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COMPUTER PROGRAM

TO PREDICT SPACECRAFT WINDOW DEFORMATIONS

AND COMPUTE WINDOW INDUCED -178

ANGULAR DEVIATIONS OF LIGHT RAYS

By David M. Kelley and Philip A. Diether

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 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.

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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:

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

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.

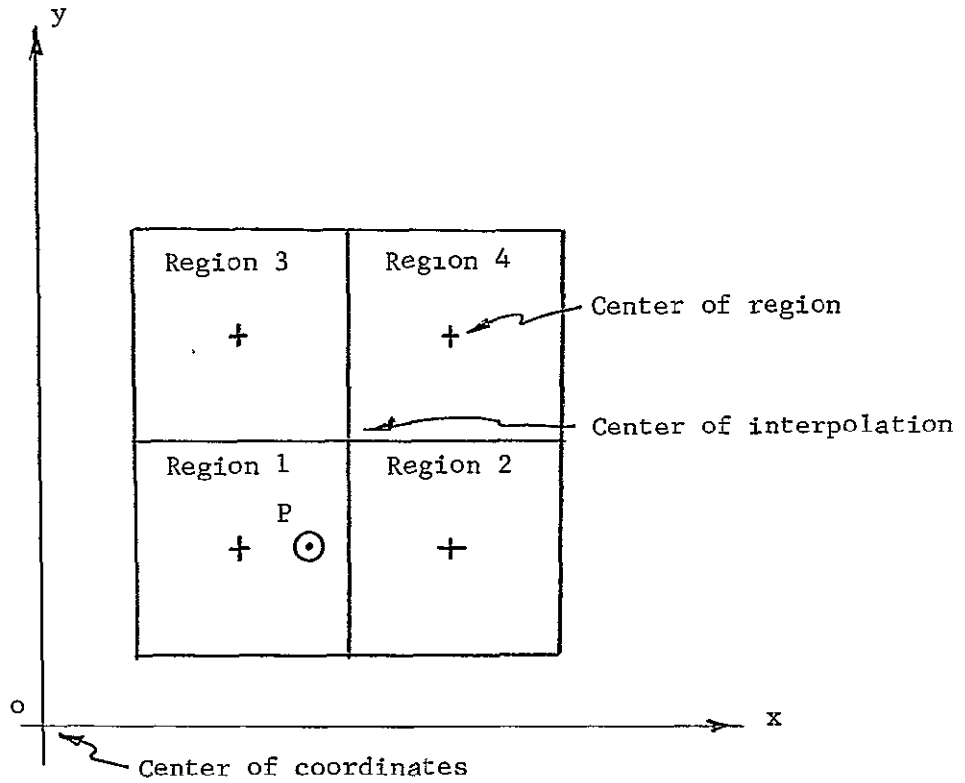


Figure 1. Interpolation Regions

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.

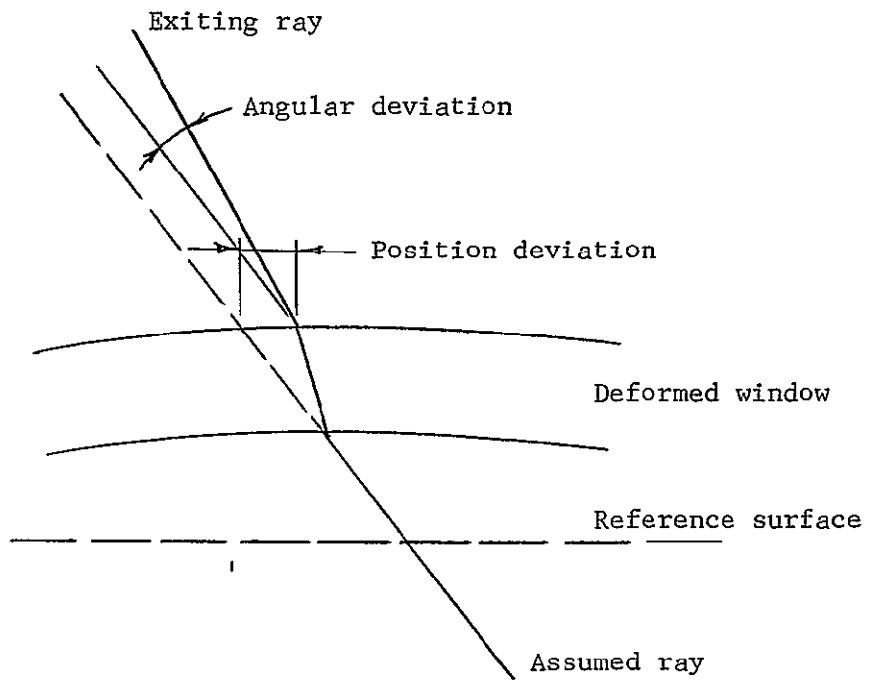


Figure 2. Light Ray Deviations

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

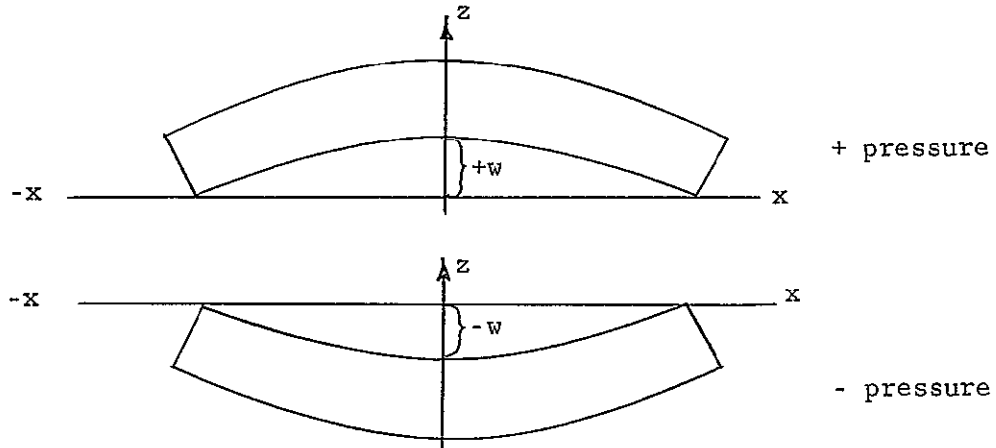
<u>Name in Printouts</u>	<u>Verbal Name</u>	<u>Storage Name and Location</u>	<u>Name in RAYTRA</u>
X	Incident ray x coordinate	RES (1-8)	XS
Y	Incident ray y coordinate	(11-18)	YS
D1	Ray angle entering	(21-28)	DELTAI
A1	Plane angle entering	(31-38)	ALPHAI
Pane Z	Pane deflection	(41-48)	ZP
Pane GX	Slope 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

