAT (1H0,2A6,A1,F5.2,A4,F5.2,A4,F5.2,5X,A6,F4.2,3X,A6,A4,F5.2,
1  A6,A3,I1,A6,A5,F3.1,2A6,F5.1,3X,A6,A1)
      WRITE (ISO,504) RT40, RES(1), RT41, RES(11), RT42, RES(21)
504  FORMAT (1H0,40X,A4,F5.2,5X,A4,F5.2,5X,A5,F6.2)
0 WRITE (ISO,505)
1 RT50,RT51, (RES(I),I= 31, 38), RT52,RT53, (RES(I),I= 71, 78),
2 RT54,RT55, (RES(I),I= 81, 88), RT56,RT57, (RES(I),I= 91, 98),
3 RT58,RT59, (RES(I),I=101,108), RT60,RT61, (RES(I),I=111,118),
4 RT62,RT63, (RES(I),I=121,128), RT64,RT65, (RES(I),I=131,138),
5 RT66,RT67, (RES(I),I=141,148), RT68,RT69, (RES(I),I=151,158),
6 RT70,RT71, (RES(I),I=161,168), RT72,RT73, (RES(I),I=171,178)
505 0  FORMAT (1H0,A6,A4,8F13.6/1H0,A6,A4,8F13.6/1H ,A6,A4,8F13.6/
1      1H0,A6,A4,8F13.6/1H ,A6,A4,8F13.6/1H ,A6,A4,8F13.6/
2      1H0,A6,A4,8E13.6/1H ,A6,A4,8E13.6/1H ,A6,A4,8E13.6/
3      1H0,A6,A4,8F13.6/1H ,A6,A4,8F13.6/1H ,A6,A4,8F13.6)
C
C==== THIS SECTION READS IN THE BOTTOM SECTION OF DATA TO BE PRINTED.
C
      READ (IS9) DUM2
      BACKSPACE IS9
      IF (DUM2 .EQ. DUM1) GO TO 800
      GO TO 106
800  READ (IS9) RT40, RES(1), RT41, RES(11), RT42, RES(21)
0 READ (IS9)
1 RT50,RT51, (RES(I),I= 31, 38), RT52,RT53, (RES(I),I= 71, 78),
2 RT54,RT55, (RES(I),I= 81, 88), RT56,RT57, (RES(I),I= 91, 98),
3 RT58,RT59, (RES(I),I=101,108), RT60,RT61, (RES(I),I=111,118),
4 RT62,RT63, (RES(I),I=121,128), RT64,RT65, (RES(I),I=131,138),
5 RT66,RT67, (RES(I),I=141,148), RT68,RT69, (RES(I),I=151,158),

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| | | | |
|--------|-----|---|------|
| | 6 | RT70,RT71, (RES(I),I=161,168), RT72,RT73, (RES(I),I=171,178) | 0930 |
| | | | 0940 |
| C | | | 0950 |
| C===== | | THIS SECTION PRINTS THE BOTTOM DATA. | 0960 |
| C | | | 0970 |
| | | WRITE (ISO,504) RT40, RES(1), RT41, RES(11), RT42, RES(21) | 0970 |
| | 0 | WRITE (ISO,505) | 0980 |
| | 1 | RT50,RT51, (RES(I),I= 31, 38), RT52,RT53, (RES(I),I= 71, 78), | 0990 |
| | 2 | RT54,RT55, (RES(I),I= 81, 88), RT56,RT57, (RES(I),I= 91, 98), | 1000 |
| | 3 | RT58,RT59, (RES(I),I=101,108), RT60,RT61, (RES(I),I=111,118), | 1010 |
| | 4 | RT62,RT63, (RES(I),I=121,128), RT64,RT65, (RES(I),I=131,138), | 1020 |
| | 5 | RT66,RT67, (RES(I),I=141,148), RT68,RT69, (RES(I),I=151,158), | 1030 |
| | 6 | RT70,RT71, (RES(I),I=161,168), RT72,RT73, (RES(I),I=171,178) | 1040 |
| | | GO TO 106 | 1050 |
| | 900 | WRITE (ISO,950) IINX, IRTV, INX | 1060 |
| | 950 | 0 FORMAT (1H1/1H0,37HYOU HAVE ONE OF THE FOLLOWING ERRORS./1H0, | 1070 |
| | 1 | 5X,55HYOUR RETRIEVAL INDEX VALUES ARE NOT IN ASCENDING ORDER./ | 1080 |
| | 2 | 1H0,5X,48HYOUR RETRIEVAL INDEX NUMBER IS SMALLER THAN THE , | 1090 |
| | 3 | 38HSMALLEST RETRIEVAL NUMBER ON THE TAPE./1H0/1H0, | 1100 |
| | 4 | 44HTHE LOWEST RETRIEVAL NUMBER ON THIS TAPE IS ,I3/1H0, | 1110 |
| | 5 | 31HYOUR RETRIEVAL INDEX NUMBER IS ,I3/1H0, | 1120 |
| | 6 | 55HTHE RETRIEVAL NUMBER OF THE DATA CAUSING THIS ERROR IS ,I3) | 1130 |
| | | GO TO 1000 | 1140 |
| | 902 | WRITE (ISO,952) LINX | 1150 |
| 199 | 952 | 0 FORMAT (1H1/1H0,37HYOU HAVE READ TO THE END OF THE DATA./1H0, | 1160 |
| | 1 | 45HTHE HIGHEST RETRIEVAL NUMBER ON THIS TAPE IS ,I3/1H0 | 1170 |
| | 2 | 31HYOUR RETRIEVAL INDEX NUMBER IS ,I3) | 1180 |
| 1000 | | STOP | 1190 |
| | | END | 1200 |