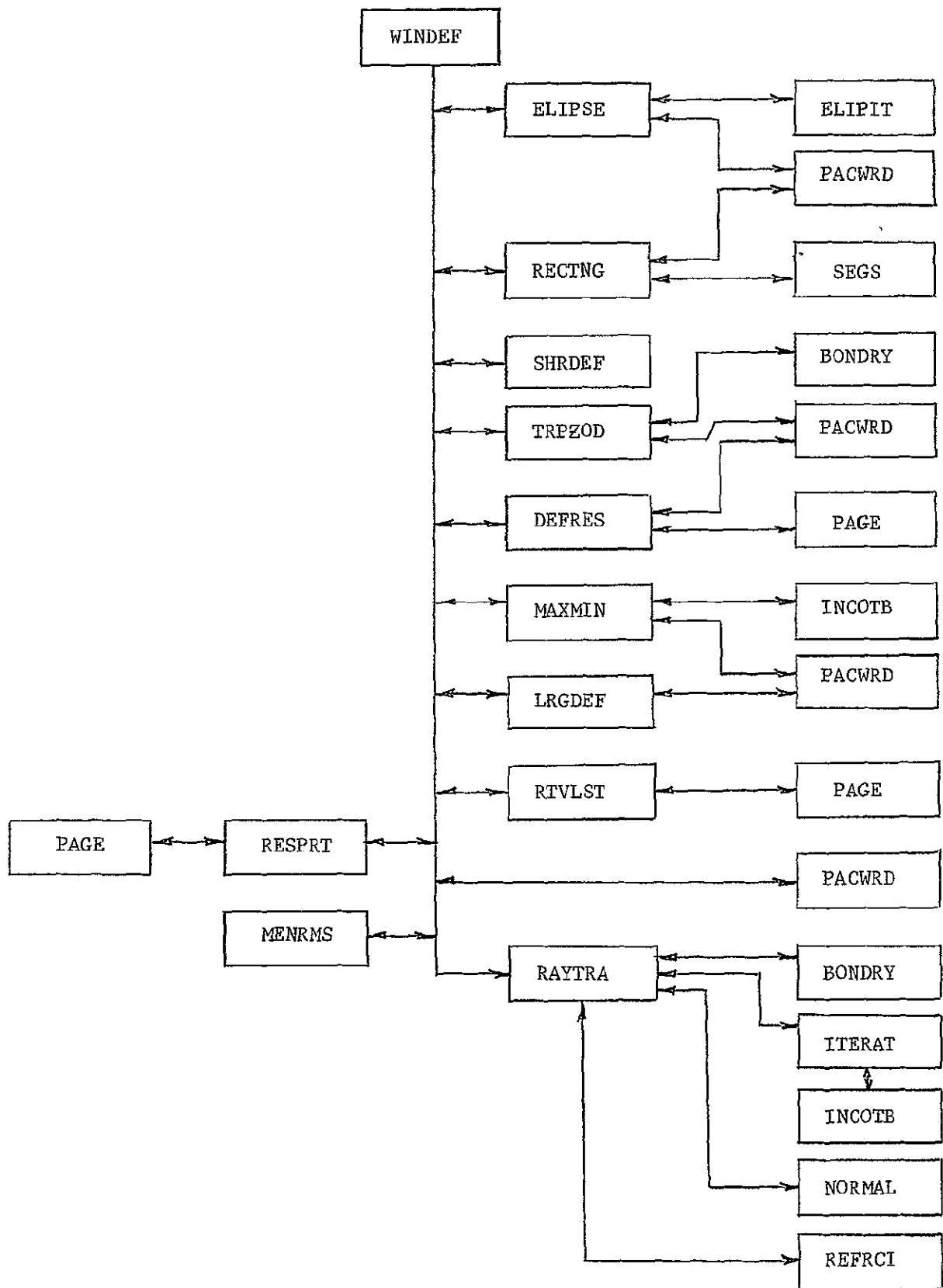


Figure 3. Program Flow Between Subroutines

DRIVER

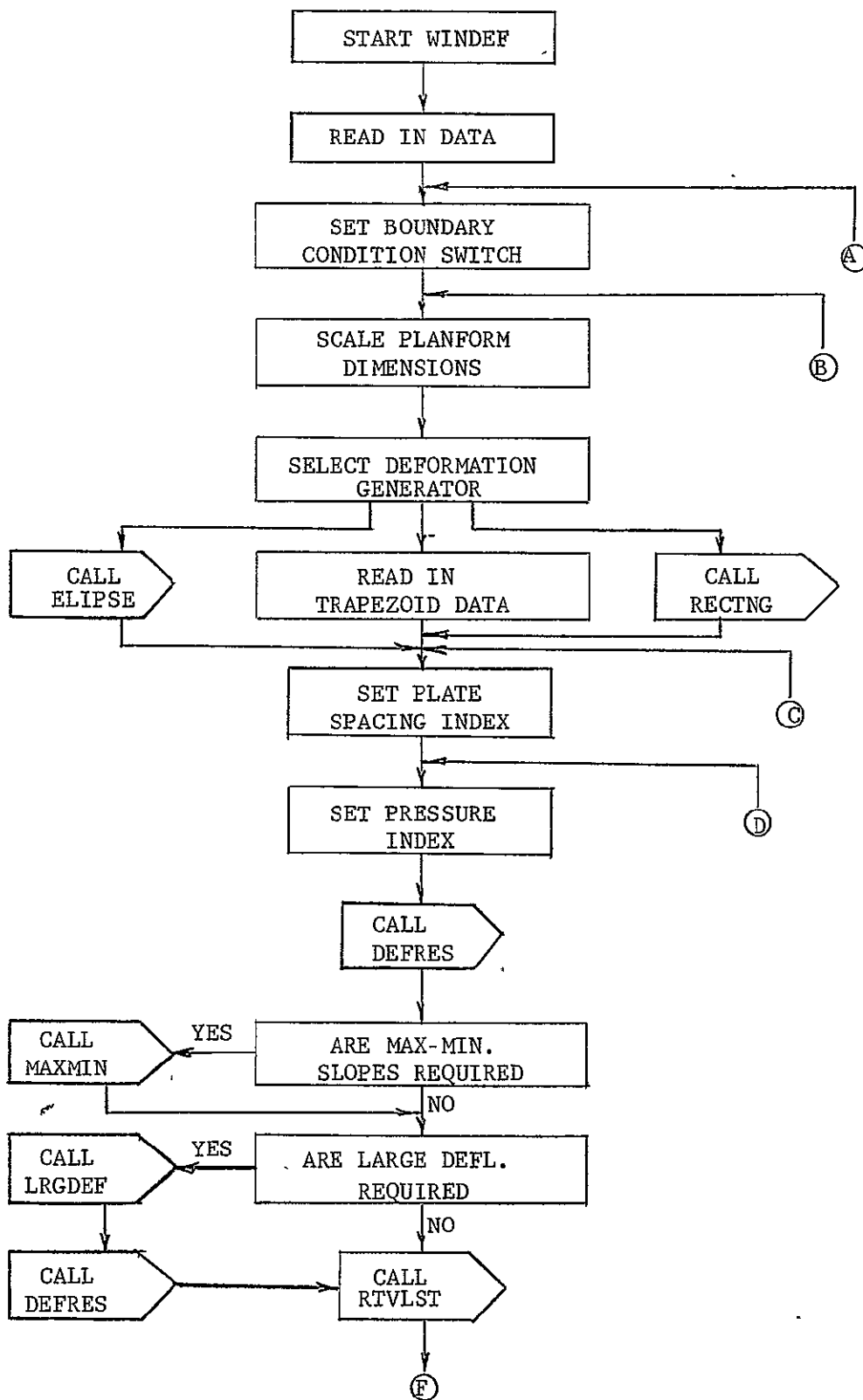


Figure 4a. Driver Flow Chart

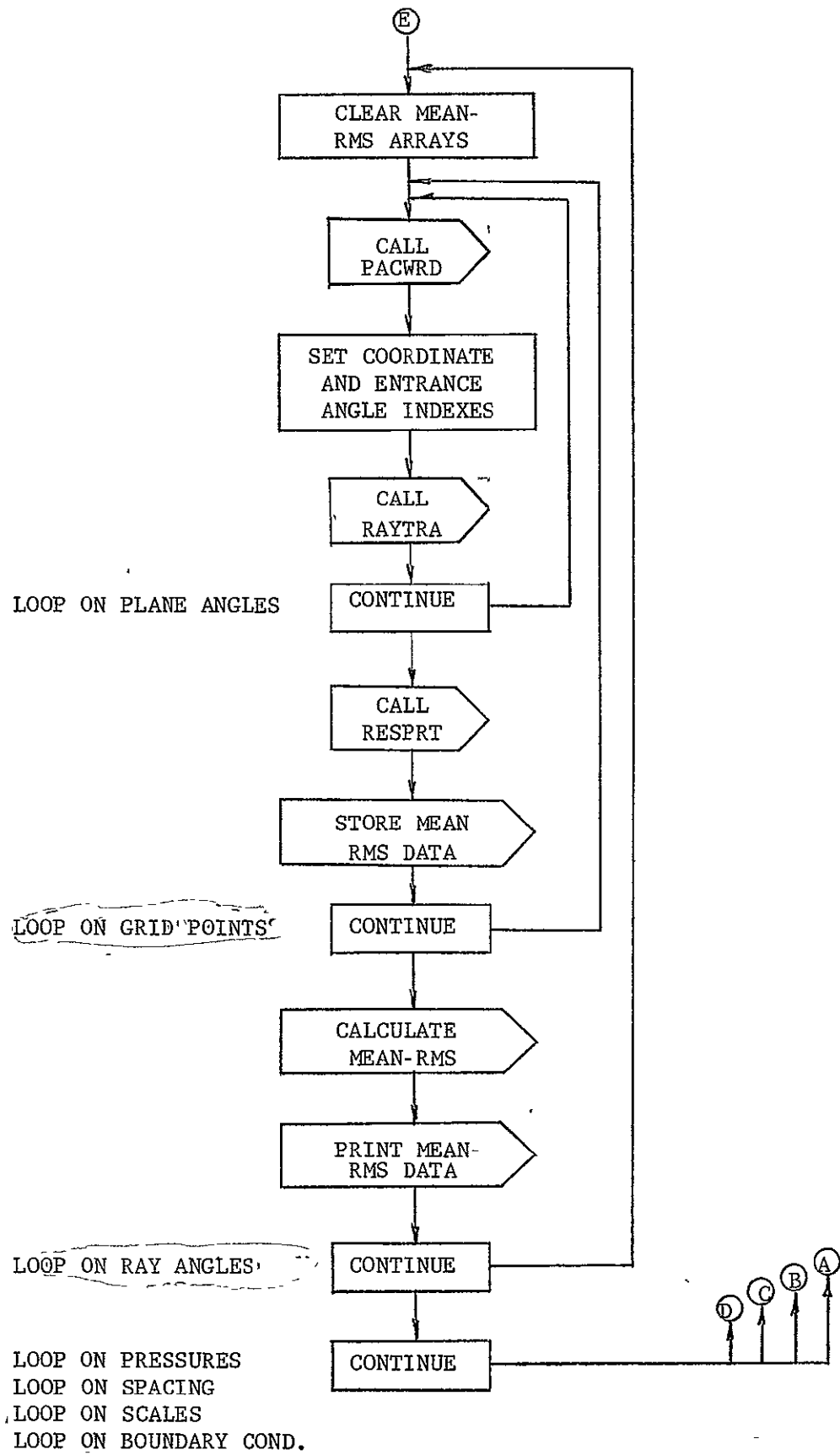


Figure 45 Driver Flow Chart (cont'd)

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

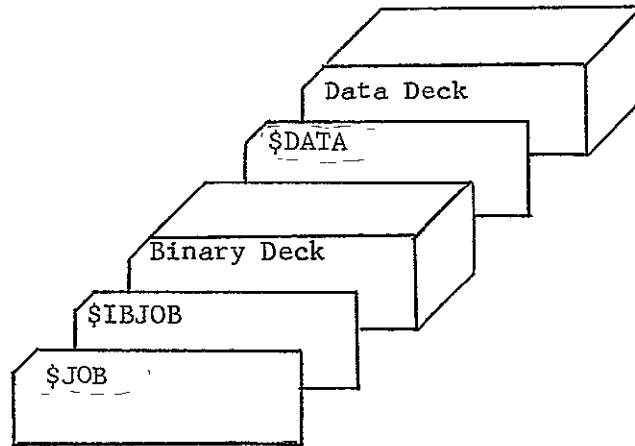


Figure 5. Program Deck-Mode 1

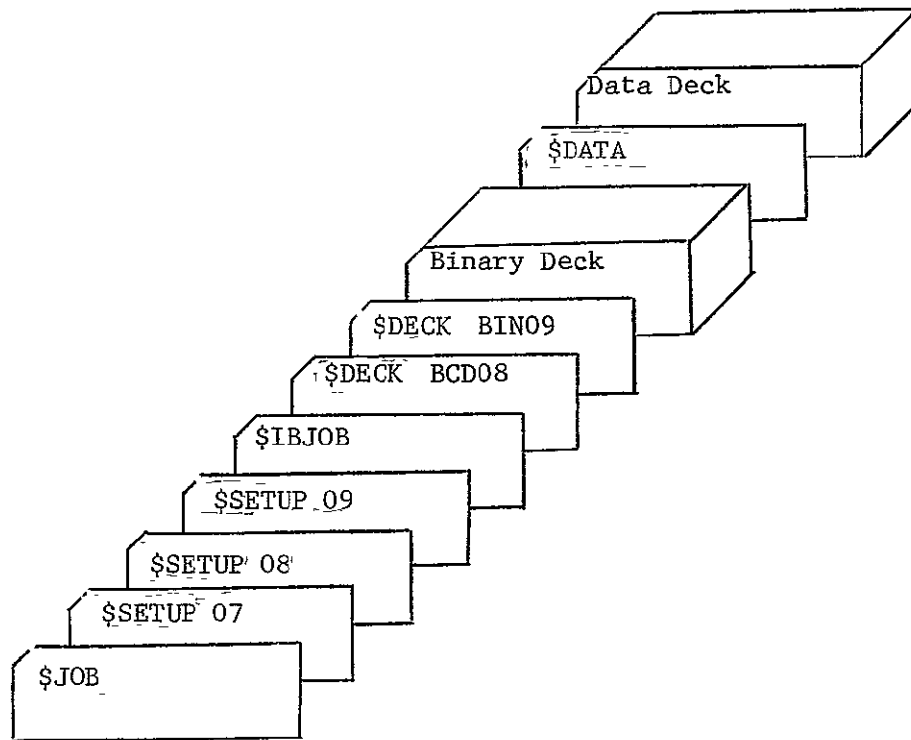


Figure 6. Program Deck-Mode 2

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.

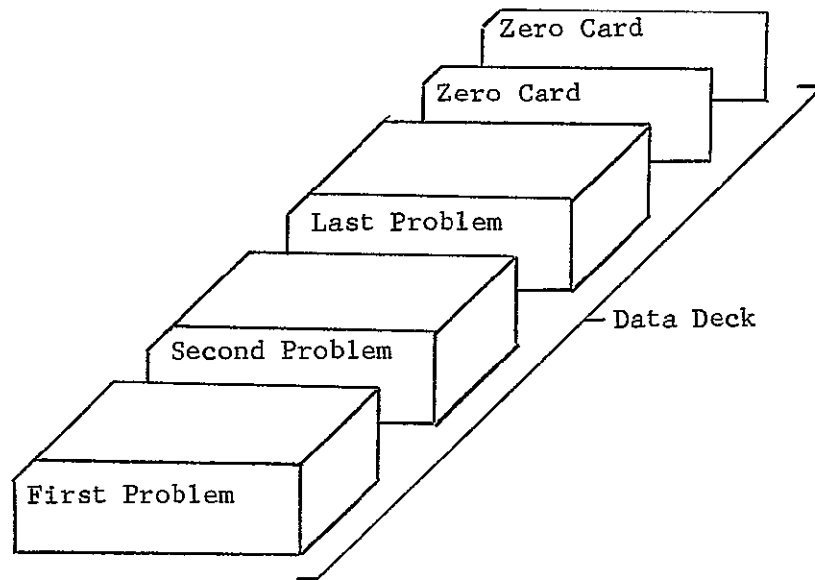


Figure 7. Data Deck

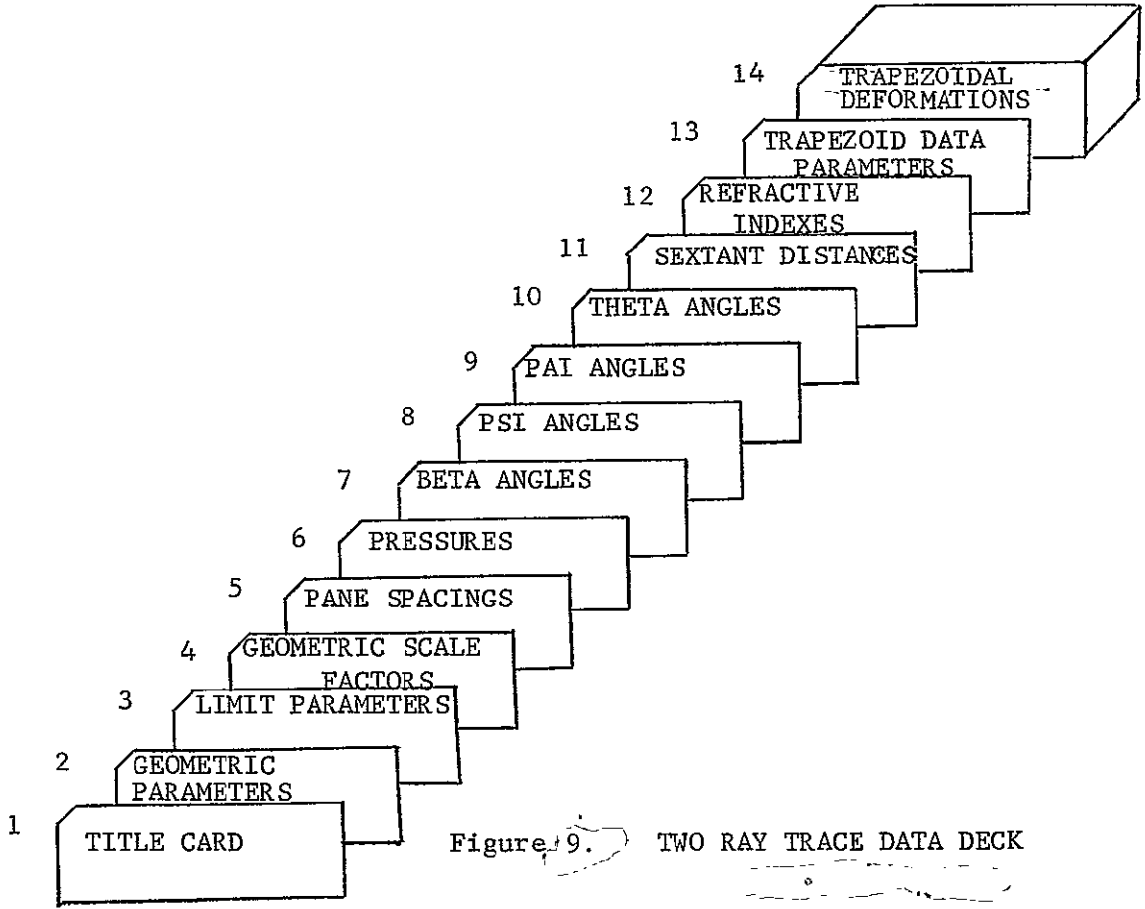
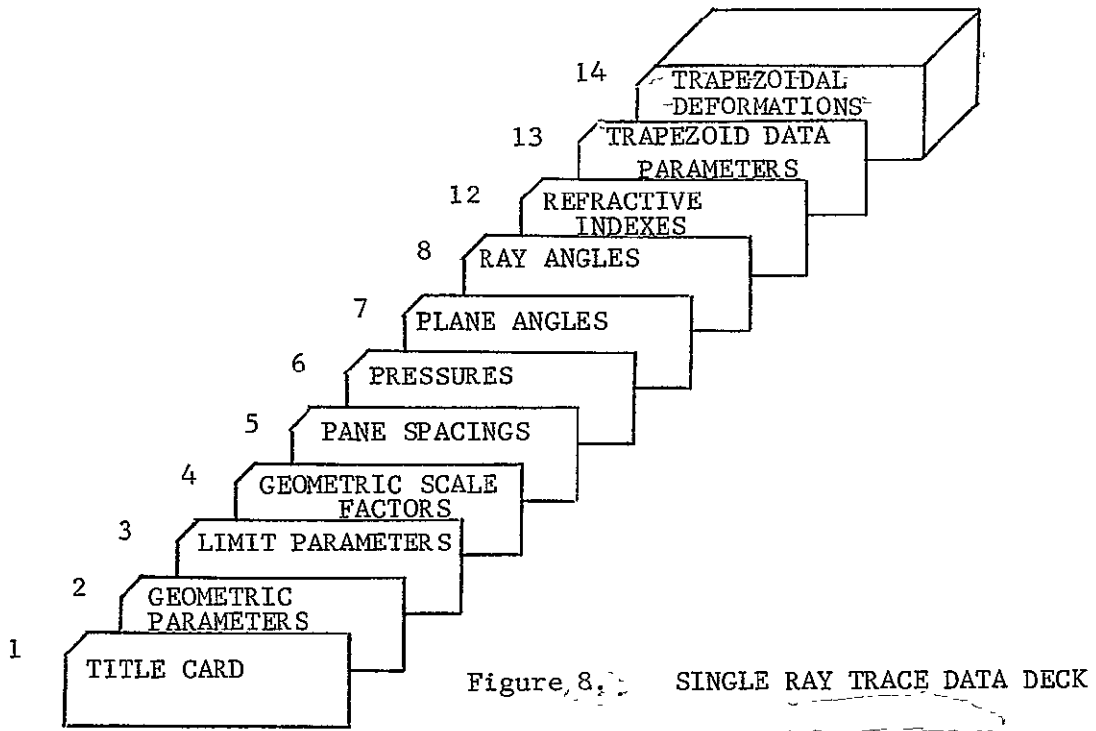


Table 5

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)

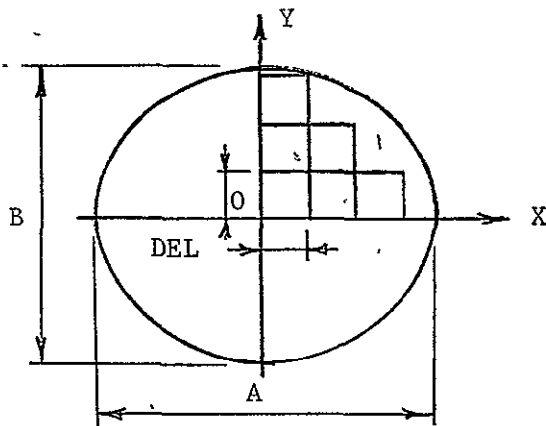
<u>Columns</u>	<u>Symbol</u>	<u>Information</u>	<u>Format</u>
13-24	ELM(J)	Deformation value ($J_{\max.} = 3$)	Octal
25-48		Same format as 1-24	
49-72		Same format as 1-24	

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

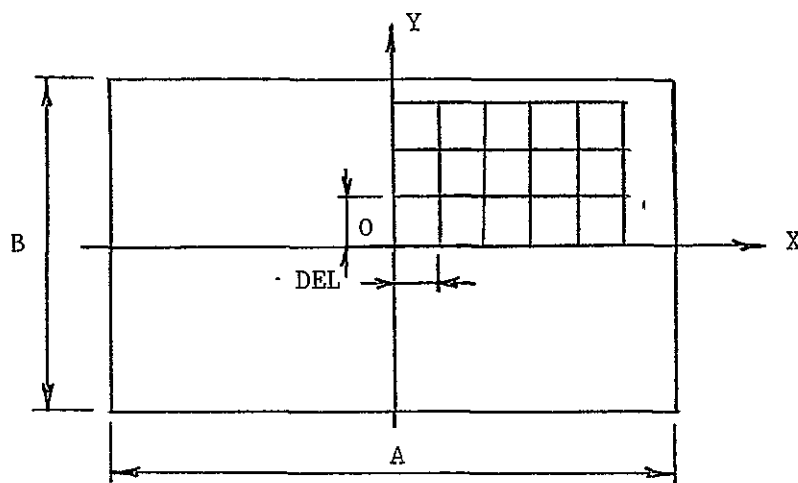
3 = deflection

4 = slope about x-axis

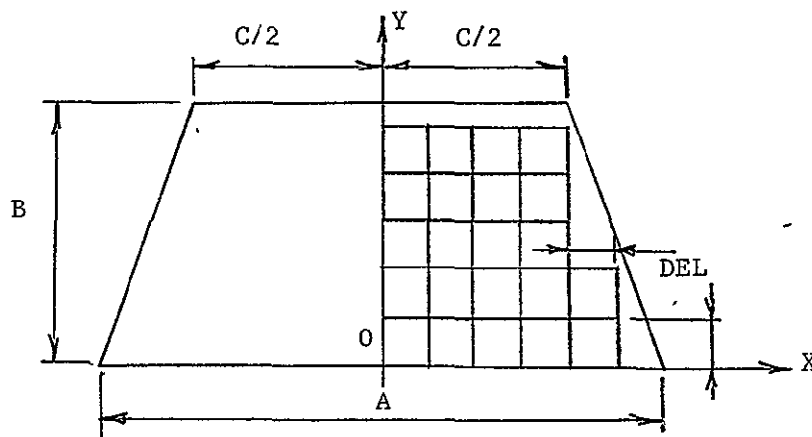
5 = slope about y-axis



(a) Ellipse



(b) Rectangle



(c) Trapezoid

Figure 10. Planform Shapes

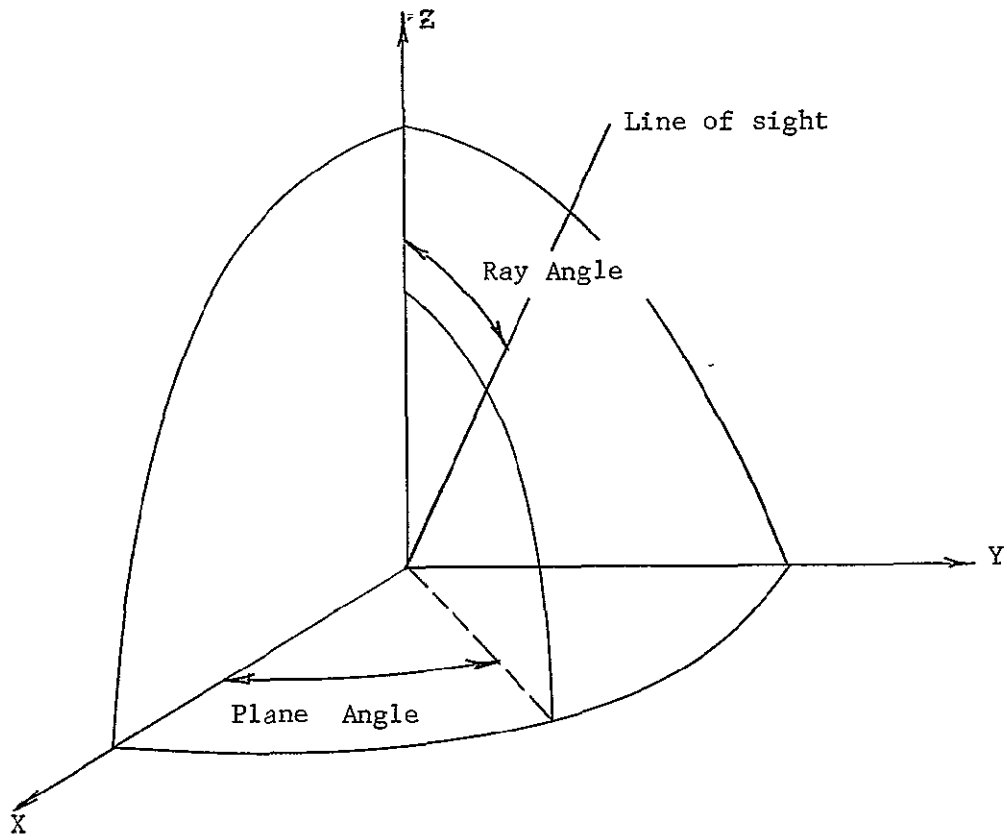


Figure 11 Single Ray Trace Angles

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

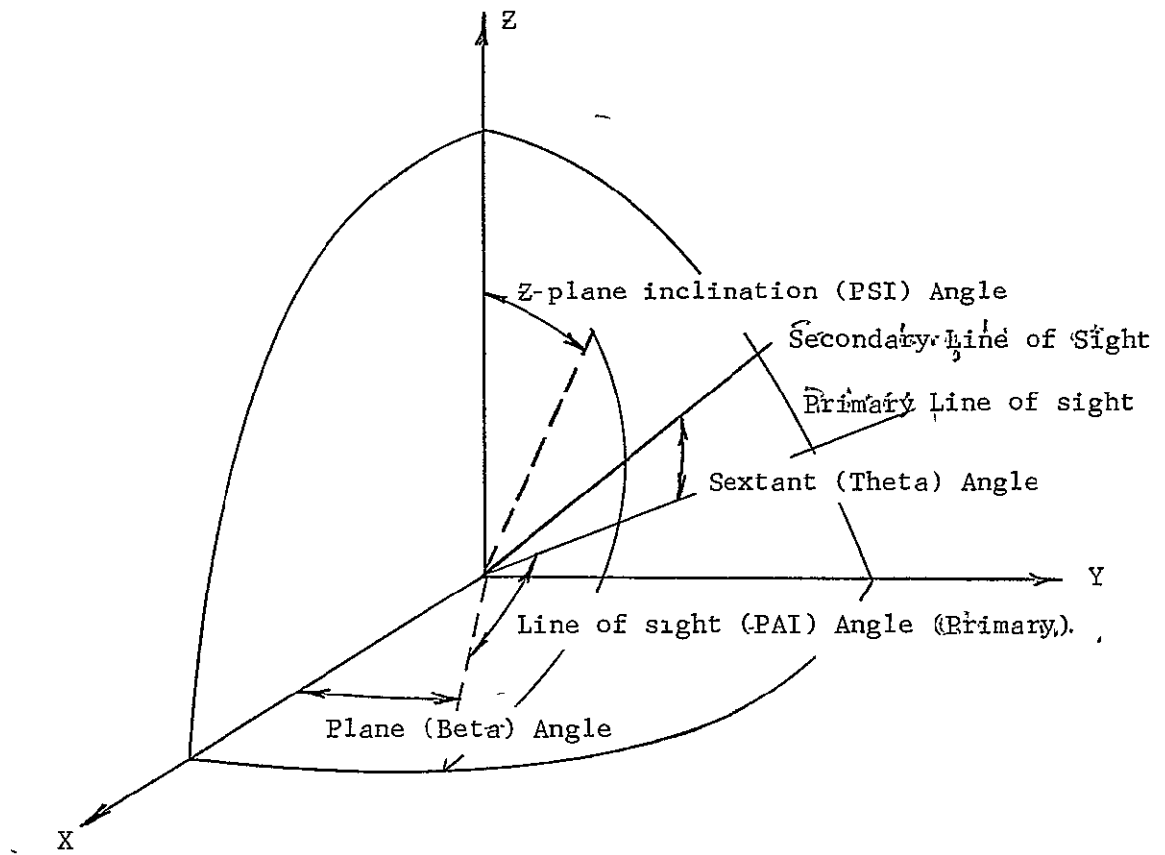


Figure (12) Two Ray Trace Angles

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 D_1 is the incidence angle measured in degrees. The remainder of the output is a tabulation of the ray trace data for each plane angle (A_1) 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^{es} the angular deviations of the rays passing through the window. The program will also compute the changeⁱⁿ 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.

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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

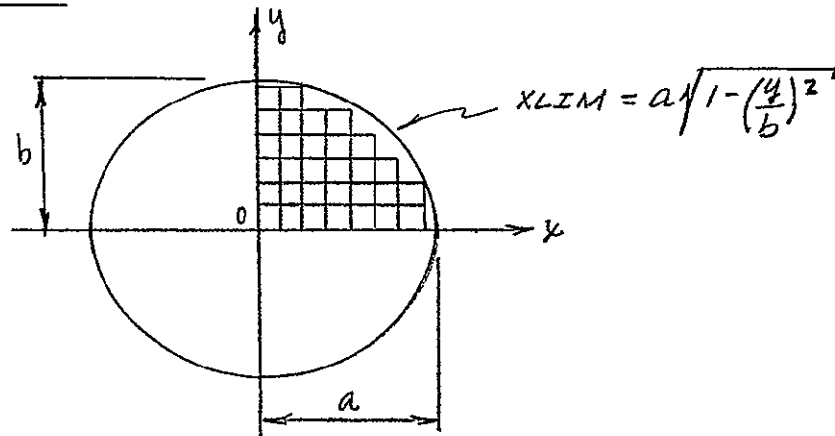


FIGURE A-1

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

= 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

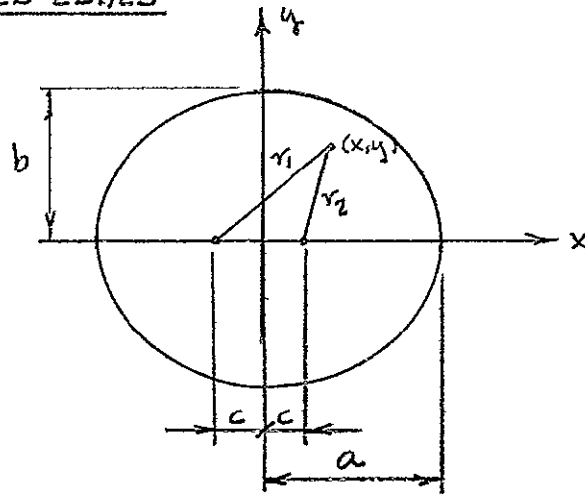
$\partial w / \partial x =$ SLOPE ABOUT X AXIS

$\partial w / \partial y =$ 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

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

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

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

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

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

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

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

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

$$a = c \cosh \alpha$$

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

$$b = c \sinh \alpha$$

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

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

(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 $\frac{\partial w}{\partial \eta} = w'_\eta$

$$\begin{aligned} w'_\xi &= w_0 [(3 \cosh 2\alpha \cosh 4\alpha - 4 \cosh 4\alpha \cos 2\eta + \cosh 2\alpha \cos 4\eta) \times \\ &\quad (-8 \cosh 4\alpha \sinh 2\xi + 4 \cosh 2\alpha \sinh 4\xi) \\ &\quad - w_1 (\cosh 2\alpha - \cos 2\eta)(2 \sinh 2\xi)] \end{aligned} \quad (12)$$

$$\begin{aligned} w'_\eta &= w_0 [(3 \cosh 2\alpha \cosh 4\alpha - 4 \cosh 4\alpha \cosh 2\xi + \cosh 2\alpha \cosh 4\xi) \times \\ &\quad (8 \cosh 4\alpha \sin 2\eta - 4 \cosh 2\alpha \sin 4\eta) \\ &\quad - w_1 (\cosh 2\xi - \cosh 2\alpha)(2 \sin 2\eta)] \end{aligned} \quad (13)$$

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

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

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

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

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

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

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

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

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

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

THE SOLUTIONS ARE:

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

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:

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

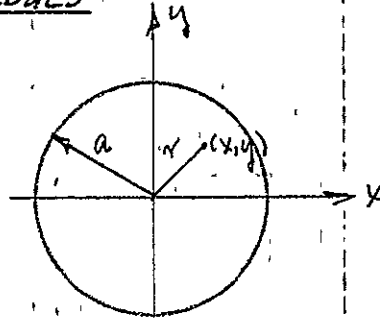
$$\left(\text{or } y - c \sinh \xi \sin \eta \right)$$

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.

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

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

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

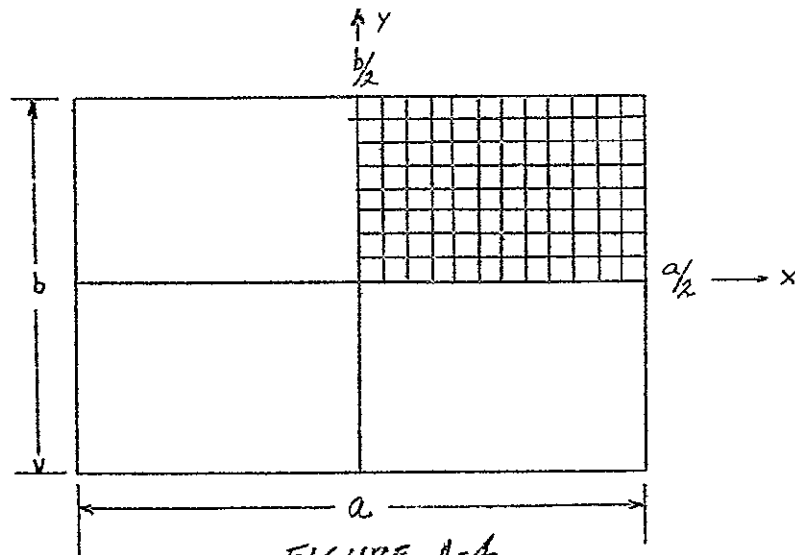


FIGURE A-4

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) $\alpha_m = \frac{m\pi b}{a}$ $\beta_m = \frac{m\pi a}{b}$

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

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

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

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

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

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

WHERE E_m & F_m ARE DEFINED BY:

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

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

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:

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

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

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

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

(37c)

V IS THE STRAIN ENERGY OF A MEMBRANE

SUBSTITUTE, INTEGRATE, AND SIMPLIFY

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

$$+ \left(\frac{CW_0^2 \pi^3}{4a^3} \cos \frac{\pi x}{a} \sin^2 \frac{\pi x}{2a} \cos^3 \frac{\pi y}{2b} \right)$$

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

$$+ \left(\frac{CW_0^2 \pi^3}{4b^3} \cos^3 \frac{\pi x}{2a} \cos \frac{\pi y}{b} \sin^2 \frac{\pi y}{2b} \right)$$

$$+ \frac{1}{4} \left[\frac{W_0^4 \pi^4}{16a^4} \sin^4 \frac{\pi x}{2a} \cos^4 \frac{\pi y}{2b} \right)$$

$$+ 2 \left(\frac{W_0^4 \pi^4}{16a^2 b^2} \sin^2 \frac{\pi x}{2a} \cos^2 \frac{\pi x}{2a} \cos^2 \frac{\pi y}{2b} \sin^2 \frac{\pi y}{2b} \right)$$

$$+ \left(\frac{W_0^4 \pi^4}{16b^4} \cos^4 \frac{\pi x}{2a} \sin^4 \frac{\pi y}{2b} \right) \left. \right]$$

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

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

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 $\nu = 0.25$*

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

LET $\nu = 0.25$

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

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

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

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

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

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

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

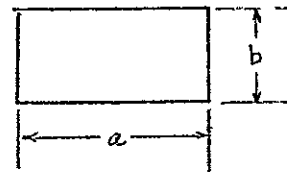
AN APPROXIMATE SOLUTION FOR SHEAR IS GIVEN BY

$$w_s = W \rho$$

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

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.

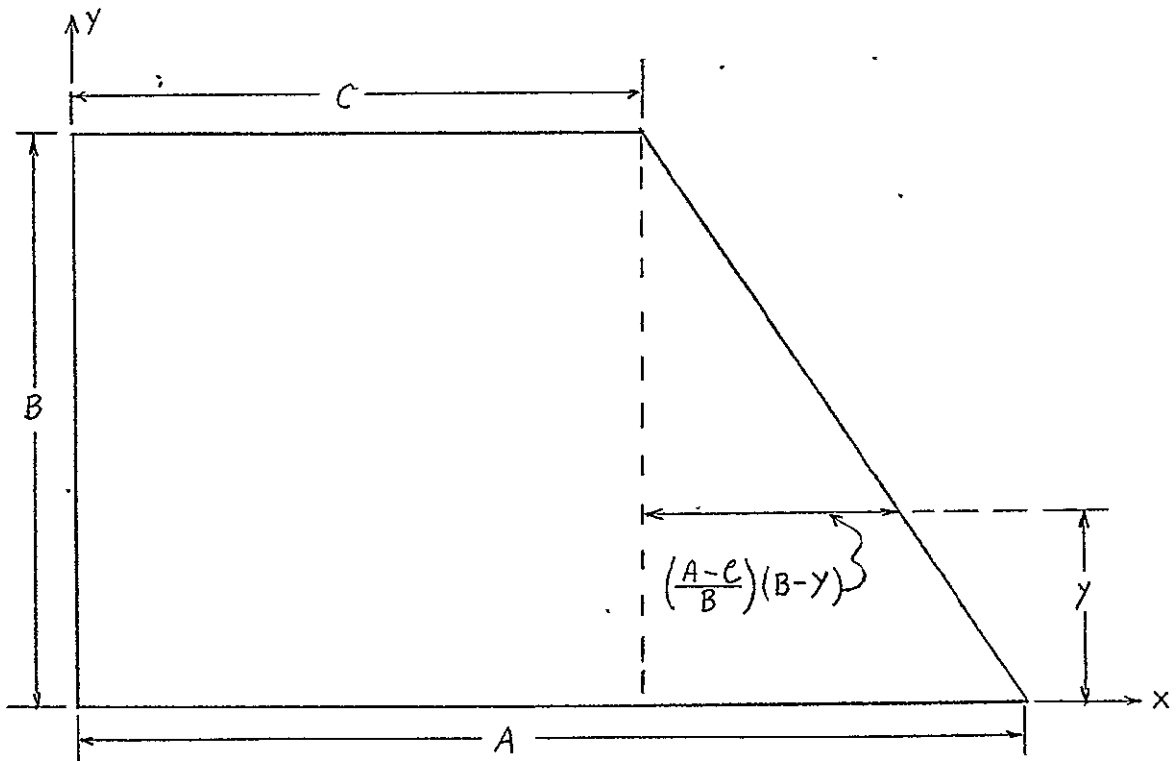
Appendix B

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..

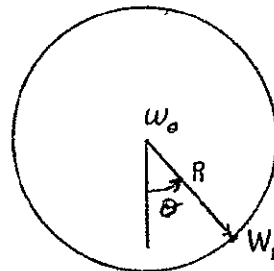
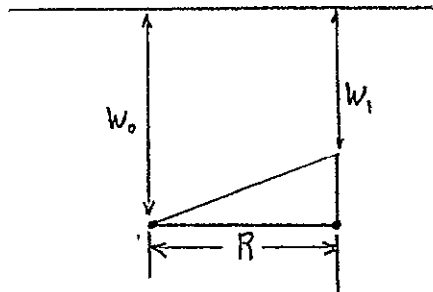
MEAN & STANDARD DEVIATION

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

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

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.

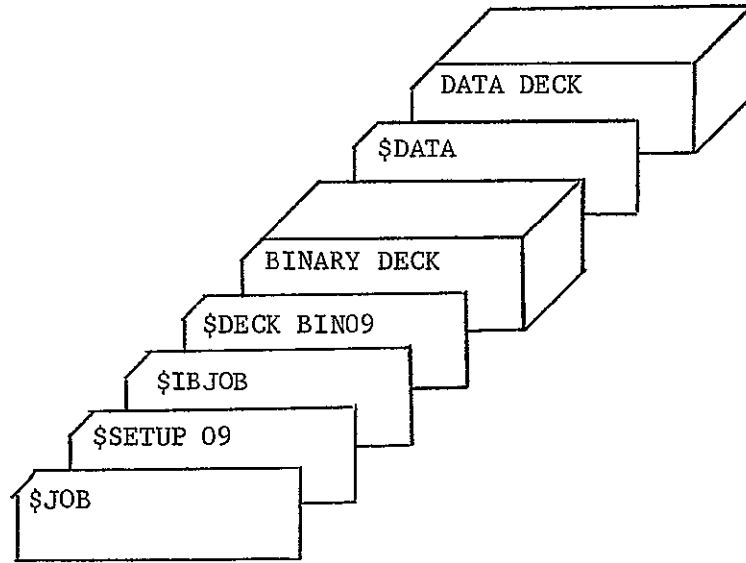


Figure C-1. Program Deck

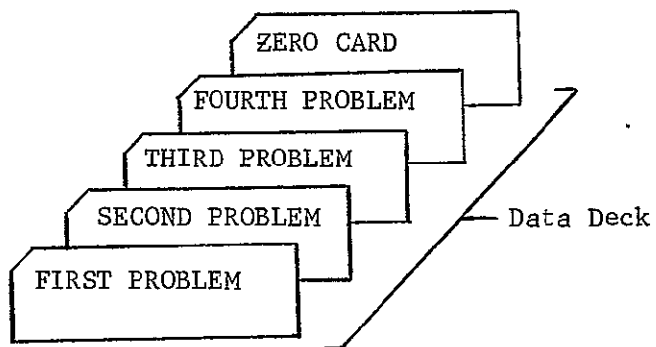


Figure C-2. Data Deck

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.

			00000
	C	WINDEF	00010
	C		00020
	C D0	WINDEF - APOLLO WINDOW DEFORMATION AND LINE OF SIGHT DRIVER	00030
	C D1	ELIPSE - ELLIPSE DEFORMATION GENERATOR	00040
	C D2	ELIPIT - ELLIPTIC COORDINATE GENERATOR	00050
	C D3	RECTNG - RECTANGULAR DEFORMATION GENERATOR	00060
	C D4	SEQS - MATRIX INVERSION AND LINEAR EQUATION SOLUTION.	00070
	C D5	TRPZOD - READS IN TRAPEZOIDAL DEFORMATION DATA FROM SAMIS	00080
	C D6	LRGDEF - LARGE DEFLECTION GENERATOR FOR RECTANGLES	00090
	C D7	DEFRES - PRINTS PLATE (WINDOW) DEFORMATION DATA	00100
	C D8	RAYTRA - DRIVER FOR RAY TRACE PROCEDURE	00110
	C D9	ITERAT - ITERATES TO FIND LOCATION OF RAY ON NEXT SURFACE	00120
	C E0	INCOTB - DETERMINES DEFORMATION OF PLATE AT INTERSECTION W/RAY	00130
	C E1	NORMAL - CALCULATES NORMAL TO PLATE AT RAY INTERSECTION POINT	00140
	C E2	REFRCI - CALCULATES NEW DIRECTION OF RAY UPON ENTERING NEW MEDIUM	00150
	C E3	RESPRT - PRINTS RAY TRACE AND MEAN-RMS RESULTS	00160
	C E4	MENRMS - STORES DATA FOR MEAN AND RMS CALCULATIONS	00170
	C E5	MAXMIN - CALCULATES MAX/MIN SLOPES AT GRID POINTS	00180
	C E6	RTVLST - RETRIEVAL LIST	00190
	C E7	BONDRY - TEST TO SEE IF POINT OF RAY IS OUTSIDE PLAN FORM BNDRY	00200
	C E8	PACWRD - INDEX WORD PACKING-UNPACKING ROUTINE	00210
78	C E9	PAGE - PRINTS PAGE NO. AT TOP OF EACH PAGE (AND RETRIEVAL NO.)	00220
	C F0	SHRDEF - SHEAR DEFORMATION GENERATOR	00230
	C F1	SINH - CALCULATES HYPERBOLIC SINE	00240
	C F2	COSH - CALCULATES HYPERBOLIC COSINE	00250
	C F3	TANH - CALCULATES HYPERBOLIC TANGENT	00260
	C		00270
	C	AA = X DIMENSION OF SHAPE	00280
	C	= LENGTH OF ELLIPSE SEMI AXIS	00290
	C	= LENGTH OF RECTANGLE	00300
	C	= 1/2 BASE LENGTH OF TRAPEZOID	00310
	C	AMN = ARRAY FOR STORING MEANS	00320
	C	AVG = ARRAY FOR STORING MEAN DATA	00330
	C	AVS = ARRAY FOR STORING RMS DATA	00340
	C	BB = Y DIMENSION OF SHAPE	00350
	C	= HEIGHT OF ELLIPSE SEMI AXIS	00360
	C	= HEIGHT OF RECTANGLE	00370
	C	= HEIGHT OF TRAPEZOID	00380
	C	BONC = BOUNDARY CONDITION	00390
	C	CC = UPPER X DIMENSION OF TRAPEZOID	00400
	C	CHAP = ICHAP = SHAP = GEOMETRIC SHAPE	00410
	C	CON = DUMMY ARRAY FOR CONSTANT AND VARIABLE STORAGE	00420
	C	CPRSS = CABIN PRESSURE	00430
	C	DEL = GRID SPACING	00440
	C	DIMA = AA DIMENSION	00450
	C	DIMB = BB DIMENSION	00460

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 = YOUNGS MODULUS	01210
C		01220
C	DOUBLE PRECISION AVG, AVS	01230
C		01240
C	COMMON DUM	01250
C		01260
C	0 EQUIVALENCE (DUM(1), CON), (DUM(501), X),	01270
C	1 (DUM(1501), W), (DUM(2251), DWX),	01280
C	2 (DUM(3001), JPN), (DUM(3501), RTV)	01290
C		01300
C	0 EQUIVALENCE (CON(1), DIMA), (CON(2), DIMB),	01310
C	1 (CON(3), DIMC), (CON(4), DEL), (CON(5), GNU),	01320
C	2 (CON(6), THIC), (CON(7), SPAD), (CON(8), PRSS),	01330
C	3 (CON(9), NPAN), (CON(10), ISI), (CON(11), ISO),	01340
C	4 (CON(12), IBC), (CON(13), NGP), (CON(14), LP7),	01350
C	5 (CON(15), FR), (CON(16), LOCP), (CON(17), IPD),	01360
C	6 (CON(18), IPR), (CON(19), CHAP), (CON(20), ISCRI),	01370
C	7 (CON(21), ISCR2), (CON(22), SKAL), (CON(23), ISEC),	01390
C	8 (CON(24), NPAG), (CON(25), YONG), (CON(26), ILRG),	01400
C	9 (CON(27), IREL), (CON(28), LP5), (CON(29), CPRSS)	01410

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	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
C		04900
	A10 = ZI	04910
	A20 = 2.0*ZI	04920
	A40 = 4.0*ZI	04930
	CA20 = COSH(A20)	04940
	CA40 = COSH(A40)	04950
	CA2S = (COSH(A20))**2	04960
	SA2S = (SINH(A20))**2	04970
	SA2Q = (SINH(A20))**4	04980
	WO = (C**4)/(12.0*128.0*CA2S*CA40*FR)	04990
	OMNU = (1.0 - GNU)	05000
	W1 = +(8.0*(OMNU)*(3.0*CA2S-2.0)*SA2Q)/(2.0*CA2S-(OMNU)*SA2S)	05010
	X(1,1) = 0.0	05020
C	CALCULATE GRID POINT DEFORMATIONS.	05030
203	I = I+1	05040
101	J = J+1	05050
	K = K+1	05060
		05070

	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 = WEP/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

86

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
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
102	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

	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/1H 7, 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

	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
			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

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)
C					16830
					16840
					16850
	1,	A1(25,2),	A2(25,2),	A3(25,2),	A4(32,2)
C					16860
					16870
					16880
C					16890
					16900
					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/ 1 (AA*2.))*COS(PI*V/(BB*2.)))	17840
	IF(NPAN.NE.2) GO TO 201	17850
	WC(K,1)=0.5*(W(I,J)*CONST5*(ABS(CONST4/CONST5))+ 1 CONST6*COS(PI*U/(AA*2.))*COS(PI*V/(BB*2.)))	17860
	WC(K,2)=0.5*(W(I,J)*CONST2*(ABS(CONST1/CONST2))+CONST3*COS(PI*U/ 1 (AA*2.))*COS(PI*V/(BB*2.)))	17870
	201 IF(ABS(X(I,J)-X1P-U)-1.0E-7)202,202,206	17880
	206 DO 210 LM=1,25	17890
	210 B(K,LM)=0.	17900
	202 CONTINUE	17910
	DO 240 K=1,2	17920
	DO 240 I=1,25	17930
	A4(I,K)=0.	17940
	DO 240 J=1,36	17950
	240 A4(I,K)=A4(I,K)+B(J,I)*WC(J,K)	17960
	C	17970
	C===== THIS SECTION MULTIPLIES THE COEFFICIENT MATRIX BY ITS TRANSPOSE	17980
	C	18000
	DO 124 I=1,25	18010
	DO 124 J=1,25	18020
	122 BR(I,J) = 0.0	18030
	DO 124 K=1,36	18040
	124 BR(I,J) = BR(I,J) + B(K,I)*B(K,J)	18050
	C	18060
	C===== THIS SECTION INVERTS THE INTERMEDIATE MATRIX.	18070
	C===== THIS SECTION CALCULATES THE COEFFICIENTS.	18080
	C	18090
	NR = 25	18100
	NC=2	18110
	CALL SEQS (BR,A4,NR,NC)	18120
	DO 280 I=1,25	18130
	GO TO (260,264,268,300),I1	18140
	260 A1(I,1)=A4(I,1)	18150
	A1(I,2)=A4(I,2)	18160
	GO TO 280	18170
	264 A2(I,1)=A4(I,1)	18180
		18190
		18200

	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	18280
C	THE POINT XP, YP.	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

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

611

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
CRESPT		19480
	SUBROUTINE RESPRT (IRT, NOPRT)	19490
C		19500
C	THIS SUBROUTINE PRINTS THE RESULTS OBTAINED BY THE RAYTRA PROG.	19510
C		19520
C	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

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

123

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510  FORMAT (1H0,46X,4A6,A3)
      GO TO (132, 133, 134), ICHAP
132  0  WRITE (IS8,501) (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
      GO TO 135
133  0  WRITE (IS8,501) (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 135
134  0  WRITE (IS8,502) (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
135  WRITE (IS8,512) RT40, RES(1), RT41, RES(11), RT42, RES(21)
      GO TO 137
136  NOCP=LOCP
      LOCP = 1
      WRITE (IS8,512) RT40, RES(1), RT41, RES(11), RT42, RES(21)
512  FORMAT (1H0/1H ,40X,A4,F5.2,5X,A4,F5.2,5X,A5,F6.2)
137  0  WRITE (IS8,514)
      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)
514  0  FORMAT (1H0,A6,A4,8F13.6/1H0,A6,A4,8F13.6/1H ,A6,A4,8F13.6/
      1  1H ,A6,A4,8F13.6/1H ,A6,A4,8F13.6/1H ,A6,A4,8F13.6/
      2  1H0,A6,A4,8E13.4/1H ,A6,A4,8E13.4/1H ,A6,A4,8E13.4/
      3  1H0,A6,A4,8F13.6/1H ,A6,A4,8F13.6/1H ,A6,A4,8F13.6)
      GO TO 119
C
C   THIS SECTION PRINTS OUT THE MEAN AND RMS SUMMATION DATA.
C
140  ISQ=ISO
      CALL PAGE (IRM, LYN, ISQ, IRT)
      WRITE (ISQ,500) RT20
      WRITE (ISQ,546)
546  FORMAT (1H0,39X,43HM E A N   A N D   R M S   S U M M A T I O N )
      GO TO (142,144,146), ICHAP
142  0  WRITE (ISQ,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
      GO TO 148
144  0  WRITE (ISQ,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

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		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
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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24690
24700
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24780

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),
	1 DWX(22,22),	DWY(22,22),	JPN(500),	RTV(500)
C				25130
	0 DIMENSION	SCAL(8),	SPAC(8),	PRES(8),
	1 RAYA(8),	RI(7),	RES(180),	
	2 RT30(2),	RT31(2),	RT32(2),	RT33(2),
	RT34(2),	SHAP(2),	CONC(2)	
C				25160
	0 DIMENSION	JT1(50),	RT2(50),	RT3(50),
	1 JT7(50),	RT8(50),	RT9(50),	JT10(50)
C				25170
	0 DATA	RT30(1)/9HELLIPSE /,	RT31(1)/9HRECTANGLE/,	
	1	RT32(1)/9HTRAPEZOID/,	RT33(1)/7HHINGED /,	
	2	RT34(1)/7HCLAMPED/,	STAR/5H*****/	
C				25200
				25210
				25220
				25230
				25240
C				25250
	LIN = LIN + 1			

	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

	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

	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
C H6 * MENRMS - STORES DATA FOR MEAN AND RMS CALCULATIONS	00220
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	00340
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

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

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	

	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 IREL, 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

	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

	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 (1H171H0,37H"THE 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

	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
		WITH SIMPLY SUPPORTED EDGES.	04790
	C		04800
	C	CALCULATE CONSTANTS	04810
	C		04820
148	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

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

150

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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

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	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 = ZI 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

	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),
	1	DWX(21,33),	JPN(500),	RTV(500)	
C					07520
		DIMENSION	EANDF(32),	MOMENT(32,32),	RHS(32)
C					07550
		EQUIVALENCE	(RHS,EANDF)		
C					07560
					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 SEQ5 (MOMENT,RHS,MN,NM)	08270
		08280
		08290
		08300
		08310
	C==== THIS SECTION GENERATES DEFORMATIONS FOR HINGED EDGES	08320
	C	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                                09300
20 IPIVOT(J)=0                                  09310
30 DO 550 I=1,N                                  09320
C                                                  09330
C====SEARCH FOR PIVOT ELEMENT                    09340
C                                                  09350
40 AMAX=0.0                                       09360
45 DO 105 J=1,N                                   09370
50 IF (IPIVOT(J)-1) 60, 105, 60                 09380
60 DO 100 K=1,N                                   09390
70 IF (IPIVOT(K)-1) 80, 100, 740               09400
80 IF(DABS(AMAX)-DABS(A(J,K)))85,100,100       09410
85 IROW=J                                         09420
90 ICOLUM=K                                       09430
95 AMAX=A(J,K)                                    09440
100 CONTINUE                                     09450
105 CONTINUE                                     09460
    IF (AMAX) 128,107,128                        09470
107 PRINT 108                                     09480
108 FORMAT (22H MATRIX IS SINGULAR. )          09490
    NCE = 1                                       09500
    GO TO 740                                       09510
128 IPIVOT(ICOLUM) =IPIVOT(ICOLUM)+1          09520
C                                                  09530
C====INTERCHANGE ROWS TO PUT PIVOT ELEMENT ON DIAGONAL 09540
C                                                  09550
130 IF (IROW-ICOLUM) 140, 260, 140            09560
140 DETERM=-DETERM                               09570
150 DO 200 L=1,N                                  09580
160 SWAP=A(IROW,L)                               09590
170 A(IROW,L)=A(ICOLUM,L)                       09600
200 A(ICOLUM,L)=SWAP                            09610
205 IF(M) 260, 260, 210                         09620
210 DO 250 L=1, M                               09630
220 SWAP=B(IROW,L)                              09640
230 B(IROW,L)=B(ICOLUM ,L)                     09650
250 B(ICOLUM,L)=SWAP                            09660
260 INDEX(I,1)=IROW                             09670
270 INDEX(I,2)=ICOLUM                           09680
310 PIVOT(I)=A(ICOLUM,ICOLUM)                   09690
320 CONTINUE                                     09700
C                                                  09710
C====DIVIDE PIVOT ROW BY PIVOT ELEMEN.         09720
C                                                  09730
330 A(ICOLUM,ICOLUM)=10.0D-1                   09740
340 DO 350 L=1,N                                  09750
350 A(ICOLUM,L)=A(ICOLUM,L)/PIVOT(I)          09760
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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		

	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

	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

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

```


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

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C
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0 EQUIVALENCE (CON( 31), SCAL), (CON( 41), SPAC), 14950
1 (CON( 51), PRES), (CON( 61), PLNA), (CON( 71), RAYA), 14960
2 (CON( 81), PAIA), (CON( 91), THEA), (CON(101), RI), 14970
3 (CON(111), RES), (CON(301), STAT), (CON(351), OIF), 14980
4 (CON(401),EANDF), (CON(451), RHS) 14990
-----
C 15000
DIMENSION CON(500), X(22,22), Y(22,22), W(22,22), DWX(22,22), 15010
1 DWY(22,22), RES(180) 15020
-----
C 15030
DIMENSION CI(3), DELTAP( 4), CN(3), RI(5), CR(3), D(3), EE(3) 15040
-----
C 15050
DIMENSION E(3), SN1(3), SN2(3), S1(3), S2(3), PNS(3), V(3) 15060
-----
C 15070
IJ = LP7-1 15080
IF (NPAN .EQ. 2) PRSS = -(PRSS-CPRSS) 15090
RES( 1) = XP 15100
RES( 2) = YP 15110
D(1) = THIC 15120
D(2) = D(1) + SPAD 15130
D(3) = D(2) + THIC 15140
N = NPAN*2 15150
DO 100 I=1,N 15160
100 DELTAP(I) = 1.0 15170
RAD = 0.017453292519 15180
DEG = 1.0/RAD 15190
SEC = 206264.8064 15200
PI = 3.141592653 15210
RES( 9) = ZSEXT 15220
RES( 10) = BETA 15230
RES( 11) = PSI 15240
RES( 12) = THETA 15250
RES( 13) = PAI 15260
RES(14)=PAI+THETA 15270
BETA = BETA*RAD 15280
PSI = PSI *RAD 15290
PAI = PAI * RAD 15300
THETA= THETA*RAD 15310
S1(1) = COS(BETA)*COS(PAI) - SIN(BETA)*SIN(PSI)*SIN(PAI) 15320
S1(2) = SIN(BETA)*COS(PAI) + COS(BETA)*SIN(PSI)*SIN(PAI) 15330
S1(3) = COS(PSI) *SIN(PAI) 15340
G = -ZSEXT -0.716 15350
310 0 A = (0.1703 + 0.335/COS(64.0*RAD + ABS(THETA/2.0)))/ 15360
1 (TAN(64.0*RAD + ABS(THETA/2.0)) - TAN(-52.0*RAD)) 15370
B = A*TAN(-52.0*RAD) + 0.1703 15380
IF(THETA.EQ.0.) GO TO 20 15390
C = (-3.274 - B + A*TAN(ABS(THETA)))/TAN(ABS(THETA)) 15400
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	$G = C - ZSEXT = 3.407$	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
	$S2(1) = \cos(\text{BETA}) * \cos(\text{SAI}) - \sin(\text{BETA}) * \sin(\text{PSI}) * \sin(\text{SAI})$	15570
	$S2(2) = \sin(\text{BETA}) * \cos(\text{SAI}) + \cos(\text{BETA}) * \sin(\text{PSI}) * \sin(\text{SAI})$	15580
	$S2(3) = \cos(\text{PSI}) * \sin(\text{SAI})$	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 REFRICI (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	17300
	1 IN THE X OR Y DIRECTION. IDX=,I2,6H. IDY=,I2,1H.)	17310
	STOP	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=SYF	19140

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-----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
800 RETURN 19380
END 19390
$IBFTC MS23H3 19400
CREFRICI 19410
SUBROUTINE REFRICI (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,43HMEAN 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

185

	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
	C	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

	IF (LINE-45) 115,115,115	23410
115	CALL PAGE (IPV, 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

	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)
198 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